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EDITORIAL

THE Council in deciding to issue the Journal of the Society of Chemical Industry weekly has taken a bold, perhaps a rash course. The Journal has from its commencement made progress, and has steadily improved its usefulness and circulation. It has by no means reached a final state ; as time proceeds, and as the editorial staff becomes more accustomed to the new venture, further experiments will be made and new features will appear in the Journal. Some of these will be successful, some no doubt will be found to be unsuitable and will be discarded. Mistakes will naturally be made, and our readers will complain of omissions and errors of judgment ; "that no grievance ever should arise in the commonwealth, that let no man in this world expect ; but when complaints are freely heard, deeply considered, and speedily reformed, then is the utmost bound of civil liberty attained, that wise men look for." We shall endeavour to profit by this excellent and time-honoured precept, and with the support of our readers, of which the letters we print in this issue are abundant evidence, we look forward to the new conditions without any misgiving, believing that, when we have recovered from such a dislocation as the present change involves, we shall have opportunities of increasing the amount of matter in the weekly Journal, its attractiveness and its interest.

It is the ambition of the Council to have a Journal which will appeal to every one who is concerned with chemistry. Those who are engaged in teaching or studying the science, those who manufacture chemicals and chemical plant, whether they are directors, managers, chemists or salesmen, those who buy and sell chemicals, and those who direct the fortunes of this country from Whitehall and Downing Street, will all find something of value to them in our pages.

Our readers abroad—and these are a large and growing number—will be informed of the news and gossip in chemical circles not only in this country but in all countries in Europe, in America, and the other continents. Our Journal already circulates in every country where chemistry is practised, and it is one of our aims to enable our readers in every country to keep acquainted with the news in the rest of the world. We rely on their co-operation and help.

* * *

The beginning of a New Year provides us with recollections and anticipations which we usually do not indulge in at other seasons. We have a sort of holiday, we assemble family parties, we gossip over by-gone days, and step aside for a moment to survey from a suitable mound the course of our lives. So far as this Journal is concerned the prospect is one of sudden change ; a well-disciplined and orderly march has enabled information on one special branch of knowledge to be purveyed at the leisurely intervals of twice a month. Now we must, within three days' of the issue of our last volume, commence the publication of a new one, at double the former speed and dealing with a larger domain of learning. We are in a measure merchants of knowledge ; we have to acquire our news, our articles, our cargoes of weighty matter; these must be sampled, re-packed, put into an attractive form, and distributed in quantities such as our customers require and at very definite times. We can never plead delay in transit, barratry, Acts of God, or the King's Enemies or any of the other moving accidents which are mentioned in detail in charter-parties, bills of lading and sundry commercial documents. Readers receive their weekly Journals with a regularity which should be a marvel, but it is taken as a matter of course. "We never came into our dining-room but at twelve and six o'clock we found excellent meat and drink on the table; our clothes were never worn out, but next morning a tailor brought us a new suit: and without question it will be so ever." So we think, carelessly, but at the New Year, when they survey the world around, we ask our readers to spare a few moments to reflect on the responsibilities of printers and editors.

* * *

America is a great country and has ideas commensurate with its greatness. We mention elsewhere an important announcement which will excite feelings of admiration and envy in the minds of British Chemists. The Allied Chemical and Dye Corporation, of which Dr. W. H. Nichols is Chairman, announced an annual gift of twenty-five thousand dollars to reward the American chemist who contributes most to the benefit of the science and the world. This is an extremely handsome proposal, well worthy of the Corporation which makes it, the Chairman who announces it and the country of its origin. It recalls the valuable Nobel Prizes, the great donations of the late Monsieur Solvay and some other benefactions. In this country we lag behind in the endowment of science. We are a small country—so is Sweden—so is Belgium. At the moment we are a poor country, and our once wealthy companies and our once wealthy men are not in a position to make princely gifts. But this was not so eight years ago, and will not be so eight years hence. The spirit of generosity remains with us yet, and we have comparatively recent instances in some handsome endowments handed over to the Universities of Oxford and Cambridge and the bequests made by Dr. Ludwig Mond and Dr. Messel. Even at the present time something might be done in this country for the advancement of chemistry by those who are comparatively well off. No amount of money will enable a second class chemist to become one of the first rank, but money will be a great help in organising the science, in promoting the application of it to industry, in the speedy publication of chemical information, in the easier means of enabling chemists here to become acquainted with their colleagues all over the world and the new discoveries which are being made.

LETTERS

From

Sir William Pope, K.B.E., F.R.S.

President of the Federal Council for Pure and Applied Chemistry

The decision of the Council to issue the JOURNAL weekly from the beginning of 1923 marks a fresh development in the activities of the Society of Chemical Industry. The Society was founded early in 1881 with a membership of 297, and published a now rare volume of 60 pages of the proceedings at its first annual meeting. From the commencement of 1882 the JOURNAL of the Society was issued in monthly numbers under the editorship of our late friend, Mr. Watson Smith, and included from its first issue "Transactions" and "Abstracts" under continuous pagination. The JOURNAL became a fortnightly issue in 1902, and was continued in the same form until the end of 1917; since January, 1918, it has appeared in fortnightly numbers, each containing an instalment of the "Review," the "Transactions," and the "Abstracts," with a separate pagination for each section.

The history of the Society's publications is one of steady progress; the aim of the Council has always been to increase the amount of information placed before the members and to render that information available with ever-increasing promptness. This being the object in view, it is clear that the next step in advance consists in converting the fortnightly issue into a weekly one.

A fortnightly issue suffers under many disadvantages. The subscriber to a weekly journal learns to expect his copy on one particular day of the week, whilst a periodical which arrives fortnightly is apt to appear as an intruder which finds no allotted place in the week's routine. Further, current information of interest which can be served up fresh in a weekly journal, grows cold when it has to wait for a fortnightly issue. Considerations such as these provide a basis for many of the criticisms which have been directed against the "Review" from time to time; they indicate that the Society will grow in vigour and in usefulness with a weekly issue of its JOURNAL.

Naturally, a weekly journal must aim at the prompt dissemination of much information of general interest to chemists, and its success will depend largely upon the extent to which the enthusiastic collaboration of all chemists can be secured; reports of meetings of societies at which chemical topics are dealt with must be obtained and published at the earliest possible moment. After conference with the Federal Council for Pure and Applied Chemistry it has been decided to make the JOURNAL the official organ of that body for the purpose of enlisting the sympathy and aid of all the societies concerned with chemical affairs in what should be, to a greater extent than has been possible with the "Review," the chemical newspaper.

Whilst the JOURNAL will remain in every sense of the term the Journal of the Society of Chemistry, the new development represents an earnest attempt by the Society to amalgamate the corporate interests of chemical science and technology. Since the widened scope of the JOURNAL should secure for its more topical part, that represented by the present "Review," a circulation outside present members of the Society, it is proposed to change the title of this section to "Chemistry and Industry" and to place this on sale separately. For members of the Society, "Chemistry and Industry" will be issued in the same blue cover as the "Transactions" and the "Abstracts," each of the three sections being separately paged as at present. A tentative arrangement has been already made for supplying Fellows of the Chemical Society with "Chemistry and Industry."

The discussions concerning the new development have been lengthy, having extended over the last two years; they have been anxious ones, by reason of the magnitude of the financial responsibilities which the Society is assuming. The scheme of work which is now being embarked upon is the result of mature reflection and consideration; it may not be perfect in every detail, but the Council may be trusted to apply the appropriate remedy to any defects which experience may reveal.

The duty now devolves upon all interested in the chemical industry and chemical science of the Empire to promote the success of "Chemistry and Industry" by contributing items of news and articles of chemical interest and by using its columns for the ventilation and discussion of technical and scientific questions.

From

Colonel G. R. Lane Fox, M.P.

H.M. Secretary for Mines

It is with much pleasure that I hear of the intention of the Society of Chemical Industry to start a weekly Journal. The reputation of the present Journal is firmly established, and for many years now it has played an important part in bringing the results of Research work in Chemistry before those concerned in the industrial application of those results and before the public generally. It is of special interest to me now, as Secretary for Mines, that the Society and its Journal have made valuable contributions to the solution of the economic and safety problems of the great mining industry of this country, and I wish the Journal in its new form every success in all its spheres of work, but particularly in this.

From

Roscoe Brunner, Esq.

Chairman of Messrs. Brunner, Mond & Co., Ltd.

I am very interested in the decision of the Society of Chemical Industry to publish the Review portion of its JOURNAL weekly instead of twice a month, and I hope and believe that this new venture will be as successful as the efforts of its promoters deserve.

In the present state of world-trade everyone, whatever his political views or prejudices may be, must welcome every possibility of improving trade, and thus increasing the production of wealth upon which the standard of life of all depends.

After the Napoleonic wars at the beginning of the last century, the loss of wealth which had been incurred in those wars was rapidly restored by the vast and unprecedented growth of trade all over the world which, as is well known, was in the main due to the large number of scientific discoveries and the industrial application of them to increased production. A similar increase in the production of wealth is once again required to repair the tremendous losses of the late war, and to no industry can the world look with such hope and such confidence as to the Chemical Industry. In that industry there are always possibilities of discoveries, or the application of discoveries already made, which may revolutionise industrial methods and render available hitherto unsuspected sources of energy and wealth.

It seems to me that such a weekly journal as you propose to publish will be of great assistance in helping the Chemical Industry to realise these possibilities. You are wisely proposing, I notice, to deal with pure chemistry and physical chemistry, as well as with applied or industrial chemistry. This combination of the two aspects of the science should be of assistance both to the chemist primarily concerned with industry, and also to the pure scientist producing results some of which may prove of value to the manufacturer.

There is no doubt that in the past there has been some justification for the reproach levelled against British industry that it was not sufficiently alive to the possibilities of research work, and of the application of the results of research work to industrial processes. A considerable improvement has taken place in this respect both during and since the war, but there is still room for further improvement and for further co-operation between the industrialist and the scientist. In this matter your new venture should perform a very great service, and be of equal assistance to both parties. I am looking forward to its first number with considerable interest, and I feel certain that all those who have the Chemical Industry at heart will, as I do, give you their warmest wishes for its unqualified prosperity and success

From

Sir Max Muspratt, Bart.

Chairman of the United Alkali Co., Ltd.

You have asked me to write a few words concerning the suggested change in the issue of the "Review" portion of our Journal. I do so with pleasure.

In the first place, may I be allowed to congratulate those responsible for the proposal which appears to me to be one likely to appeal to the majority of the members and so add materially to the usefulness of our Society?

The Society of Chemical Industry, as the older members know, grew rapidly from a comparatively small and local beginning. Its Journal, with the publication of original papers, abstracts of patents, and chemical literature, received early recognition, and almost from the start became indispensable to any chemist interested in the industrial aspect of our science.

During the earlier period of the Society's existence, and whilst its membership and activities were confined to these Islands, monthly publication sufficed. The extension of membership and the foundation of Sections in the United States of America and the Colonies, coupled with the formation of other scientific associations dealing with special branches of chemistry and the consequent increase in the volume of research work published, naturally added to the pages of our Journal, and the present bi-monthly publication has fully justified its inception.

The initiation of the "Review" portion of the Journal was again clearly in the line of progress. For its past success I feel the congratulations of all members will be accorded to the late editor, Dr. E. H. Tripp. There is no doubt the present "Review" is a distinct success; it possesses in its "News and Notes" a human element and permits the introduction of many items of interest which might less readily find a place in the purely scientific pages.

The early publication of abstracts of papers read before our own Sections, or reports of meetings of other societies; the summarised accounts of progress in special branches of science and technology are of interest to all, but perhaps more particularly to those busied with the commercial aspect of industry who desire reports of progress to be early and concise.

I heartily welcome the suggestion of weekly publication of this interesting and valuable portion of our Journal, and I wish the Society and yourself as the new editor all success in the venture.

From

M. Paul Kestner

President of the Société de Chimie Industrielle

Vous voulez bien m'apprendre que la Society of Chemical Industry a décidé de faire paraître dorénavant hebdomadairement son bulletin, ou tout au moins la portion de ce bulletin consacrée à la revue.

En me faisant cette communication vous voulez m'associer l'un des premiers à votre joie et à votre légitime fierté. Vous me savez un des plus anciens membres de votre Société, l'un de ses plus fidèles amis; vous avez eu la délicate pensée que je devais être l'un des premiers à connaître l'heureuse nouvelle; je vous en remercie.

A cette occasion, je me souviens du plaisir que déjà j'avais ressenti lorsque votre Société avait réussi à franchir cette première grande étape, rêve de toutes les Associations à leur début: la parution bi-mensuelle des annales et de la documentation.

Quel service votre Journal a ainsi rendu en augmentant sa périodicité!

J'en appelle au témoignage de tous ceux pour qui, comme pour moi, il a été un instrument de travail infiniment précieux, toujours attendu avec impatience.

Et maintenant, c'est la perfection même que vous allez atteindre en arrivant à l'étape dernière: celle de la parution hebdomadaire; ainsi se trouvera parachevée la belle oeuvre qui a été celle de la Society of Chemical Industry, cette oeuvre que vos amis français n'ont cessée d'admirer, et en même temps, je puis le dire, de vous envier.

Je ne puis mieux vous exprimer mon approbation qu'en vous disant: votre Société est pour nous un modèle; votre dernière initiative sera un stimulant puissant qui nous décidera à nous engager nous-mêmes dans la voie que vous nous tracez.

Vers cette voie tend depuis longtemps notre préoccupation constante; à votre exemple, nous nous y engagerons, je l'espère, avec la même volonté et la même énergie.

From

Sir James Walker, F.R.S.

President of the Chemical Society

The establishment of a new weekly journal of Chemistry which students, teachers and industrialists alike may read is an event certain to have most beneficial and far-reaching consequences.

The student with his antiquated text-books—all text-books are in reality antiquated—is only late, if at all, brought into touch with current scientific research through lectures and journals: the young research worker is too apt to become a premature specialist: the teacher, harassed by the work of instruction or administration, too readily loses heart before the accumulating pile of chemical literature. And if such be the case on the academic side, notable for its leisured ease, how must it be aggravated for the busy industrialist. Furthermore, the technical chemist has no time to make himself acquainted with what is going on in the domain of pure chemistry; and the academic chemist remains ignorant of technical advances for the same reason. Each branch of our science should serve as a stimulus and auxiliary to the other, and it is a chief function of the new journal to bring this to pass by publishing short readable articles on the things that matter in the chemistry of the day, whether pure or applied. Mutual knowledge is the basis for effective collaboration.

The generous offer made by the Society of Chemical Industry to the Chemical Society in respect to the first year's issue of the new weekly is welcome evidence of the spirit of co-operation that already exists between the Councils of these Societies, a spirit which *Chemistry and Industry* will, amongst the membership, do much to foster. It enters on its career with the good wishes of chemists of every occupation and every interest.

THE CALCIUM CARBIDE INQUIRY

SIR WILLIAM J. POPE

Part I

THE hearing of an application before a Board of Trade Referee early in 1922, for the inclusion of calcium carbide among the substances covered by the Safeguarding of Industries Act evoked a lengthy discussion of the definition of an organic compound; the learned Referee ultimately stated as his opinion that calcium carbide was properly excluded from the list of synthetic organic chemicals and the application accordingly failed.

The transcript of the shorthand notes shows that, from the standpoint of the chemist, the proceedings degenerated into an orgy of misapprehension and misinterpretation; commenting on the subject in a letter to the *Times*, I remarked that "owing to the fact that the Referee, himself a distinguished lawyer, has not been given the assistance of a chemist as assessor, these Board of Trade inquiries have become ridiculous farces played to the shame of British methods of legal procedure." Sir Arthur Colefax, one of the leading counsel engaged in the inquiry, is not convinced by my criticisms, which he says "are not well-founded and are ungenerous"; it seems therefore desirable that the grounds for regarding calcium carbide as a typical synthetic organic compound should be discussed in one of our technical journals.

The Definition of an Organic Compound

The modern and very precise meaning attaching to the term "organic compound" began to take shape at the overthrow of the Berzelius' assumption that "the elements present in living bodies obey laws totally different from those which rule inanimate nature." The intervention of a vital force in the formation of chemical products by living matter became superfluous and as Kekulé stated, "whilst, formerly, chemistry was divided because a boundary was seen, afterwards, such a boundary was looked for because it was found convenient to have one"—*Lehrbuch der organischen Chemie oder der Chemie der Kohlenstoffverbindungen*, 1859, vol. 1, page 8.

The new standpoint was given by A. Laurent (*Chemical Method, Odling's translation*, page 179).

1. "We maintain for our part, that an organic substance is simply a substance containing carbon; thus marble, cyanogen, carbonic acid, chloro-carbonic acid, etc. are organic substances. As on the one hand, cyanogen, carbonic acid and acetic acid can combine with all the metals and on the other hand, we have carbon compounds containing sulphur, selenium, chlorine, nitrogen, etc., it is clear that organic chemistry comprises, not only the combinations of carbon with hydrogen, oxygen and nitrogen, as is ordinarily stated, but also the combinations of carbon with all simple bodies whatever. Organic chemistry thus defined, or the chemistry of carbon, differs from mineral chemistry by the unlimited number of combinations which may be produced when but two or three simple substances are associated with carbon."

There is no ambiguity in this careful statement: every compound of carbon is an organic compound; but it only became the accepted definition after long and exhaustive discussion. Dumas never freed his mind from the definition of his youth (Faraday Lecture, *Chemical News*, July 2, 1869); Gmelin (*Handbook of Chemistry*, 1852, vol. 7, page 5), in objecting to the oxides of carbon being included among organic substances, referred to the then hypothetical, but now well-known oxalic anhydride, C_2O_3. Ultimately, however, every definition of an organic compound given by an acknowledged master of organic chemistry, in which modern knowledge disclosed no inconsistency, was found to conform very closely to that of Laurent. The following is a representative list of these definitions.

2. "We thus define organic chemistry as the chemistry of the carbon compounds."—A. von Kekulé, *loc. cit.*, page 11.

3. "Chemistry is the study of the atom; organic chemistry is thus that of the carbon atom . . . . organic chemistry has for its object not only the study of the compounds of carbon but also that of the element itself."—J. H. van't Hoff, *Ansichten über die organische Chemie*, 1881, vol. 1, page 1.

4. "Organic chemistry may be generally defined as the chemistry of carbon and its compounds, since carbon is the one essential element in all organic compounds."—H. E. Armstrong, *Organic Chemistry; the Chemistry of Carbon and its Compounds*, 1886, page 1.

5. "In order not to have to describe carbonic acid as an organic compound, L. Gmelin defined organic chemistry as the chemistry of those carbon compounds which contain more than one atom of carbon in the molecule. Wood spirit, CH_4O, and the formic acid, CH_2O_2, contained in ants would thus not be organic compounds. As is seen, this limitation cannot be retained and we must define organic chemistry as the chemistry of all the carbon compounds."—F. Beilstein, *Handbuch der organischen Chemie*, 1893, vol. 1, page 1.

6. "And organic chemistry becomes the chemistry of the carbon compounds."—J. B. Cohen, *Theoretical Organic Chemistry*, 1903, page 3.

7. "Organic chemistry is the chemistry of the carbon compounds—partly upon grounds of convenience, carbon itself and some of its principal compounds, such as carbonic acid, which is so widely distributed in the mineral kingdom, are treated of under inorganic chemistry."—A. Bernthsen, *Textbook of Organic Chemistry*, 1906, page 1.

8. "At the present day we mean by 'organic compounds' simply the compounds of carbon. . . . There is apparently no *a priori* reason why any element should not be associated with carbon, and enter into the composition of an organic compound."—T. E. Thorpe, *History of Chemistry*, 1909, vol. 1, page 128.

9. "Organic chemistry is hence the chemistry of the carbon compounds."—V. von Richter, *Chemie der Kohlenstoffverbindungen oder organische Chemie*, 1909, page 2.

10. "Organic chemistry, therefore, is the chemistry of the carbon compounds. Some of the simpler compounds of carbon, such as carbon dioxide and carbon monoxide, which are of general importance, are always described in works on inorganic chemistry for the sake of convenience; they are, nevertheless, organic compounds, because they contain carbon."—W. H. Perkin and F. S. Kipping, *Organic Chemistry*, 1911, page 3.

11. "Organic chemistry is the chemistry of the carbon compounds."—A. F. Hollemann, *Textbook of Organic Chemistry*, 1914, page 1.

12. "Organic chemistry is the chemistry of all carbon compounds; every carbon compound is, by definition, an organic substance." C. Moureu, *Fundamental Principles of Organic Chemistry*, 1921, page 2.

13. "The organic chemistry of to-day is a chemistry of the carbon compounds. . . . Organic chemistry embraces all the compounds of this element; only a few of the most simple—carbonic oxide, carbonic acid and its salts and certain compounds of carbon with other metalloids or metals (carbides) produced at high temperatures—are treated on grounds of expediency in inorganic chemistry."—V. Meyer and P. Jacobson, *Lehrbuch der organischen Chemie*, 1907, vol. 1, page 2.

The above definitions of the scope of organic chemistry are quoted from the writings of celebrated organic chemists who have spent their lives in developing their subject and who, in this occupation, have necessarily given profound attention to the meaning of the term "organic compound." These definitions agree that every compound of carbon is to be regarded as an organic compound but a few others, also of outstanding authority, have been designed for the express purpose of excluding carbon monoxide and dioxide from the class of organic substances; we thus have—

14. "We consequently define organic chemistry as the chemistry of the hydrocarbons and their derivatives."—C. Schorlemmer, *Lehrbuch der Kohlenstoffverbindungen oder der organischen Chemie*, 1897, page 7. Whilst this probably excludes carbon monoxide it includes carbon dioxide as a simple derivative of methane and is indefinite to the extent that it may be taken to exclude purine, as being too distantly derived from a hydrocarbon.

15. "The name organic is commonly restricted, by chemists, to compounds the molecules of which consist of one or more atoms of carbon *directly* combined either with carbon, nitrogen or hydrogen. Thus, according to this definition, carbonic anhydride and hydric potassium carbonate are mineral or inorganic compounds, because the carbon which they contain is directly combined with oxygen only."—E. Frankland, *Lecture Notes for Chemical Students*, 1872, vol. 2, page 1. This definition is faulty in that it excludes perchloromethyl ether, $(CCl_3)_2O$, from the category of organic compounds.

The following statement emphasises an aspect of the question which arose during the carbide enquiry:—

16. "The name chemistry of the compounds of carbon has been objected to as being too broad. Strictly speaking, this title includes the carbonates, and it is customary to treat of these widely distributed substances under the head of inorganic chemistry."—Ira Remsen, *The Study of the Compounds of Carbon or Organic Chemistry*, 1886, page 2. Although Remsen regards the carbonates as organic substances he notes that they are treated under the head of inorganic chemistry because their omnipresence makes them of interest to others than specialists in organic chemistry.

The situation may now be summarised as follows:—All definitions of an organic compound which have been given by organic chemists of repute and which have not become invalidated by modern knowledge agree in including the compounds of carbon generally; a small minority of such chemists exclude from their definitions, carbonic oxide, carbonic anhydride and the salts of carbonic acid with inorganic bases. No other compounds of carbon are excluded from the definition by any organic chemist of repute.

Statements discordant with the foregoing have, of course, been advanced; but these are not the production of organic chemists of repute or even of chemists who, by virtue of their devotion to original investigation, have had need to reflect carefully upon questions of definition. We thus have the following:—

17. "Indeed it may be said that no exact definition of an 'organic' compound has ever been framed, and we have to accept the general statement that 'organic' chemistry is the chemistry of the carbon compounds with certain generally acknowledged exceptions." G. S. Newth, *Textbook of Inorganic Chemistry*, 1903, page 296. The opening phrase of this statement is erroneous in view of the many exact and concordant definitions previously quoted; the fact that the writer has not been a contributor to organic chemical knowledge renders his statement of as little authority as those given by the dictionaries. *Lloyd's Encyclopædic Dictionary*, 1895, defines organic chemistry as "The chemistry of the carbon compounds in which the hydrogen or nitrogen of the substance is directly united with carbon"; this definition is clearly unacceptable because it excludes such organic compounds as tetrabromothiophene, croconic acid and perchlorobenzene. It is nearly as objectionable as the following:—

18. "In all organic compounds carbon and hydrogen appear as never-failing constituents."—E. P. Möller, *The Law of Atomic Linking*, 1895, page 4.

The wealth of available definitions, identical in purport, by outstanding organic chemists and the reason why no importance can be attributed to conceptions of an organic compound formulated by authors unknown to organic chemistry did not transpire during the calcium carbide hearing. The idea was promulgated that because a particular compound is treated in works on inorganic chemistry it is necessarily not an organic compound; this is, of course, absurd, for text-books on inorganic chemistry deal habitually with many well-recognised organic compounds. Thus, H. Erdmann in his *Lehrbuch der Anorganischen Chemie*, treats at length of the hydrocarbons methane, ethylene and acetylene and discusses the constitutions of the paraffin hydrocarbons in general; W. Ramsay, in his *System of Inorganic Chemistry* deals at length with methane, ethylene, acetylene and the organometallic compounds and Alexander Smith in his *General Inorganic Chemistry*, describes many hydrocarbons, acetic and oxalic acids, the starches and sugars, ethyl alcohol, ether, the soaps, drying oils, etc., and discusses in notable detail the constitution and behaviour of organic compounds. This is, of course, all in harmony with the definition, accepted by all the authorities, that organic chemistry is the chemistry of the carbon compounds; it is in recognition of the fact that the inorganic chemist in order to be efficient, must know something about organic chemistry, just as he must know something about the elementary laws of physics and something of elementary mathematics.

The most eminent organic chemist called in the hearing, Professor W. H. Perkin, was unshaken in his adhesion to the classical definition of an organic compound. The Referee was, however, much impressed by the fact that von Groth, who is not a chemist, describes the crystallographic properties of the carbides under an inorganic heading although he does not remark that the same author deals with many complex organic compounds under a similar heading. The Referee then quoted in his decision the following mistranslation of the definition by Meyer and Jacobson (No. 13 above)—"in Meyer and Jacobson it is stated that organic chemistry embraces all compounds of carbon except the simplest—viz., carbon monoxide, carbon dioxide and its salts, and certain compounds which arise at very high temperatures—viz., the carbides, which are usually dealt with in the inorganic branch on the ground of suitability." Meyer and Jacobson's definition includes carbon monoxide, carbon dioxide and the carbides as organic substances but the Referee translates it as meaning that these are not organic compounds. The bias arising from the mistranslation is reflected in the Referee's later observation, again in his decision, that—"The strongest statement in favour of the complainants is found in Richter, who says in terms that calcium carbide is organic, but he also says that carbon dioxide and carbon monoxide are organic, whereas it is conceded that they are not so regarded." The mistranslation of one authoritative definition is thus used to contradict the others. The Referee gathered the further erroneous impression that the expressions "compounds of carbon without exception," "hydrocarbons and their derivatives" and "compounds of carbon which contain an organic radicle" are so discordant as to justify him in concluding that "there is not a technical meaning of the words 'organic chemical' which has been generally accepted by chemists."

In a later communication it will be shown that calcium carbide is not only an organic compound but that it is a synthetic compound which is a simple derivative of the hydrocarbon acetylene and contains an organic radicle.

FROM THE TIMES 11th DECEMBER 1922

SAFEGUARDING OF INDUSTRIES ACT

To the Editor of The Times

Sir,—The debate in the Commons on the Safeguarding of Industries Act, 1921, showed that, whatever differences of opinion exist as to the wisdom of the measure, the attack upon it was advisedly based upon the manner of its interpretation rather than upon its spirit. The tactics of the Opposition were sound; probably few pieces of legislation have been so marred by faulty drafting of the explanatory schedule as has been that designed for the protection of the key industries.

Without discussing the whole of the schedule I would draw attention to its last paragraph, which describes as imported "goods chargeable with duty" the following:—

> All synthetic organic chemicals (other than synthetic organic dyestuffs, colours, and colouring matters imported for use as such, and organic intermediate products imported for their manufacture), analytical reagents, all other fine chemicals (except sulphate of quinine of vegetable origin) and chemicals manufactured by fermentation processes.

The chemical trade distinguishes between a "fine chemical" and a "heavy chemical," just as ordinary mortals distinguish a "heavy dog" from a "fine dog"; the really heavy or the really fine is unmistakable, but no definition of either can be given without prescribing numerical dimensions of heaviness or fineness in an entirely arbitrary manner. The introduction of the term "fine chemical" into the interpreting schedule is as direct an invitation to litigation as if statute exempted heavy dogs but charged 40s. for a licence to keep a fine dog; the legal profession has good reason to know that the invitation has been widely accepted.

Similar incompetence marks the drafting of other phrases in the schedule. To speak of "sulphate of quinine of vegetable origin" is as tautological as to specify mutton chops got from the sheep, because all sulphate of quinine is of vegetable origin; the expression "chemicals manufactured by fermentation processes" embraces unintentionally too wide a field, for it includes Chile nitrate and natural indigo.

But whilst the Government official who drafted the schedule has exhibited a marked talent for vague and inaccurate expression, the legal interpreters have shown him to be not without close competitors. Early in the year an application was heard before a Board of Trade referee for the inclusion of calcium carbide among the scheduled chemicals as belonging to the class of "synthetic organic chemicals"; the legal arguments turned largely on what is meant by an organic compound. Many definitions of an organic compound have been given by eminent organic chemists, and all, though different in wording, agree in stating that the term "organic compound" includes all the compounds of carbon.

The referee, in his decision, quoted a very carefully worded definition by a German authority, but quoted it in the form of a mistranslation which entirely altered its meaning; on this erroneous statement of fact, the referee rejected the application. Calcium carbide, one of the most typical synthetic organic compounds, is declared by the referee, on a false translation of a German definition, not to be an organic chemical.

The history of the calcium carbide inquiry has been repeated in connexion with many other applications concerning the interpretation of the schedule; in all, the definitions and facts of organic chemistry, one of the exact sciences, have been misinterpreted and remoulded in a manner which would have delighted Lewis Carroll. Owing to the fact that the referee, himself a distinguished lawyer, has not been given the assistance of a chemist as assessor, these Board of Trade inquiries have become ridiculous farces played to the shame of British methods of legal procedure.

William J. Pope

Cambridge, Dec. 8

FROM THE TIMES 16th DECEMBER 1922

SAFEGUARDING OF INDUSTRIES ACT

To the Editor of The Times

Sir,—If Sir William Pope had confined himself, in the letter which you published on December 11, to contending that the drafting of that portion of the schedule to the Safeguarding of Industries Act which he quotes is unsatisfactory, he would have found few, if any, of those who have had to consider the meaning of the expressions used therein in disagreement with him.

It should, however, I think, be recognised that it must have been a task of considerable difficulty to draft this portion of the schedule so as to carry out the policy of the Act; and, further, it should not be overlooked that, in respect of the list of many thousands of substances—being the Board of Trade's interpretation of such portion of the schedule—the applications for revision of such list which have been brought to a hearing number sixteen, and that probably not half-a-dozen more will be brought to a hearing. Sir William is on safe ground in his criticism of the expression "fine chemical." It lacks desirable precision. It is not a scientific term, and, as a trade term, it is of doubtful significance. His criticisms, however, of the "legal interpreters" and of "these Board of Trade inquiries" are not well-founded and are ungenerous.

There has been only one legal interpreter of the above portion of the schedule—a distinguished lawyer, as Sir William acknowledges. He was appointed, as provided by the Act, by the late Lord Chancellor, and, I suggest, is improperly described as "a Board of Trade Referee." I believe I shall have the consent of all who have been engaged in these hearings—whether as party, witnesses, or counsel—in maintaining that the learned Referee has discharged his difficult duties in a remarkably able, painstaking, and conscientious manner. When Sir William says that "owing to the fact that the Referee, himself a distinguished lawyer, has not been given the assistance of a chemist as assessor, these Board of Trade inquiries have become ridiculous farces, played to the shame of British methods of legal procedure," he appears to be unmindful of the fact that the learned Referee has had the duty, and has discharged it, of deciding the applications on the evidence before him. as also of the fact that such evidence has, in the main, been the evidence of chemists, not only fully qualified, but distinguished as such, although Sir William has not—and this is undoubtedly to be regretted—himself been a witness in any of the inquiries.

Sir William refers to, and apparently relies in support of the views expressed in the passage in his letter which I have quoted above, upon the calcium carbide application. He says that calcium carbide is one of the most typical synthetic organic compounds. He further says that all definitions of the expression "organic compound," given by eminent organic chemists, agree in stating that the term includes all the compounds of carbon. I, as counsel, was present throughout the inquiry, and heard the whole of the evidence. So far from all the chemists agreeing that the term "organic compound" includes all carbon compounds, all the distinguished chemists, whether eminent in organic or inorganic chemistry, who gave evidence excluded one or other carbon compound from the definition of "organic compound." Further, there was the sharpest division of opinion on the part of the chemists as to whether calcium carbide—which Sir William regards as one of the most typical synthetic organic compounds—was either a synthetic or an organic compound. On the evidence as a whole, and not on any isolated definition, such as Sir William says was mistranslated, the Referee decided the case, holding that the applicants had not established that calcium carbide was a synthetic organic chemical.

I submit that, had Sir William been better informed, he would have refrained from criticising these inquiries or their results, at any rate in language which does not bear the impress of that accuracy in statement or care in consideration which, in fairness to the learned Referee and those who have taken part in such inquiries, may reasonably be demanded.

Yours faithfully,
ARTHUR COLEFAX

The Temple

LEGISLATIVE AND DEPARTMENTAL INTERFERENCE WITH INDUSTRY AND THE COMMON WEAL*

By PROF. H. E. ARMSTRONG, F.R.S.

MILK

I begin with mother's milk. To what extent are chemists advising the mothers that milk is not made out of nothing and that inability to satisfy, if not to feed the child at all, more often than not is the mother's fault, due to the fact that she has been insufficiently and ineffectively fed, may be even in her own distant infancy? How many chemists pay any attention to the subject and can advise even their own wives?

Passing to the cow—we chemists have done an evil thing in connexion with cow's milk, in having been parties during nearly fifty years to an early abuse of the Food Adulteration Act, without ever seeking to remedy its consequences. When the Act became operative, some vendors were charged with watering milk, the ground being that the percentages of fat, etc., were below the imposed standard. Proof was given by not a few that there had been no watering; the milk was merely poor in quality. Instead of enforcing improvement of quality, the standard was lowered, I believe, to admit all natural milks; as a consequence, milk may be legally watered down to this standard. It is not possible to say to what extent, if at all, milk is now diluted; but it is well known that the large vendors standardise by mixing milks of all qualities and that no premium is placed upon the production of milk of high quality. As a consequence, the quality of the milk supply of large towns has in no way been improved in recent years, especially as no care is taken by most to mix the morning and afternoon milks, which are often very different in quality.

The matter has been left in the hands of the Public Analyst. The condition of affairs is well known, however, to the Board of Agriculture, to the Ministry of Health, to the Somerset House Authorities and to the Agricultural Societies; but neither the Government Departments nor chemists have yet had the wit to promote any improvement. Is it surprising that the public gain no faith in science, if science make no appearance, by coming forward in its protection, in so vital a situation?

Now a still worse thing is happening. The Ministry of Health, acting independently, if not against the Ministry of Agriculture, has secured the passing of a measure, to come into operation on January 1st, 1923, which will legalise the application to milk of an unnatural treatment known to have a most definite and, without hesitation be it said, detrimental effect upon its food value. So far as I have been able to discover, no attempt was made to discuss the possible effect of the measure in any proper scientific manner, to determine to what extent the supposed advantage of the treatment outweighs the disadvantages, known or conceivable; doubtless it was drafted to satisfy some popular cry and in accordance with the whim of one or more departmental experts.

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* A paper read before the Nottingham Section on December 13, 1922.

The position is one of extraordinary difficulty. On all sides there is very properly an outcry for clean milk and the advance of knowledge is leading an increasing proportion of dairymen to do their best to meet the demand and produce milk of high quality; but the low standard to which I have referred is against advance; now there is danger, that this may be further checked by the operation of the new Act, as the Act provides a means, viz., heating, which it is assumed will render dirty, infected milk harmless, in the sense that it will not carry infectious disease.

In the later years of the war, when there was a shortage of milk, not a little that was known to be very dirty was *pasteurised*, by the vendors, to render it safe; the practice has grown apace, without the public being consulted or made aware of the change. It is stated that whereas in 1918 thirty per cent. of the milk sold in London was pasteurised, now up to eighty per cent. is so treated. Londoners, for the most part, are dealing with a whited sepulchre.

It is the old question, whether we should—

> "rather bear those ills we have
> Than fly to others that we know not of ?"

Conscience has made no cowards of the milk vendors; to serve commercial ends in the main, the trade is boldly, without permission asked, changing the character of our fundamental food, that upon which our infants and children are nourished. Their whole lives may be imperilled by this change: their growth stunted and their level of health lowered.

That milk is changed by heating above blood heat is certain—no one who has the slightest knowledge of the subject will deny this; the extent of the change, the number of factors affected, be they advitants or enzymes or unknowns of other kinds, is entirely unknown to us. All we can assert is, that being present in so vital a product—vital in the sense that it is made by the living for the living—it is unlikely that they should not each and all have their purpose and be essential to complete and healthy growth. Heated milk, we know, produces scurvy in sensitive animals and not infrequently in human infants; moreover, it is found that before the external symptoms of scurvy are apparent, the structure of the teeth is seriously affected; for all we know, there may be other effects not open to present observation, more or less deep-seated, even coming into operation later in life.

Why should we "denaturalise" our milk as we do spirit by methylating it? In the latter case, the object is clear and admitted; in the former, the object is definitely charitable but the result is possibly as uncharitable as that which is aimed at and secured in the latter.

The vendors aim at making the milk keep, *i.e.* at preventing it from turning sour, an almost natural change, which does not depreciate its dietetic value—as instanced by the advocacy and use of sour milk by the Metchnikoff school. In Denmark the desired result is secured by cooling. If the state of Denmark be not rotten in such respect, why should ours be? Why should we seek to kill when we can easily cure by simple means? Answer:—because we are a lazy and totally unorganised people, in the hands of an unthinking bureaucracy, without light of scientific method.

We are guided by science, may be the retort. Have we not a bacteriologist? have we not made experiments with guinea pigs? even with a monkey who was cured by heated milk? —as we were solemnly told at University College, London, a few days ago.

Due respect we must have for those fearsome wild fowl, the bacteria—but we need not bow down and worship them always, at the command of those who perpetually gaze upon them and have no time left for the exercise of a reasonable logic. The real issue is the "to be or not to be" of tubercular disease of bovine origin and on that the medical profession is in no way at one. The assumed risk is 6·5 per cent. of the total number of deaths from tuberculosis; the accuracy of the estimate is open to question but even if it be accepted, such a loss is small in comparison with the injury which may conceivably be wrought upon the population at large by denaturalising our primary food. The battle of life cannot be fought without loss by the way. We shall need to fight with hale forces in future; our population is at least double what our country can carry; it is desirable to eliminate the unfit. To-day we are forced to put sentiment aside; if we do not, the incidence of natural economic causes, if not sudden revolt, will bring about what we have not the sense to accomplish.

The bacteria themselves are against our stupid ways. They at once take advantage of the gaps we introduce to attack us. Nothing so predisposes to disease as insufficient and faulty feeding. This is particularly true of tubercular disease, the modern cure for which is a high diet and exercise in the fresh air.

You know the awful example held up in *Struwelpeter*:—

> "Augustus was a chubby lad,
> Fresh rosy cheeks Augustus had,"

until one day he began to damn his soup and refused to take it; thence-forward he languished and soon died.

Apparently the "soup" is, in some way taken from milk, when it is heated. The infant fed on dried milk, at first, is like Augustus—though only when coaxed with fruit juice, cold-drawn cod liver oil, etc., but in the second year is peculiarly susceptible to infectious disease. We have yet to write the after-history of its teeth and other delicate parts of its mechanism.

Up to within half a dozen years ago, the value of food was assessed upon a basis of calories—as if it were so much timber. It was recognised, that a certain ratio of fat, carbohydrate and protein was desirable ; but beyond this little real attention was paid to quality. The doctrine was long taught in the cookery schools, that the value of protein foods was to be reckoned in terms of nitrogen ; Emil Fischer's work made this view impossible. Then came the discovery of advitants—of a class of natural condiments in the absence of which from food,

"the hungry sheep look up and are not fed."

Three at least are recognised already ; there may be thirty for all we know, the inquiry is so new and so difficult. Some if not all, are very sensitive to change. Modern methods of preserving food, modern methods of cooking food—especially the substitution of baking for roasting, an unfortunate consequence of the use of gas stoves—seem all to favour this destruction. In some way our urbanized civilisation has gone astray, we know ; some explanation of our large C3 population has to be given—to say that faulty feeding is one of its great causes is no mere guess. Sir Arthur Keith tells us—"In olden days the teeth were often ground down to their sockets (which means that the food was uncooked) ; nowadays, even after sixty years of wear, we may observe *in such of them as have survived the modern disease of caries,* that their chewing surfaces are scarcely worn." It is significant, as I have said already, that before the external symptoms of scurvy are apparent, the structure of the teeth is adversely affected. Caries has been detected in Prehistoric Man, though in rare cases ; so the disease is not of modern origin ; as few now escape it, there must be some favouring condition at work and the indications are all towards our denaturalised diet, rather than to loss of an aforetime natural occupation. Quite a number of inmates of our asylums, we know, were done to death in all kindness by feeding them on food stewed so long that it was deprived of all "goodness," to use the popular phrase : of advitants, in our scientific jargon. The advitants apparently are vegetable products and are but passed on to the animal. We have yet to feed ourselves rationally. Abroad, no chief meal is served without some sort of green salad or fresh fruit ; here neither is thought to be a necessary regular article of diet.

(*To be continued*)

OBSERVATIONS BY "EYE-WITNESS"

"THE Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them."

The new guise in which the old Journal of the Society now makes its appearance affords an opportunity for a weekly comment on matters chemical which has hitherto been lacking. The expression of official policy which all editors are by reason of their position condemned to expound in editorial articles places a restraint upon them which makes for tranquillity but not always for progress. I am happy, then, to accept the Editor's suggestion that I should comment on the passing events in the chemical world, and where necessary ventilate those unorthodox opinions which it is the privilege of the extremely young and the very old to express.

Why are there so many Chemical Societies and Associations ?

This is one of the questions which is constantly in the minds of chemists and chemical industrialists, and even found expression in a speech delivered by the President of the Society of Chemical Industry a few weeks ago. There are a lot of them. They seem to have arisen because the older societies were unwilling or unable to broaden their bases and adapt themselves quickly to the changing needs of the times. But I am not convinced that there are too many societies. Man is a gregarious animal and the scientific variety of the species likes to congregate if a reasonable excuse can be provided for so doing. The numerous Societies provide the excuse ; they enable us to deceive ourselves into thinking we are performing serious duties, when in reality we are merely, but wisely, broadening our minds by mixing with our fellow-chemists. The real weakness of the numerous Societies is the lack of co-ordination—a blessed word.

What about the Federal Council ?

Whether the Federal Council can supply the missing adhesive depends on several factors. What is wanted is a body which by reason of its outstanding prestige, its single-mindedness and its known impartiality shall command the confidence of all the learned and semi-learned societies and associations. I suppose the Royal Society might have done the job if it had not been burdened with the weight of its own great prestige and its age-long traditions. What is wanted is a body which can unite the existing organisations in one representative whole. It must stimulate any society which is falling behind in the march of progress. It must, where necessary, promote the formation of new societies under its own ægis. It must even prevent the frivolous formation of a society which proposes to cover ground already covered by existing societies. This means a sinking to a small extent of the individuality which the societies overprize, and—be it whispered—the conversion of the permanent officials of the societies to a working together with other officials in a manner which is not always relished. I am all in favour of giving the Federal Council a chance. It is up to the members of its Council to justify the confidence they are receiving before they apply for a further instalment.

The Federal Council Applies for Funds

I was very glad to see that the Federal Council had issued an appeal for funds I shall send my mite a little later on. It is, of course, very right and proper that the first list should consist of contributions from those of our leaders who are willing to head the list with £50 notes. I am sure no one will criticise their generosity. In one way it shows the members of the Federal Council are prepared to dip into their pockets before searching other people's. I like the leaders who lead, but if the movement is to be a success it must be enthusiastically supported by the rank and file, and I would like to see a thousand one-guinea subscriptions and a similar number of half-guineas. That is the company with which I shall march.

Congratulations to Dr. Hodgkinson,

who has recently attained, so my newspaper informs me, the dignity of a Borough Councillor in Woolwich. My favourite reading nowadays is the newspaper, and an item of this description always catches my eye, possibly because it is so infrequent. I often wonder why so few of our scientific men take any active part in public life. Whatever the cause, the result is bad for science. The tendency of scientific men to become absorbed in their own subject is responsible in a large degree for the public attitude of indifference which characterised this country up to the time of the war and which will again become prevalent unless a greater number of scientists are prepared to engage in public work. I looked through the published list of members of Council; how few of them are in the public eye as they ought to be. Sir William Pope? Yes, and his scientific work and reputation has not suffered by it. The same applies to Sir Max Muspratt and Dr. E. F. Armstrong; but they are engaged in industry. Mr. Woolcock, of course, does not even pretend to more than a speaking acquaintance with the subject. But what about the others? Ought not they to follow in Dr. Hodgkinson's footsteps?

Chestnuts

I saw another interesting announcement in another of my newspapers to the effect that five thousand tons of chestnuts were among the cargo of the White Star liner *Homeric* when she sailed from Southampton for New York the other day; this is in addition to the quantity taken back personally by Dr. Ellwood Hendrick. This news will cause a sigh of relief from those of us who have to listen to so many after-dinner speeches at chemical functions. Let us hope that the next crop may exhibit the fruits of much research and careful fertilisation before they are produced for our delectation. I asked one of our most prolific talkers how he managed to use the apposite but somewhat aged stories with which he is accustomed to embellish his post-prandial oratory. He told me that he thinks of a story and then fits his speech round it. Very much like the man who used to pay the butler to slam the door as he left the room and then began: "Was that a gun? It reminds me once I was shooting in Burmah . . ."

Dr. M. O. Forster

Which reminds *me* that a friend of mine showed me a letter from our old friend Forster, who has now taken up his quarters in Bangalore. He seems from his letter to have had a delightful and profitable voyage—bridge was played. The Indian Institute of Science has over 300 acres, two to three miles out of Bangalore, and a large rectangle about half a mile long and a quarter of a mile wide has been reclaimed from the jungle and converted into a sort of garden city. In the middle are the library and offices, an imposing and spacious building with a tower, and at intervals round three sides of the rectangle are the hostel, the laboratories and the staff-bungalows, all built very substantially of local stone. I am sure we all wish Dr. Forster good fortune and hope we shall hear more of him from time to time.

A STIMULUS TO CHEMISTRY IN AMERICA

The Journal of Industrial and Engineering Chemistry recently published a letter from the Allied Chemical and Dye Corporation offering an annual prize of twenty-five thousand dollars to reward the chemist, residing in the United States, who in the opinion of a properly constituted jury has contributed most to the benefit of the science and the world. A committee is to be appointed to consider and suggest the rules governing the selection each year of the chemist who is deemed most worthy.

We comment on this interesting announcement in our editorial columns.

NEWS FROM THE SECTIONS

EDINBURGH AND EAST OF SCOTLAND

The third ordinary general meeting of the present session was held jointly with the Royal Scottish Society of Arts, the Glasgow Section of the Society of Chemical Industry and the Edinburgh Section of the Institute of Chemistry in the Hall of the Royal Scottish Society of Arts in Edinburgh on December 11. Dr. T. W. Drinkwater, vice-president of the Royal Scottish Society of Arts, presided over a large attendance including twenty-two members of the Glasgow Section of the Society of Chemical Industry, and Prof. H. S. Allen read a paper on "Modern Theories of the Structure of the Atom." In reviewing the present state of knowledge regarding the atom from the arithmetical, geometrical, and dynamical points of view, Professor Allen referred to the researches of Sir J. J. Thomson, Mr. C. T. R. Wilson and Sir Ernest Rutherford, and to the theory of atomic numbers advanced by Moseley. Greatly as the chemical balance had enabled the chemist to add to our knowledge, the gold-leaf electroscope had proved an even more powerful instrument of research in the hands of the physicist. The work of Sir William Bragg and Prof. W. L. Bragg on crystal structure was discussed, and also the theories of Professor Bohr, Professor Lewis, and Dr. Irving Langmuir, whose exposition at the Edinburgh meeting of the British Association was recalled. Magnetic theories of the atom had been advanced by Parsons, Sir Alfred Ewing, Principal Laurie and Professor Whittaker. After mentioning the researches of Professor Barkla, Professor Soddy and Dr. Aston, all Nobel prize-winners, the lecturer referred to Sir Ernest Rutherford's remark that the study of the nucleus of atoms might profitably be left to the next generation, but added that Sir Ernest had since tackled this problem himself. The lecture was illustrated with models and lantern slides and was followed by a discussion opened by the chairman, other speakers being Professor Caven, Glasgow, Dr. Cranston, Glasgow, and Messrs. Winklow and J. A. Watson, Edinburgh.

GLASGOW SECTION

The third meeting, held at Edinburgh on December 11, was the first of the joint meetings of the Scottish Sections; and, judging from the number travelling from Glasgow, it would seem that the proposal to hold joint meetings has been received favourably by the members.

The fourth meeting was held in the Institute of Engineers and Shipbuilders, Glasgow, on December 14, when Dr. Knox read a paper on "Nitrogen Fixation."

In his introductory remarks, Dr. Knox briefly reviewed the development of the nitrogen industries and explained that owing to recent economic conditions no comparison of costs would be made. Short accounts were given of the main features of the arc process, the manufacture of cyanamide, and the production of synthetic ammonia as well as its subsequent oxidation to nitric acid.

Arc Process.—The manufacture of nitric acid by the direct oxidation of atmospheric nitrogen involved the use of cheap electrical power, and the main reactions were the production of nitric oxide and its oxidation to nitrogen peroxide. The chief drawbacks in the process were the low electrical efficiency, and the necessity of providing a large absorption plant. Mention was made of the Häusser process, which was still in the experimental stage.

Calcium Cyanamide or "Nitrolim" was manufactured by causing nitrogen, obtained from liquid air, to react with calcium carbide at the temperature of the electric furnace. The product of such a reaction could be used as a fertiliser, for the production of ammonia, or for the production of low-grade cyanides. Reference was also made to Bücher's process for producing cyanides from sodium carbonate and the nitrogen of producer gas at a temperature of 900° C. in presence of iron as a catalyst.

Synthetic Ammonia.—The Haber process, in which atmospheric nitrogen combined with pure hydrogen at a temperature of 600° C. in presence of iron as catalyst and a promoter, the exact nature of which was a trade secret, was outlined. A modification of the process had been introduced by Claude, who utilised a pressure of 1000 atmospheres, thereby greatly reducing the size of the plant required. The ammonia so prepared could be oxidised catalytically to nitric acid. In conclusion attention was drawn to the fact that, compared with other countries, Britain was not paying sufficient attention to this important industry.

An interesting discussion followed, in which Mr. J. H. Young stated that, in 1913, he had prepared cyanides by a method similar to that published by Bücher, four years later, in 1917.

MEETINGS OF OTHER SOCIETIES

CHEMICAL SOCIETY

Two papers were read at the meeting of the Chemical Society on December 21, Sir James Walker presiding:—

"Benzbisthiazoles, Part II," by S. R. H. Edge; "Ring Chain Tautomerism, Part IV—The Effect of the Methyl Ethyl Grouping on the Carbon Tetrahedral Angle," by J. F. Thorpe and B. Singh.

The names were submitted of 92 candidates for election to the Society.

INSTITUTION OF CHEMICAL ENGINEERS

The fifteenth meeting of the Provisional Committee was held on December 6 at 166, Piccadilly, London, W., Sir Arthur Duckham presiding.

The hon. treasurer's report revealed the fact that the balance at the bank and in hand was £27 18s. As this sum will be insufficient to carry the Institution forward to the time when the first Council is elected, the hon. treasurer was requested to ask subscribers for a second instalment of their donations. The solicitor's report stated that the Board of Trade had announced that the licence had been granted and would be issued in a few days. A hearty vote of thanks was passed to Mr. Bonus for his work as solicitor.

A report was submitted on the work of the Selection Committee, and further names were put forward of gentlemen who were qualified for membership and associate-membership. The Selection Committee stated that many applications were held in abeyance until they could be dealt with by the first Council, when formed.

INSTITUTE OF CHEMISTRY

The Huddersfield Section held a meeting on November 24 jointly with the Huddersfield Engineering and Textile Societies, the local Section of the Society of Dyers and Colourists, and the West Yorkshire Metallurgical Society.

Dr. H. T. Calvert, of the Ministry of Health, addressed a large meeting on the subject of "Water for Industrial Purposes, with Special Reference to Textile and Engineering Needs." Dr. Calvert observed that water is the most neglected of the raw materials of industry, and pointed out that local sections such as those of the Institute of Chemistry, should be of great value in educating local manufacturers to realise that trained men are available to attack with every prospect of success the industrial problems which present themselves daily. Dr. Calvert proceeded to give an account of the sources of our water supply and the origin of the various impurities, including the various forms of life which may so multiply as to become the cause of considerable trouble.

"First secure your water" is a good maxim to adopt, for by suitable treatment it is technically possible to render any water suitable for any particular purpose. The practicability is largely a question of local conditions and expense.

The storage of water and its purification were dealt with systematically. For the textile industries a purer water is generally required than for the engineering industries, or rather, a purer water is usually obtained because the damage caused by unsuitable water is more immediately evident. The processes used for potable water, generally find application in the industries some five or ten years later. Amongst these processes in increasing order of cost are:—(1) Sedimentation; (2) chemical precipitation or coagulation followed by sedimentation; (3) filtration; (4) sterilisation. Of these, the last has at present a very limited application in industry in this country, though perhaps it will be generally adopted when it is realised how many faults and defects in the finished products are due to moulds and bacteria present in the raw water used in the processes.

THE OPTICAL SOCIETY

At the meeting held at the Imperial College on December 14, Sir F. W. Dyson presiding, the following papers were read:

(1) "A Large Aperture Aplanatic Lens not Corrected for Colour." (2) "The Optical Cosine Law." By T. Smith, M.A. (1) A lens suitable for spectroscopic work with aplanatic corrections for all zones may have as large an aperture as f/1 or still greater, all the surfaces being strictly spherical. An actual lens made by Messrs. Ross, Ltd., of 3-in. aperture possesses corrections comparable with those given by the theoretical investigation. With a slightly reduced aperture, correction for colour may be obtained without prejudice to the quality of the spherical corrections. The investigation shows that the production of suitable glass discs is the outstanding difficulty in the way of great increases in the relative apertures of telescope objectives. (2) The law of refraction, the sine law relating to coma, and other exact laws of optical instruments are particular cases of a very general law which assumes the form of a cosine relation. As an example of the application of the law, the principles which should govern the construction of a variable power telescope yielding aplanatic correction at all magnifications are investigated.

(3) "A Constant Bubble." By S. Weston. A difficulty always encountered in an accurate spirit level of the type usually mounted on surveying instruments is the alteration of the length of the air bubble due to variation of temperature. This difficulty has been entirely overcome in a new type of level. The first consideration in the manufacture of such a bubble is to obtain the exact proportion of air and spirit. The cross-section of the tube containing the liquid is so shaped that as the temperature rises and the surface tension gradually decreases only the cross-sectional area of the bubble is affected, its length remaining unaltered.

Demonstrations were also given by Dr. J. S. Anderson on (1) a method of measuring the internal diameters of transparent tubes; and (2) a differential refractometer.

PERSONALIA

Mr. W. R. Cooper has been appointed editor of *Science Abstracts*.

Dr. R. C. Farmer has rejoined the Research Department of the War Office as Deputy Director of Explosives Research.

The President of the Board of Trade has appointed Captain G. E. W. Bowyer, M.C., M.P., to be his Parliamentary Private Secretary (unpaid), and Captain V. A. Cazalet, M.C., to be an Assistant Private Secretary (unpaid).

Dr. W. Rosenhain, superintendent of the Metallurgy Department of the National Physical Laboratory, will leave England in February for an extended tour in the United States, where he will lecture on metallurgical subjects before various universities and educational organisations.

The list of New-Year Honours includes the names of Sir Frank Baines, C.B.E., M.V.O., who is appointed a Commander of the Royal Victorian Order (C.V.O.); Dr. D. O. Masson, professor of chemistry in the University of Melbourne, who is promoted to a knighthood of the Order of the British Empire (K.B.E.), and Dr. J. W. Evans, F.R.S., representative of the Colonies on the Governing Body of the Imperial Mineral Resources Bureau, who has been appointed a C.B.E.

Awards recently made by the Society of Engineers for papers read or published during 1922 include the president's gold medal to Dr. C. V. Drysdale for his paper on "The Testing of Small Electrical Plant," the Nursey premium to Dr. H. Chatley for his paper on "The Physical Properties of Claymud," a Society premium to Mr. A. S. E. Ackermann for his paper on "The Physical Properties of Clay," and the Green premium to Mr. A. G. Short for his paper on "Heating."

* * *

The death is announced of Mr. A. W. Phillips, president and general manager of Dewis Chemical Products, Inc. (U.S.A.), and known for his work on the production of smokeless powder.

From France the death is announced of Monsieur E. Bouty, professor of experimental physics at the Sorbonne, and editor of the *Journal de Physique*, and of the *Annales de Physique*.

NEWS AND NOTES

UNITED STATES

Silica in 1920

The United States Geological Survey reports that sales of silica in the United States during 1920 totalled 328,740 short tons, valued at $3,152,734, and comprised 68,190 t. of quartz, 1,183,014 t. of sand and sandstone, 569,677 t. of tripoli, and 1,079,693 t. of diatomaceous earth. An increase of 8 per cent. in quantity and a decrease of 14 per cent. in value were shown by the sales of quartz, pegmatite and quartzite.

Quicksilver in 1920

The progressive decrease in the output of mercury in the United States that has been recorded since 1918 by the U.S. Geological Survey (*cf.* J., 1921, 310 R), continued in 1920 and by the end of the year all the mines except the New Almaden (California) and Chisos (Texas) mines had suspended operations. The output from 17 mines was 13,392 flasks (flask=75 lb.), valued at $1,066,807; not only was this the lowest recorded since 1860, but an even lower production was anticipated in 1921, possibly less than in 1850 (7723 flasks), the year when production first became important. This decrease is due to the fact that the ores now available in the United States are mostly too low in grade for profitable working. For this reason and because of the high exchange value of the dollar, exports fell by 7614 to 1553 flasks and imports rose by 3534 to 14,169 flasks. The apparent consumption was 26,008 flasks, an increase over that in 1919, but smaller than in 1917; the demand, however, was small towards the end of the year and manufacturers of mercurial products apparently held large stocks.

FRANCE

Eirini-d'Eyrinys, a Forgotten Predecessor of Pasteur

In the issue of the *Chemiker-Zeitung* for November 28, 1922, M. A. Rakusin draws attention to one of the appendices to the Russian translation of Sporny's treatise on "Asphalt and Bitumens," published in 1878. This appendix, of which the original source is not indicated, consists of a dissertation by a French physician, Prof. Eirini-d'Eyrinys, and describes the results of experiments on the disinfecting and prophylactic properties of asphalt, carried out in the year 1721 in the Hôtel des Invalides. In it the view is expressed that epidemic diseases are caused by "an immense number of invisible infusoria" which propagate with great rapidity and are transmitted from place to place on clothing, etc. Further, it is stated that the experimental results obtained show that either the oil isolated from asphalt or the fumes of burning asphalt will exterminate worms, bugs, etc., remove stench and purify the air, and disinfect clothing and other articles which have been in contact with persons suffering from plague, furniture and metallic objects remaining unharmed. The investigations were prosecuted at the instance of Le Blanc, then the French Minister of War, and it is possible that a complete account of it is to be found in the archives of the Invalides. Although Pasteur discussed the achievements of his predecessors up to the time of van Helmont in detail, he made no mention of Eirini-d'Eyrinys in his classical communications to the French Chemical Society in 1859 and to the Académie des Sciences in 1860.

Pasteur Celebrations

Prior to the celebration of Pasteur's centenary in May, 1923 (*cf.* J., 1922, 111 R), meetings in his honour will be held in this country from February 2 to 19, 1923, under the auspices of the Federated Committees of the Alliance Française in the United Kingdom. The hon. secretary of the Federated Committees, Mlle. Yvonne Salmo, of 14, Morgan Road, Reading, informs us that Dr. Pasteur Vallery-Radot, the grandson of Pasteur, will deliver a lecture on his grandfather's life and work in the rooms of the Royal Society of Medicine, London, and this will be followed by a banquet which will be attended by members of that Society and of the Institute of Brewing, and to which it is proposed to invite members of the various chemical societies. M. René Vallery-Radot will come to London, but his health will not permit him to go to the provinces, where Dr. P. Vallery-Radot will visit Manchester, Newcastle, Bradford, Liverpool, Cardiff, Reading, Leicester, Wolverhampton, Southampton, and Portsmouth (Feb. 19). In each of these towns the local branch of the Alliance Française is inviting the medical and chemical societies to take part in the proceedings. The Lord Mayor of Cardiff will extend a civic welcome to the visitors, and at Newcastle-on-Tyne Sir Theodore Morison will offer the hospitality of Armstrong College.

GERMANY

The Crisis in German Research Laboratories in 1922

Prof. A. von Wassermann, Director of the Kaiser-Wilhelm Institute for Experimental Therapy in Berlin-Dahlem, has recently discussed in a lecture the crisis that has arisen in the financial affairs of German scientific institutions. He said that, owing to the enormous depreciation of the currency, most of these places were on the brink of ruin, especially those engaged in experimental research. What a disaster the closing, through lack of funds, of any of these institutes would be to Germany, could easily be understood, when it was remembered that progress in all branches of natural science depended on experimental work, and that each branch was more or less dependent on others. Thus, medicine is dependent for its advancement on physical chemistry, especially on the colloidal branch of that science. He compared the interdependence of the sciences to the mechanism of a clock, which is completely put out of gear when one wheel is stopped, and stated that the work of the institutes was being hindered by the inability to purchase new instruments and material, as well as by the impossibility of obtaining foreign literature owing to its high cost in marks. The layman was reminded that biological research had an important bearing on public health; for example, experimental research on syphilis during the last 18 years had rendered possible a sure diagnosis, and produced cures for and protection against the disease, results which 500 years of careful observation had previously failed to produce. In the cure of other diseases due to specific bacteria success had also been obtained, and further advancement was possible only if the work of scientific research could be carried on uninterruptedly. It should be remembered that the ultimate aid of all reasearch was to produce, not only academic, but principally practical results and that, for this reason, all modern clinics and hospitals of any importance maintained their own bacteriological, chemical and X-ray laboratories, which were ever working in the service of the sick. Everyone should therefore realise, he said, what it would mean if these laboratories were unable to obtain the necessary means for carrying out their work, for not only would all research activity cease, but a retrograde step would be taken in the task of alleviating and curing the sufferings of mankind.

GENERAL

Federal Council for Pure and Applied Chemistry

The constituent societies of the Federal Council have appointed the following as their representatives on that body:—

Chemical Society:—Sir Wm. J. Pope, K.B.E., F.R.S.; Prof. J. C. Philip, F.R.S.; Prof. J. F. Thorpe, F.R.S.

Society of Chemical Industry:—F. H. Carr, O.B.E.; W. J. U. Woolcock, O.B.E.; Dr. Stephen Miall.

Association of British Chemical Manufacturers:—Dr. E. F. Armstrong, F.R.S.; E. V .Evans, F.I.C.; Dr. P. C. C. Isherwood.

Society of Public Analysts:—Dr. S. Rideal.

Faraday Society:—W. R. Cooper.

Biochemical Society:—Dr. J. C. Drummond.

Institute of Brewing:—A. Chaston Chapman, F.R.S.

Society of Dyers and Colourists:—C. F. Cross, F.R.S.

Society of Glass Technology:—Dr. W. E. Turner.

Iron and Steel Institute:—Sir Robert Hadfield, Bart., F.R.S.; F. W. Harbord.

Ceramic Society:—Dr. Mellor.

Institute of Chemistry:—Sir Herbert Jackson, K.B.E., F.R.S.

Institution of Gas Engineers:—Dr. H. G. Colman.

Society of Leather Trade Chemists (British Section):—J. T. Wood.

Mineralogical Society:—Dr. G. T. Prior, F.R.S.

Institute of Metals:—Sir Thomas Rose.

Royal Agricultural Society:—Dr. J. A. Voelcker.

Co-opted Members:—Dr. M. O. Forster, F.R.S.; H. E. Coley.

The Toxic Action of Cyanamide

It has been found that persons working with cyanamide are liable to fleeting exanthemata of the head and chest, accompanied by rapid breathing, increased action of the heart, and low blood-pressure, the attack lasting about an hour. The attack only comes on when the patient has consumed alcohol, so that persons working with the fertiliser should abstain from alcoholic drinks. The effect is due not to the toxic nature of the cyanamide, but to its power of energising the action of substances such as chloral hydrate, sodium bromide, theobromine, etc. Thus a man who took a dose of cyanamide in the morning and a glass of beer in the evening developed typical symptoms, the attack lasting six hours. Similarly, if a guinea-pig be given a physiologically inactive dose of sodium bromide, and a subsequent dose of cyanamide, symptoms of acute bromide-poisoning are immediately observed. —(*J. Ind. Hygiene, Sept.*, 1922.)

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for December* 21 *and* 28)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Algiers	Chemicals	716
Argentina	Glazed tiles	692
Australia, New Zealand	Tinplate, enamelled ware	662
Bulgaria	Porcelain insulators	9550/F.E./E.C.
Canada	Epsom salts	10169/E.D./E.C.
Chile	Ingots of antimony, tin, lead and zinc, pig iron, coke (tender for)	6858/F.L./E.C.
,,	Iron, steel, brass, paint, varnish (tender for)	7204/F.L./G.P.
Egypt	Oils, paint, asbestos, chemicals (tender for)	9621/F.E./G.P.
Egypt, Sudan, Palestine	Washing blue, starch	714
Italy	Paper, electric lamps	673
Netherlands	Iron, steel, non-ferrous metals	677
,,	Cottonseed oil	699
,,	Tin, tin foil	702
,,	Tinplate	703
New Zealand	Celluloid goods	666
,,	Druggists' supplies	670
Poland	Emery, sand paper	679
,,	Leather	681
Spain	Pitch	708
Spain, Portugal	Tinplate, tin, earthenware, copper sulphate	662
Switzerland	Paper, cardboard	686
,,	Leather, artificial leather	712
United States	Glassware, pottery	687
,,	Chemicals, colours, oils, wax, minerals	717
,,	Druggists' supplies	718
Yugoslavia	Tin	682

TARIFF CUSTOMS EXCISE

Austria—Czechoslovakia.—The commercial convention between these two countries came into force on November 14, 1922.

Canada.—Proprietary medicines must be provided with a label bearing the registered number of the medicine, the name and address of the manufacturer, and the proportion of any scheduled drug or drugs contained in the medicine.

Federated Malay States.—A list of export duties on rubber and of import duties on alcoholic liquors is given in the issue for December 21.

France.—A Bill has been introduced to modify the "turnover" tax and abolish the import tax.

Germany.—An import licence is required for foods (fruits, etc.) prepared with sugar. The export of composition wax is prohibited save under licence.

Greece.—The prohibition on the importation of "luxury" articles has been withdrawn, and the "coefficients of increase" applied to the duties on petrol, chocolate, white metal, etc. have been modified.

Grenada.—Additional export duties have been applied to cotton, cottonseed, and cocoa.

Guadeloupe.—The text of the regulations controlling the importation and sale of poisons may be consulted at the Department.

Norway.—Spirits and strong alcoholic liquors containing over 14 per cent. of alcohol by volume may be imported only through the A./S. Vinmonopolet.

Poland.—Salts and compounds containing gold, silver and platinum, organic compounds of iodine, certain compounds of mercury and of bismuth, synthetic organic colours, pigments, and varnish have been added to the list of goods the duties on which are subject to a surtax of 149,900 per cent. when paid in paper money.

Russia.—Regulations have been issued defining the procedure for importing and exporting goods.

Straits Settlements.—The new export duties proposed for rubber and the revised import duties on alcoholic liquors are detailed in the issue for December 21.

REPORTS

Report on the Economic and Financial Conditions in Venezuela, Dated September, 1922. *By* H. H. D. Beaumont, *H.B.M. Minister, Caracas. Pp.* 40. *Department of Overseas Trade. London: H.M. Stationery Office*, 1922. *Price* 1s.

Since the publication of the last report on Venezuela (*cf.* J., 1922, 14 R), the trade depression has not lifted, but the gradual exhaustion of stocks of imported goods is considered a more hopeful sign. Exports of sugar (refined and unrefined) in 1921 amounted to 13,782 tons, valued at 5,299,472 bolivars, against 18,811 tons, valued at bs. 17,920,272 in 1920, and it appears that in future the sugar industry will hardly be able to compete in the world's markets. The exports of hides and skins decreased from 2242 tons (bs. 6,022,059) in 1920 to 1127 (bs. 1,012,751) in 1921. Exports of balata were 979 tons in 1921, as compared with 1412 tons in 1920; prices at present are very low. The Caribbean Petroleum Co. remains the only oil-producing firm, and has now reached the profit-earning stage; its output rose from 69,539 tons of crude oil in 1920 to 218,246 t. in 1921, a year when 183,949 tons were exported. Exports of gold in 1921 increased by 4370 oz. troy to 30,257 oz., and of asphalt by 24,243 t. to 46,165 t. Owing to a fire in two of the most productive seams, and to labour difficulties, the production of coal fell by 7000 tons to 22,094 tons. Successful experiments have been made with briquettes, which are produced on a small scale. Only 11,323 tons of copper ore was mined by the South American Copper Syndicate in 1921, 6422 tons being exported; a smelting plant is now being erected at the mines.

Exports during 1921 totalled bs. 133,559,884 in value (the value of the bolivar during this period averaged 10·3d.; par value = 9·5d.), the United States taking 39·7 per cent., Holland and Curacao 22·9 per cent., Spain 11 per cent., France 9·1 per cent., and Great Britain and Trinidad 9·0 per cent. Of the imports, valued at bs. 95,508,367, the United States supplied 57·5 per cent. and Great Britain 18·7 per cent. Among the chief imports were:—Cement 10,222 tons (bs. 1,356,000); drugs 331 t. (bs. 2,379,000); perfumes, soaps, etc. 151 t. (bs. 1,004,000); skins 70 t. (bs. 979,000); and stearin 414 t. (bs. 561,000). The total value of the trade decreased from about £23,644,000 in 1920 to £9,433,000 in 1921; but whereas in the former year imports exceeded exports by £7,708,000, in 1921 the exports were the larger by £1,629,000.

REVIEWS

The Chemical Engineering Catalog. *Seventh annual edition. Pp.* 1183. *New York: The Chemical Catalog Co., Inc.*, 1922. *Price* $10, *or on loan for one year* $2.

The seventh edition of this volume fully maintains the standard of quality of its predecessors. The size is a little reduced but its 1100 odd pages (8½ x 11½ in.) fulfil the declared purpose of providing "a direct, permanent and economical information system, completely covering the entire worth-while buying power of the Chemical Industries of U.S.A."

The volume is published under the supervision of a committee appointed by the American Institute of Chemical Engineers, the American Chemical Society and the Society of Chemical Industry. No matter is passed for publication which is merely display advertising, but those taking space are expected to give data, facts, suggestions and details of application to specific technical and scientific problems. The present volume shows a distinct advance in the quality of the information supplied by advertisers.

A most useful feature is the classified directory of plant and materials which is amply cross-indexed and is primarily a record of manufacturers and their exclusive agents; it includes many firms who have not taken space in the catalogue. The plant and equipment section, which forms the body of the compilation, is well filled with illustrations and diagrams which help materially in showing what plant is available, data as to materials treated, processes catered for; overall sizes, power consumption, etc. form a prominent feature.

It has been recognised that chemical engineers and others in charge of production are responsible not only for the specifically chemical equipment, but also for the power plant, hoisting, conveying and power-transmission equipment, not to speak of testing, measuring and recording apparatus and materials of construction. The corresponding manufacturers are consequently well represented in the catalogue. On the average each has about 1·8 pages, but many have far more, one firm taking 66 pages. The section on chemicals and materials is not so large and on the average fewer data are given. Nevertheless, in many cases average analyses appear, together with specific gravities, melting-points, technical applications, and details of standard containers.

An index of some 1200 technical and scientific books is a helpful feature and there is a good synopsis of each work indexed.

Such a compilation is excellent advertising for American industry and must be specially helpful to its export trade. Can our own industry afford to ignore the possibilities latent in co-operative advertising of this nature?

E. A. A.

MARKET REPORT

This Market Report is compiled from special information received by the Society from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The condition of this section is practically the same as reported last week. An advance is recorded in the price of **Sodium Acetate** 97/98% to £23 per ton. Quotations for products not reported last week are as follows :—

Nitric Acid 80° Tw. ..	£25 per ton.
Sulphuric Acid 94% arsenical	£6 10s. per ton.
Potassium Bichromate	6¼d. per lb. delivered.
Salammoniac ..	£32 per ton delivered.
Sodium Nitrite ..	£30 per ton, 100% basis, delivered.
Sodium Sulphite, anhydrous for home consumption.	
5 ton lots ..	£27 10s. f.o.r. London.
2 ton lots ..	£28 f.o.r. London.
1 cwt.	drums included.

WOOD DISTILLATION PRODUCTS

Acetic Acid and **Acetone** have for some time past been the outstanding features of this section, supplies of the latter being particularly scarce. The price of the British Standard Specification is about £130 per ton. With regard to other products trade generally shows signs of improvement, but orders are rather difficult to obtain on pre-war quantities. Quotations for the principal products in this section are as follows :

Acetate of Lime, Brown	£8 per ton delivered.
Acetate of Lime, Grey 80% ..	£14 per ton delivered.
Acetate of Lime, Liquor	9d. per gall. 32° Tw. delivered.
Brown Sugar of Lead	£35 per ton delivered.
Charcoal	£9 10s. to £10 per ton.
Iron Liquor ..	1s. 6d. 32° Tw. 1s. 2d. 24° Tw.
Red Liquor ..	1s. 3d. 14/15° Tw.
Wood Creosote ..	2s. 6d. per gall. unrefined.
Wood Naphtha, Miscible	5s. per gall. 60% O.P.
Wood Naphtha, Solvent	4s. 6d. per gall. 60% O.P.
Wood Tar	£4 per ton delivered.

TAR PRODUCTS

Very little change is to be reported in this branch, The weakness of **Pitch** has proved to be only temporary, as was expected in view of the small amount available, and the position is again firmer. An improvement is also reported in the markets for **Toluol** and **Solvent Naphtha.** Current prices may be judged by the following quotations :—

Benzole, Crude 65's	1s. 2d. per gallon.
Benzole, Standard Motor	1s. 11d. to 2s. per gallon.
Benzole, Pure ..	2s. to 2s. 6d. per gallon.
Toluol 90% ..	1s. 10d. per gallon.
Toluol, Pure ..	2s. per gallon.
Xylol	3s. to 3s. 4d. per gallon.
Creosote, Standard Specification ..	7d. to 8d. per gallon.
Naphtha Solvent 90/160	1s. 8d. to 1s. 9d. per gallon.
Naphthalene Crude, drained Creosote Salt	£5 to £7 per ton.
Napthalene, Crude, hot pressed ..	£9 per ton.
Naphthalene, Crystals	£16 per ton.
Naphthalene, Flaked	£14 10s. per ton.

DYESTUFFS INTERMEDIATES

The tendency of dyestuffs prices to fall seems to have been arrested and business is reported to be fairly good with orders being placed for larger quantities. Trade is bound to be quiet, however, until after the holidays, but a further improvement is confidently anticipated in the New Year.

Manufacturers' quotations for the chief intermediates are as follows, prices being carriage paid and inclusive of packages.

Acid H.	5s. 4d. lb. 100% basis.
Acid Naphthionic ..	2s. 8d. ,, ,, ,,
Acid Neville and Minther	6s. ,, ,, ,,
Acid Sulphanilic ..	1s. 6d. ,, ,, ,,
Benzidine Base ..	6s. 6d. ,, ,, ,,
Dinitrobenzene ..	1s. 3d. ,,
Diphenylamine ..	4s. 1d. ,,
α-Naphthol ..	2s. 9d. ,,
β-Naphthol ..	1s. 2d. ,,
α-Naphthylamine ..	1s. 7d. ,,
β-Naphthylamine ..	4s. 6d. ,,
p-Nitraniline ..	3s. ,,
Nitronaphthalene ..	1s. ,,
R. Salt	2s. 5d. ,, 100% basis
Napthionate Soda	2s. 8½d. ,, ,, ,,
Aniline Oil and Salts	10d. per lb. naked sellers' works
Dinitrotoluene 48/50	8½d. ,, ,, ,, ,, ,,
,, 66/68	1s. 2½d. ,, ,, ,, ,,
Nitrobenzene ..	8d. ,, ,, ,, ,, ,,

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The raw material for **Citric** and **Tartaric Acid** derivatives is again dearer this week owing to the continued appreciation of the Italian exchange and prices of these products therefore keep firm. The market for **Citric Acid** is still quiet at 1s. 6d.—1s. 8d., and **Tartaric Acid** 1s. 1½d. to 1s. 2½d., both delivered and less 5 per cent.

Cream of Tartar is in good demand and prices are firm at 100s. per cwt., less 2½ per cent. delivered.

Acetyl Salicylic Acid is in very strong demand at 3s. per lb. The same applies to **Salicylic Acid** at 1s. 4d. to 1s. 6d.

There is a fair demand for **Bismuth Salts** at unchanged prices, but the market for **Bromides** is rather flat.

Iron Perchloride is unsteady at 18s. to 20s. per cwt. in consequence of German offers at low prices.

Magnesium Oxide, heavy, is steady at 2s. to 2s. 3d. per lb.

Mercurials are unchanged in price, although **Mercury** itself is rather dearer.

Potassium Iodide. The demand for this product is extraordinarily heavy at 15s. 8d. to 16s. 5d., and no offers are being made from Japan. There is a possibility of an increase in the price of **Iodine.**

Among photographic chemicals **Amidol** is offered at 9s. per lb., carriage paid, while **Sodium Hyposulphite Pea Crystals** are quoted at £15 to £17 per ton, according to quantity, carriage paid to buyers' station.

Paraldehyde is offered at 1s. 6d. per lb.

With regard to other products in this section the position is substantially the same as reported last week.

PERFUMERY CHEMICALS

Several of the products in this class show a fall in value this week, notably **Linalol** and **Linalyl Acetate, Phenyl Ethyl Alcohol, Terpeneol** and **Vanillin.** Exceptionally, however, **Methyl Benzoate** shows a sharp rise in price.

Prices of the chief chemicals in this section are as follows :—

Amyl Acetate	2s. 3d. per lb.
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate	3s. 3d. ,, ,,
Anethol - Melting point 21/22° C.	4s. 6d. ,, ,,
Benzyl Acetate from Chlorine free Benzyl-Alcohol	3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine	3s. 3d. ,, ,,
Benzaldehyde free from Chlorine	3s. 3d. ,, ,,
Benzyl Benzoate 19.5° C. ..	3s. 3d. ,, ,,
Cinnamic Aldehyde 98/100 Natural	15s. ,, ,,
Citronellol	22s. 6d. ,, ,,
Citrol 100%	10s. 6d. ,, ,,
Ethyl Phthalate	4s. 6d. ,, ,,
Eugenol 100%	10s. 6d. ,, ,,
Geraniol (from Palmarosa)	32s. 6d. ,, ,,
Geraniol	5s. 6d. to 12s. 6d. per lb.
Linalol ex Bois de Rose ..	18s. 6d. per lb.
Linalyl Acetate ex Bois de Rose Linalol	19s. 6d. ,, ,,
Methyl Benzoate	10s. 6d. ,, ,,
Phenyl Ethyl Acetate ..	10s. ,, ,,
Phenyl Ethyl Alcohol ..	17s. 6d. ,, ,,
Rhodinol	52s. 6d. ,, ,,
Terpineol	2s. 10½d. ,,
Vanillin, 100%	25s. ,, ,,

ESSENTIAL OILS

Almond Oil, foreign, 17s. per lb., English 20s.

Anise Oil has recovered to 2s. 2d. per lb. after a short set-back.

Bergamot Oil, 14s. to 16s., according to quality.

Bourbon Geranium Oil, 24s. 9d. to 26s., spot, supplies are very scarce and forward quotations very firm.

Camphor Oil (White), 85s. per cwt., very quiet.

Cananga Oil (Java), 8s. 9d. to 10s. per lb.

Cinnamon Oil, leaf, 4d. to 4½d. per oz., rather more enquiry.

Cassia Oil, 8s. 7½d. to 9s., scarce on spot. Forward quotations are about 2s. cheaper.

Citronella Oil (Java), firm at 3s. 3d. to 3s. 6d.

Citronella Oil (Ceylon), 2s. 5d. to 2s. 6d. per lb.

Clove Oil, 8s. to 9s. per lb. Quotations for Jan-Feb. delivery are being made from 6s. to 6s. 3d.

Eucalyptus Oil, 1s. 4d. to 1s. 10d., according to quality.

Lavender Oil, 11s. to 14s. 6d., according to quality

Lemon Oil, 2s. 10d., spot. The product fluctuates considerably, but on the whole the tendency is upward.

Lemon Grass Oil, 2¾d. per oz., is very quiet.

Orange Oil (Sweet), 9s. to 9s. 6d., spot. Quotations for shipment, 8s. to 8s. 6d. per lb.

Otto of Rose Oil (Anatolian), 24s.

Palma Rosa Oil, 22s. to 24s., spot, but difficult to find. Quotations for shipment, 16s. c.i.f.

Peppermint Oil (English), 70s. to 80s., but demand small.

Peppermint Oil (Wayne County), 13s. to 13s. 6d., firm and slightly dearer.

Peppermint Oil (Japanese), 8s. to 8s. 6d., slightly cheaper.

Petitgrain Oil (Paraguay), 6s. 9d. to 7s. per lb., flat and being offered freely.

TRADE NOTES

The Quebracho Industry in S. America

The quebracho forests of Argentina and Paraguay are in danger of extinction unless provision is made for systematic replanting and general conservation. In 1922 not more than 71·3 million metric tons of quebracho was standing in Argentina and 3·5 mill. t. in Paraguay. As the potential production of quebracho extract in the two Republics is at least 240,000 t. per annum, and 1 ton of extract is obtained from 4·75 t. of logs, the annual cut of wood for the tanning industry alone must amount to 1·4 mill. tons. The danger of denudation becomes still more evident when it is realised that large quantities of wood are consumed for constructional purposes, and that there is a large annual output of logs (108,945 t. in 1917; 56,582 t. in 1920). Further, as the railways extend through the forestal regions exploitation of quebracho will be facilitated. From these and other causes it is estimated that the life of the existing forests will be reduced to 20 or 25 years. Re-afforestation should not prove difficult, because the natural stock can be replaced in 25 to 50 years, if suitable methods are used.

The dissolution is announced of the Quebracho Trust, which comprised about 70 per cent. of the producers of extract, the chief being the Forestal Land, Timber and Railways Co. The trust was organised for the sale of extract, but was not entirely successful, owing to competition from producers who were not members. As a result of the dissolution, prices have fallen from £23 to £21 per metric ton, and it is expected that the weaker producers will gradually be eliminated.—(*U.S. Com. Rep., Nov.* 6, 1922.)

The Alcohol Industry

Grain was originally used as the raw material of the German alcohol industry, but heavy taxation forced the distilleries to move into the country districts and substitute potatoes for grain as raw material. Before the war about 80 per cent. of the alcohol distilled in Germany was made from potatoes, of which 2·5 million tons was utilised by 6000 distilleries with an annual output of 66 million gallons. Supplies of raw material have always been short, especially in 1916–17, when the production fell by over 50 per cent., and the subsequent loss of the Posen district to Poland has reduced the productive capacity by 25 per cent. At present foreign grain has to be imported, as prices of potatoes are adjusted to conserve the crop for use as food. Since 1919 the industry has been a monopoly of the State, which supervises production and distribution and fixes the sale price. In recent years production of alcohol has been as follows:—

	Gallons
1913–14	84,568,000
1917–18	51,876,000
1918–19	29,062,000
1919–20	13,420,000
1920–21	40,304,000
1921–22	*24,200,000

* Estimated.

The increased output since 1919–20 is due chiefly to the use of imported grain. On August 15, 1922, the price of grain alcohol and of potato spirit was 5000 and 1000 marks per hectolitre, respectively, corresponding to 1s. 6d. and 3½d. per gallon, at the rate of exchange then current. Up to October, 1921, the price was the same for each kind.—(*U.S. Com. Rep., Oct.* 30, 1922.)

The German Chemical Society and Trade with Japan

The following items of interest are taken from the report of the meeting of the German Chemical Society on November 13:—

A new ship for the Hugo Stinnes Shipping and Overseas Trading Company was christened at Wilhelmshaven on October 14 by Mrs. Eugenie Piloty, a daughter of the late Prof. A. von Baeyer, the name "Adolph von Baeyer" being given to the vessel. Professor R. Willstätter delivered an address expressing the satisfaction of the German Chemical Society that this vessel of 8000 tons, intended for passenger and goods traffic between Germany and Japan, should carry the name of one of the founders of the Society.

At the unveiling of the Baeyer memorial at Munich on October 20, Dr. O. Hahn announced that the Japanese industrial leader, Mr. Hojimi Hoshi, who two years ago gave 2 million marks for the promotion of chemical science in Germany, had now signified his intention of making further gifts. Mr. Hoshi proposes to make a contribution of about 8 million paper marks (about 2000 yen) per month for three years for the support of chemical research, and to give a further sum of 40 million marks for general cultural purposes in order to express his sympathy for Germany.

The Cement Market in Jamaica

Imports of cement into Jamaica during 1921 totalled 3905 long tons, of which the United Kingdom supplied 53, the United States 28, and Canada 17 per cent. Most of the imported cement conformed to the British standard test and was therefore admitted at a reduced rate of duty; cement which does not pass the test is dutiable at a much higher rate. Wooden barrels holding 400 lb. are preferred as containers. The demand for cement is likely to increase in the near future, but, although the British product now dominates the market, Canadian competition is very keen.—(*Comm. Int. J., Can., Sept.* 23, 1922.)

The Match Industry in Latvia

The A.-G. W. A. Lapschin has purchased the match factories of L. A. Hirschmann in Goldingen, Libau, Riga, and Frauenburg, and as the administration has been transferred almost entirely from Russia to Riga, the company is entirely Latvian. New plant has been installed in the Libau factory, and the Goldingen factory is to be extended, so that the two factories will eventually produce from 100,000 to 120,000 cases of matches per annum, a quantity on which the excise duties alone will amount to 25 million roubles (Latvian rouble = about 0·17d.). The factory in Frauenburg produces only matchwood for export.—(*Chem. Ind., Sept.* 25, 1922.)

Transport of Samples by Passenger Train

We are informed by the Association of British Chemical Manufacturers that as the result of its negotiations with the Railway Companies the following new Regulation will come into force on and from January 1, 1923:—"Samples of inflammable liquids and substances made therefrom be accepted for conveyance by passenger train, provided each sample is contained in a sealed glass bottle, not exceeding 8 oz. in capacity, packed in a wooden box containing sufficient sawdust to absorb the whole of the liquid in the event of leakage; the traffic will be conveyed at owner's risk only and will be charged full parcels rates, including collection and delivery within the usual limits at places where arrangements for these services are in operation. The appropriate form of owner's risk consignment note must be signed."

PUBLICATIONS RECEIVED

An Apparatus for the Measurement of Specific Gravity of Gases in Small Quantities. *By* A. Blackie. *Department of Scientific and Industrial Research. Fuel Research Board. Technical Paper No. 5. Pp.* 6. *London: H.M. Stationery Office*, 1922. *Price* 3d.

Carotinoids and Related Pigments. *By* Prof. L. S. Palmer. *American Chemical Society, Monograph Series. Pp.* 316. *New York: The Chemical Catalog Co., Inc.*, 1922. *Price* $4.50.

Cements and Artificial Stone. *By the late* J. Watson. *Edited by* Dr. R. H. Rastall. *Pp.* 131. *Cambridge: W. Heffer and Sons. Ltd.*, 1922. *Price* 6s.

The Theory of Emulsions and Emulsification. *By* Dr. W. Clayton. *Foreword by* Prof. F. G. Donnan. *Pp.* 160. *London: J. and A. Churchill*, 1923. *Price* 9s. 6d.

Starch and Starch Products. *By* Dr. H. A. Auden. *Pitman's Common Commodities and Industries Series. Pp.* 121. *London: Sir Isaac Pitman and Sons, Ltd.*, 1922. *Price* 3s.

Memoirés et Rapports sur les Matières Grasses. Congrès de la Production Coloniale de l'Exposition Coloniale de Marseille, 1922. *Vol. I. Pp.* 476. *Vol. II. Pp.* 211. *Marseille: Institut Colonial*, 1922.

Memorandum by the Chief Engineer of the Manchester Steam Users' Association for 1921. *Pp.* 29. *Manchester and London: Taylor, Garnett, Evans and Co.*, 1922.

Third Annual Report of the Governors of the Imperial Mineral Resources Bureau. *Pp.* 72. *London: Imperial Mineral Resources Bureau*, 1922.

JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

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EDITORIAL

THE letter which we print in this week's issue from Viscount Leverhulme deals with so important an aspect of chemistry and industry that we feel it should receive more publicity than was possible in our first number, which was prepared and published in what was to many of our readers, a holiday period. Viscount Leverhulme hopes that we shall include the human element in industry, as well as the chemical formula. He has for many years made a special study of this problem and his advice is therefore of value. How can we do anything to help in arriving at that proper consideration of the industrial situation which will utlimately produce industrial peace ? Only by publishing articles on both sides of this question and so providing a place in which the employers and the employees may put forward their points of view, consider the facts, perhaps new to them, submitted by those on the other side of the table, and devise the best means of bringing harmony out of the conflicting interests. If we can be useful in this respect, we shall achieve a success even greater than our President and Lord Leverhulme expect, and we look forward to a discussion on this topic in our columns by them, and by others who similarly occupy positions of importance in the industrial world.

* * *

It is worthy of remark that chemistry, now becoming so exact a science, a branch of knowledge which affects us throughout every phase of our life and plays an important part in every branch of industry, a subject referred to in a host of Acts of Parliament and Orders in Council, should have so few definitions. For some purposes exact definitions need not be formally stated : large contracts are made in "pig-lead—our usual brand," "caustic," and "B.O.V.," in circumstances which both buyer and seller clearly understand. It is when chemistry and chemical operations become the subject of legislation and litigation that some definite meanings become essential to the harmonious progress of the science and the community. Hobbes says in his Leviathan, "The light of human minds is perspicuous words, but by exact definitions first snuffed, and purged from ambiguity." The late Mr. W. G. Pogson Smith wrote : "A definition must be held to be satisfactory if it be clear. The master claims a free and absolute right of arbitrary definition. Agreement on definition is the *sine qua non* of intelligible reasoning." What trouble there would be if the Federal Council were to attempt definitions of "sovereignty," "command," and "sanction" ! The master minds in chemistry have the right to lay down the definitions of their science, and we hope the article from Sir William Pope will lead to universal agreement on this fundamental one which forms the subject of his writing. We know that hasty legislation sometimes encourages the use of vague phrases, and that the wiliness of the politician sometimes deliberately finds these are the line of least resistance. Many a man in the old days was returned to Parliament as a Tariff Reformer, who would have been rejected if the exact meaning of Tariff Reform had been explained, the exact duties to be levied on each commodity set out in a schedule and so on. A vague phrase like "heavy chemicals" may be rushed through a tired House of Commons when a detailed list would provoke opposition which cannot be overcome.

The subject is of such importance to the whole chemical community that we are inviting other contributions on this topic and we hope at a later date to be able to deal with the matter in a manner worthy of the attention it requires.

* * *

One of the principal functions of *Chemistry and Industry* is to provide a record, week by week, of the meetings of the many and far-flung Sections of the Society. To do this, we perforce must depend on the zeal of the local Honorary Secretaries, whose services—recently applauded in a Presidential Address—are given so freely, despite the pressure of more urgent duties. But a weekly *Journal* has an insatiable maw, and we would urge, with Herrick, that "old time is still a-flying," and that the prompt dispatch of accounts of Sectional Meetings is essential if our "News from the Sections" is to be of real service and interest. "News" which reaches us long after a meeting has already lost some of its value; other accounts may have been published elsewhere, and the member who, prevented from attending a meeting by seasonal ills or more frivolous engagements, is desirous of acquainting himself with the proceedings, and fails to find an account in these columns within a reasonable time, is not without just cause of complaint. No time is lost between our receipt of any News from the Sections and its dispatch to the printers, and we therefore ask all Honorary Secretaries of Sections and Authors of papers to collaborate with us in ensuring that reports of Sectional Meetings are published with the minimum delay.

* * *

In our last issue we published an article in which Prof. H. E. Armstrong strongly condemned a recent legislative effort in connexion with the supply of pure milk. An interesting commentary on this criticism is supplied by a note in the *Manchester Guardian*, which states that although the Milk Act has been in force a week, hardly any notice has been taken of it in London. On Thursday, a request for "a pint of first-class milk" met with the response "what is first-class milk?" but on Saturday the same request elicited the reply that "first-class milk costs 7d. per pint . . . !" We are reminded of Sir William Pope's letter to the *Times*, quoted in our last issue, in which he suggests that, owing to faulty draughting in the Safeguarding of Industries Act, the confusion in interpreting terms such as "organic" and "fine" chemicals has not been without benefit to the legal profession. It is almost impossible to over-estimate the importance of the milk question. In the old days, when children were reared in the country and in small towns, they usually obtained a sufficient amount of good milk and of good and wholesome food of other descriptions. Now, owing to the huge population which this country has to support and to the habit, a product of our modern civilisation, of crowding together in large towns and cities, the young children who are to be our future citizens are becoming more and more dependent on foods artificially manipulated and preserved. The foods so treated have not the same qualities as the fresh ones. Preserved meats, preserved vegetables, highly cleaned and whitened flour and such things have not the same value as foodstuffs as the articles which were obtained fifty years ago. So long as fresh milk of a good quality was available this compensated to a great extent for the deficiencies of other foods for children. But now we are threatened with milk which has been sophisticated or pasteurised, and we have no reason to think that such milk will have the properties of fresh milk. The future of all young children in towns—and how large a proportion these form—is in jeopardy. The question requires urgent attention.

LETTERS

From

The Rt. Honble. Viscount Leverhulme

Chairman of Messrs. Lever Brothers, Ltd.

I am very glad to hear that the Society of Chemical Industry have decided that, commencing with next January, they will issue their Journal weekly under the title of "Chemistry and Industry," instead of fortnightly as at present.

One of the greatest Generals the world ever produced said that an army moved on its stomach, but I am certain that however an army might move, the art of warfare and the art of peace both equally move on the science of chemistry and industry. This science has made giant strides during the last century, and if only our knowledge of human nature and our handling of human nature in our industries had kept pace with the science of chemistry, I am confident that all the present so-called industrial unrest would never have existed.

Therefore the linking together of Chemistry and Industry in the title of your paper I hope includes the human element in industry as well as the chemical formula. There is just as certainly a formula for dealing with human nature as there is a formula for dealing with organic and inorganic chemistry, and the principle underlying the formula for human nature is "sympathy" and "brotherhood."

From

J. Arthur Reavell, Esq.

Chairman of the Chemical Engineering Group

The publication of the Society's Journal under its new name and as a weekly issue, instead of fortnightly, will no doubt be received with great satisfaction by the large majority of our members.

For a long while there has been severe criticism of the journal from many directions, and the most frequent criticism was that the news published in it had already appeared in the ordinary technical press.

If all the members will support the editor and his staff, and those who can write suitable articles and supply suitable technical matter to the new journal will do so, then the Society will have a really live publication that will appeal to every class of member.

The Journal of the French Society (*La Société de Chimie Industrielle*), started only a few years ago, has rapidly proved itself to be a most valuable technical journal, always providing its readers with thoroughly live technical matter. What has been done by our French colleagues can surely be done here, as we are certainly not lacking in talent, nor is the chemical industry in this country behind any other in the world.

There is no doubt that the Chemical Engineering Group will do their share in providing a considerable amount of up-to-date matter in the shape of papers read at their many meetings, and these papers should have the widest publicity for the benefit of the industry. Where can they get better publicity and a better reception than in the official publication of the Society ?

As Chairman of the Chemical Engineering Group, I will certainly give the new effort the heartiest possible support and I wish it every success.

From

Brigadier-General Sir William Alexander, K.B.E.

Chairman of British Dyestuffs Corporation, Ltd.

It is with great interest that I have heard of the proposal of the Society of Chemical Industry to publish weekly instead of fortnightly the Review portion of its Journal. "Bis dat qui cito dat" is as true of news as of subscriptions or presents, and it will be of real advantage to the members of the Society as also to subscribers in general to receive an earlier intimation of trade intelligence and of business operations. In making this change, the Society is treading the established path of development in the world of journalism. The tempo has been accelerated, and coexistent with the monthly and weekly reviews giving their considered surveys we have the daily papers keenly competing with each other for priority of news and the evening papers, with their many editions, recounting events, important and trivial, as they are taking place and occasionally showing the prescience of anticipation.

It is of the highest importance to the Chemical Industries, and thus to the community at large, that an expert finger should be kept constantly on the pulse of the news in its bearing, not only on commerce but on those advances in science which, in ever increasing measure and with greater promptness than before, are being exploited for the benefit of industry.

There is yet a further advantage in a quickened service. The pace at which information is scanned and absorbed and acted on bears some ratio to the intervals between its appearances.

The monthly reviews languish in state on our tables, while the columns of the evening paper are harvested immediately. The attention paid to news and reports will, I think, be increased by the weekly appearance of the Review, and there will also, no doubt, be some beneficial effect on the news-getting services themselves.

I congratulate the Society on this progressive move and wish all possible success to the new undertaking.

LEGISLATIVE AND DEPARTMENTAL INTERFERENCE WITH INDUSTRY AND THE COMMON WEAL

(*Continued*)

By PROF. H. E. ARMSTRONG, F.R.S.

The street-hawker of fruit to-day spells salvation to the masses and should be highly honoured of men; the town office-worker, who is no longer fed from the grill but on long-stewed food, would probably go under were it not for his services. If salads, fruit and raw milk were substituted for cigarettes, the proportion of C3's would most certainly be diminished.

I may say in conclusion, that I have had the opportunity, during the war, of seeing the detrimental effect, upon the development of a large number of boys, of the lowered diet to which they were necessarily condemned; the effect in medical opinion is continued and obvious to-day. Boys of the age of those I refer to when the experiment began, who have been under improved post-war conditions, are not showing similar effects—so that these cannot well be set down to the conditions of boarding-school life, other than feeding.

I have already spoken my mind on this subject in *Nature*. Thus far I have received no public support from my "biochemical" friends, neither have they sought to controvert my view. The prefix they have chosen to adopt appears to me to be meaningless—they are a lifeless crowd. The time is at hand when all chemists must realise that their first duty is to themselves—to understand themselves. The Organic Chemistry of to-day has nothing to do with real life; we must restore to the term organic its proper meaning and organic chemistry must be the primary study of every would-be chemist. To-day there are few whose opinion is of value on any vital problem—we prefer to consider problems of purely commercial value, instead of those of health and life. Hence my lone tears—for as yet I have found no one to weep openly with me. I trust I have moved some of you.

To deal with the subject exhaustively would occupy hours. My desire to-day is to stir you into activity on your own behalf—on behalf of your own and your friends' children and of the public at large. This will be upon your conscience, if you do not act! It is essential that you should aid in pressing upon the public the unique value of milk for children and in every way seek to promote the production of an ample supply of safe and high quality.

Smoke Abatement

I am led to touch upon this subject, as it was the chief topic of my address to this section in 1917; also and particularly, because I would call attention to the misdirected zeal displayed by the Ministry of Health and at least one other Government Department. That smoke is a curse to us in our cities, we are all aware, and need no proof of its evil effects. We regret fog the more as, in the winter season it is the product of fine weather; hence, this year in London, fogs have been exceptionally prevalent—there has been neither wind to blow them away nor rain to wash them down; but even in London they have been curiously patchy and sharply defined, an indication of special local conditions. What is science doing to rid us of the nuisance? Nothing; only measuring it! Continually it doth cry, regretting the magnitude thereof—but mere crocodile tears such as are shed will never wash the dirt from our sky. In one of our recent worst fogs, at South Kensington, the pundits were seen solemnly enumerating the soot particles, while close at hand the chimney of a works engaged in combating the nightmare was belching forth dense clouds of black smoke, which made the fog appear luminous—no doubt the "average" arrived at was duly recorded against the fog demon. Formerly we had the reputation of being a practical race; to-day we but live on this reputation, gained for us by our uneducated, unscientific forefathers. Seemingly education and science have deprived us of all *nous*!

Smoke has ranked with Divorce and the Criminal Courts, in public interest, during years past; every woman in the country is alive to the nuisance—and does her best to perpetuate it; many men have sufficient intelligence to bemoan it, as it interrupts their journey to "work." A Smoke Abatement Bill was introduced into the Upper House by Lord Newton, in the 1914 session. It was withdrawn, upon an assurance of the President of the Local Government Board that he would appoint a *strong* Departmental Committee to deal with the subject. A Committee was appointed but action was suspended during the war; it was reconstituted by the Ministry of Health in January, 1920, with Lord Newton as chairman. The Report has been the subject of recent discussion and a Bill embodying some of its recommendations was submitted to the House of Lords at the close of last session; this Bill did little more than increase the fines upon offenders; no notice was taken in it of the sparse constructive proposals in the Report of the Committee.

The Committee was charged to consider "the present state of the law with regard to the pollution of the air by smoke and other noxious vapours and its administration and to advise what steps are desirable and practicable with a view to diminishing the evils still arising from such pollution."

It was of the usual character, technically unqualified in the main; certainly not "strong"; it had but one chemist and he had been engaged only in measuring fog and its effects—things which no one wants measured, as they appear in every washing or decorator's bill—not constructively in promoting smoke prevention. As I remarked recently at the Royal Society of Arts, when appointing the Committee, the Ministry of Health should have applied to this Society to nominate three fit and proper persons to serve on the Committee, to deal constructively with the problems of smoke.

The Committee heard about 130 witnesses on 20 days. Nearly all the evidence was directed to proof of nuisance and in some cases to the difficulty, if not impossibility, of avoiding it. Very little constructive evidence was taken and this related to the use of gas or central-heating appliances. Smokeless, easily combustible, solid fuel was considered only on two occasions—the 13th and 20th days. No scientific evidence was given on the subject. The printed evidence occupies 390 folio pages and is an informing, though for the most part futile, document. Why it has not been issued, it would be interesting to know.

We are told that £1,517 5s. 10½d. is the estimated gross cost of printing and publishing the sketchy final Report and the interim Report, including the expenses of the Committee.

There can be no question that Lord Newton and the other members of the Committee did their utmost but the task was beyond such a body; it had not upon it a sufficient number of persons versed in the subject and particularly no one of constructive outlook. A great deal of money has been spent to no purpose—in proving what is generally known and deplored; the Committee had no proper scientific outlook, it therefore made no use of scientific method.

If the proposed Act had been passed, it would but have raised the fines to be laid upon the poor smoke producer, who sometimes suffers from his own ignorance but more often from that of his agents, whose carelessness it is almost impossible to overcome.

Our false system of education, affecting as it does all grades of society from that of the House of Peers downwards, is the main cause of the smoke nuisance. Had the responsible members of the Ministry of Health been properly educated, they would have constituted the Committee of men who would have dealt with the problem constructively from the beginning.

All the Committee has done on the constructive side is to advocate the greater use of gas and central-heating—two methods, we know, which have the disadvantage of being definitely less favourable to health than our present system of open firing. Dust fuel, which in the future is likely largely to displace gas firing and probably will be the solution of most of the difficulties of large scale heating, was not considered.

Smokeless Solid Fuel

This came under the notice of the Committee and it is clear that the advantages and possibilities of an easily combustible fuel produced by carbonising coal at low temperatures were realised. Apart from Mr. MacLauren's evidence on the 13th day, the subject was dealt with, as I happen to know, entirely by accident, only on the last (20th) day. A great opportunity was therefore missed of displaying to the public the case for such fuel free from partisan advocacy. The baldest possible reference is made to the subject in the report.

To quote one paragraph : " For some years various experts have been endeavouring to discover some practicable means of carrying out low-temperature carbonisation under commercial conditions. In particular, the Fuel Research Board have conducted, during the past two years, at H.M. Fuel Research Station, experiments with a considerable variety of coals and have determined the yields and quality of gas, oil and coke produced under definite conditions."

It is an astounding fact that the endeavours referred to have been made by persons having no connexion with coal interests—of the inventor type. Government has never moved in the matter. No colliery proprietor, none of the great users of coal at Sheffield or elsewhere, none of the Gas Companies, had touched the problem of low temperature carbonisation up to a few months ago. Fortunately, though methodless, we are a sporting race : as usual, private persons, gifted with some imagination, some foresight, some spirit of adventure have stepped into the breach and though technically utterly incompetent for the task and always unsystematic in their ways, at the expense of their own and other people's fortunes, have struggled on doggedly and won through—I say, won through advisedly. Given efficient co-operation of chemist and engineer and systematic study, the problem would have been solved years ago.

At last even the Gas World is catching the low temperature disease, though the technical press is still seeking to vaccinate against its spread. Success was being achieved, until recently without help from Science.

As to H.M. Fuel Research Board, referred to in Lord Newton's Report as though it represented something real, the information that has emanated from this august body is worthless for all practical purposes. Its programme seems to be merely to bake sponge cakes from every sort of coal, instead of from sugar and flour ; to find out what the cake weighs and what is lost in baking it. No one who has to deal with coal in practice will have any use for this information. The weight of the cake produced from a given coal at a given temperature is fairly constant and may be easily determined in any chemical laboratory, with ordinary appliances, at no great cost of money or time. The yield of gas and oil at a given temperature, under one set of conditions, is of little value ; by varying the conditions without varying the temperature great variations in the relative proportions of gas and oil are easily induced : the volume may be more than doubled.

The business of a National Fuel Research Board should be not to undertake work not even of academic value but to aim at practical results and to help, by honest co-operation with all the agencies in sight, to secure the result which, on all hands, is accounted to be that of greatest industrial importance in the life of our nation—the production of a suitable, smokeless fuel, at an economic price. If we can render our cities clean and clear and at the same time economise coal, we shall enter into a new heaven upon earth. There is no present prospect that H.M. Fuel Research Board will contribute to this end—it works in secret and takes no cognizance of outside knowledge ; it seems to have no practical outlook ; and what is its cost ? No accounts are published. Sir Charles Parsons told us at the Bournemouth British Association meeting in 1919, that the primary cost of the Station at Greenwich would be £250,000. There must have been a large maintenance expenditure in the interval. It is clear that the organisation needs overhauling and reconstruction—if indeed it be in any way worth while to maintain it in existence.

The problems of fuel are the problems of first importance for us to consider, as our nation, for the most part, is fed upon coal and we cannot sufficiently use our coal to feed the large number we have encouraged into existence through its extravagant use. Chemists in the gas industry have perforce greatly neglected the subject hitherto ; their place has been usurped by the engineer and by one of very narrow outlook. Ere long, however, the gas industry will be ranked one of the first of chemical industries and the fascination of the problems it presents clearly recognised. The gas-works chemist must soon be fully in evidence ; he must be a whole one. Fortunately your treasurer is leading the way ; you will shortly have to recognise him as an organic chemist *pur sang*, a reverent student of the past, bent on making honest use of the capital the past has given us.

Gaseous Fuel—The Therm

As not even the patronage of H.M. Fuel Research Board has been able to secure public belief in the Therm, a Committee of five has been appointed by the Board of Trade, I assume, to inquire into the complaints that have been raised. Of course, as usual, the Committee consists of men who have no knowledge of the subject they are to consider—consequently they will have no feeling for it and will necessarily accept the view most alluringly put before them. In the end the public will not be enlightened.

Again I say, the Federal Council or this Society should be asked to nominate fit and proper persons to serve on the Committee. If we are to live with gas in the future, at all events until we put our heads into some oven filled with gas, it were well that we were taught to understand and respect the fluid; also that some agreement were laid down as to its composition—a matter of some concern to us. This great opportunity is offered by the inquiry and it should be conducted to such end.

THE FEDERAL COUNCIL

You are to publish a weekly *Journal*, which is to be the proclaimed organ of the Federal Council for Pure and Applied Chemistry. The said Council, thus far, has had a shadowy form; that the conception behind it, the great ideal it embodies, is real, is shown by the very fact that its achieved existence and influence is now to be so publicly admitted and proclaimed. The future of chemistry in this country depends upon the extent to which chemists generally are mastered by that ideal, upon the way in which they qualify to be its recognised exponents.

The ideal is that of solidarity—the subordination of mere individual interests to those of the body politic, more particularly to those of the Science we profess and proclaim to be fundamental to all human activity, indeed to the world at large: *as all life has its being in chemical change.*

This must be our constant message to the public and to those who would govern us to-day. We are no mere analysts, to be called in when some chief of police eats promiscuous chocolates or a man gives poison to a wife of whom he is tired; we are not mere dispensers of drugs: *we are the masters of the materials which make the universe;* all industries, including agriculture, can be made subject to our control; in fact, the only people who can have no use for us and who may well hate us are the clerics: we cannot picture a world made at the rate suggested in Genesis, nor in the manner described in the books which they so often misread to the public. Up to the war, in this country, chemists were in the wilderness; the opportunity given during the war was taken by not a few and our science came into repute. There is great danger that the shield thus won may not be held, unless the greatest care be taken to maintain a strong team. The system of training is seriously in fault. The production of bits of chemists in place of whole chemists is a proved failure. The Federal Council is itself proof of chemical tit-bit'ry; it will only be a really Federal body when it is a Council of Chemists, one and indivisible, all working together, though may be in different walks. I say this to mark my opinion, that the setting up recently of two new independent hives is not a healthy sign; it is proof that the altruistic co-operative spirit is not yet sufficiently alive among us. We are at the most critical period in the history of our nation. A misdirected, scientific zeal has brought us into possession of a population which we cannot carry. Science, properly used, alone can save us; but science has to force its way through and to the fore; it will receive no invitation from the democracy, whose spirit is congenitally unscientific and not to be educated; we have the whole literary and clerical clan against us and this is not to be handled with gloves.

A PALACE OF CHEMISTRY

If successfully conducted, your new venture will spread the Federal ideal; ultimately the ideal will be embodied in a Palace of Chemistry. One of the most prominent buildings in Brussels is the Palais des Académies; this name appears in big letters on the cornice. The Federal victory will only be won when British chemists similarly proclaim themselves in some one of the great throughfares of London and a focus is provided where all can meet and find a common home. The further aim should be, moreover, to make that Palace an acknowledged *Palace of Truth*, one in which judicial methods are alone practised and no false worship of icons of any kind is permitted.

THE USE OF LEAD IN PAINTS

I have painted the milk of to-day as a whited sepulchre. Let me now point out how the bureaucrat and sentimentalist ocmbined would deprive us of the most efficient of our White Paints. This time, it is the Home Office that would hamper us, and again we have to deal with a semi-scientific tyranny, emanating not from the bacteriologist but from the medical man, overcome by the humanitarian desire to protect a particular class, but unprepared to consider either the needs of industry or the requirements of the public.

Nearly ten years ago, in April, 1913, Mr. C. A. Klein and I brought the subject directly under the notice of your Society, and our communication, we believe, has not been without influence on subsequent official action. I may note here that your eminently respectable Publication Committee made many alterations in our paper, so depriving it of all point and significance; these we successfully resisted. I offer this remark, in no way of complaint but to make clear my view, that open and free expression of considered opinion is the need of our time and that your Society will prove of value in proportion as it provides a platform for such discussion. You must be a fighting body, if you are to progress: as Recording Angels, you may be ornamental, but of little use.

(*To be continued*)

MEDITATIONS OF A SODIUM ATOM

Collected by "Meniscus"

These racy "meditations," perhaps "rhapsodies," are really nearer the truth, form one of the essays sent in by members of the staff of the United Alkali Company, Ltd., in a competition to celebrate the Centenary of the foundation of the Alkali Industry in this country. The Company must be congratulated on a finished product so suitable for this interesting occasion and we hope other firms will follow this example.

* * *

EXULTANT! I am overwhelmed with joy. It is 1923 and I celebrate the Centenary of my crowning glory. One hundred years ago I arose from darkness to the dawn of a new day of usefulness and service, radiant with hope for the world of man. How often do I puzzle scientists and doctors, almost driving them to despair as they seek to elucidate my mysteries and fathom the secret precincts of my nature. They call me a Sodium Atom and what strange guesses have been made regarding me. From Democritus and Lucretius to Dalton a thousand theories have held their sway, and as each new one is propounded I just laugh at their efforts, and wonder "Shall I tell?" Ever ready to render service unto man, the infinite numbers of my family are scattered throughout the world in a variety of relationships. In the world's childhood, long ago, change was ever my lot, and as the mass of earth cooled down I was diffused through the whole, but my great affinity for Chlorine resulted in my being hidden in the depths of the earth, to be known to man as Sodium Chloride or Common Salt.

The years rolled by and we were left untouched or unheard of, with only an occasional effort to organise for man's service the millions of tons of salt. Indeed, apart from use as a food preservative, no other use seemed available.

To me such an existence spelled monotony; the relationship with Chlorine bored, and I longed for the time when man should liberate and utilise me for his service.

The dawn of a new day was breaking, Lavoisier, Guyton de Morveau and, greatest of all, Nicholas Leblanc, were tunnelling through the walls of night; freedom and liberty were in sight. Alas, the fires of Blood Red Revolution swept through France; Lavoisier perished, condemned to the guillotine. Nicholas Leblanc died, and the fruits of his labours were unexplored.

The young French Physician poured forth energy of mind and will in the determination to attain a prize of about £100. "It shall be done; no longer shall soda be exclusively obtained by burning wood and treating the ashes with lime." The fires played round the crucible, and Leblanc's great process was accomplished. The Product of Salt and Sulphuric Acid heated with coke and lime had yielded the precious Soda.

Cheated of his prize, and later, deprived of his works, Nicholas Leblanc was plunged into dire, distressing poverty, and with the burden of sorrows and age he sought refuge in a workhouse. In 1806 he perished by his own hand. So ended the life of one, whose name was to become immortal.

* * *

An anxious waiting company of men and women assembled on the sun-kissed plains of Holland, eagerly gathered round the arriving coach. That something was wrong appeared evident by the gloom which overshadowed their faces. For many weeks, day after day, the group had gathered to discuss the non-arrival of yarns and cloth from Scotland to be bleached. A strange tale seemed to fall from the lips of a man who had stepped from the coach. Speaking to the bewildered throng, he continued, "They are able to do in Scotland in twenty-four hours what has taken us months and months to perform. Someone named Tennant has opened a Works at Glasgow. He mixes Salt and Manganese together and treats them with Vitriol and an evil gas comes off, but this strange gas he passes through lime and extracts with water, and lo! when the yarns are just dipped in, out they come whiter than the fairest lily, whiter than the Arctic Snows."

In 1799 Charles Tennant had opened a small Works on the Clyde for the manufacture of Bleaching Powder, but I, Sodium, who had held Chlorine so long and had now yielded it up for man's service, was treated as a necessary evil and along with Manganese and sulphate was cast away as refuse, until later, when, as Weldon Mud, the ingenuity of man found utility for this apparent waste.

* * *

About 1822, in a quaint room in Dublin, a piece of Salt lay surrounded by retorts and flasks, upon a table. Meditatively James Muspratt fingered the small white mass. His keen eyes showed talent and perception. Determination, restlessness, passion, daring, were inscribed on his personality. "Only a piece of Salt, but in you lies untold wealth, in you lies the prosperity of Dear Old England—Leblanc—Liverpool—the Mersey with its vast facilities for foreign trade—."

The heavy Salt duty had been removed. Slowly the first great British Chemical Works arose in Vauxhall Road, Liverpool, and in 1823 James Muspratt commenced manufacturing on a commercial scale the soda and its by-products which were to prove the foundation of a thousand other industries and of Britain's Commercial Supremacy.

So rejoice with me. 1923! The Centenary year of my Crowning Glory.

In the process of the preparation of Soda, Salt is first treated with Vitriol and the Chlorine is liberated, but immediately combines with Hydrogen to form Hydrochloric Acid Gas, and Oh ! the havoc of that gas. Farmers cried out against its devastating work on their crops ; buildings began to fall before its corroding action ; high chimneys failed to carry away the torrents of the gas, and the Alkali Industry seemed in jeopardy, unless something could be done to counteract the deadly fumes.

In 1836 a remedy was proposed by William Gossage, namely, the erection of coke tower condensers through which trickling water would absorb the gas. But on approaching James Muspratt, Gossage received a rebuff and Muspratt, thinking only of the magnitude of his works, exclaimed " Sure ! all the waters of Ballyshannon itself would not suffice to condense the acid I produce."

However, the Gossage Towers did work and effectually condensed the acid. But further troubles were soon to be experienced, for the excess Hydrochloric Acid was running to waste into the Canal and the boatmen found the rivets dropping from their barges with the resultant sinking of them.

* * *

Chlorine was known and utilised for service, but linked up with Hydrogen, it formed a dangerous combination, and to separate the two was indeed a problem.

The Handmaids of Patience and Perseverance waited upon the labours of Henry Deacon, and success at length crowned his efforts and research. The troublesome gas was passed over heated Copper salts and what joy beamed upon his face when Chlorine was evolved. The Deacon Process was patented as the most economical method for the preparation of Chlorine, the vital element in Bleaching Powder.

The service of Chlorine can hardly be estimated, and its production runs to several thousand tons per annum. Man has overcome difficulties of handling, and now it is sent out in its elemental state compressed to a liquid, in iron cylinders. Should the supply of Chlorine cease, all paper makers would despair, sanitary inspectors would forsake their posts, doctors could no longer administer Chloroform to their patients, white clothes and linens would be luxuries for the rich ; many dyes also would sink from the memory of man should this valuable element fail.

* * *

Widnes had become the scene of operations for Muspratt and his co-workers, but whilst the flourishing Industry was springing up on the Merseyside, similar operations had commenced on the Tyne under the control of Christian Allhusen. A transformation had taken place in St. Helens. Instead of green fields, with orchards and thatched cottages, the tall chimneys of chemical works had made their appearance. Such men as Josiah C. Gamble, who was the first chemist to introduce into the United Kingdom the working of Vitriol Chambers, Henry Baxter, and Andreas Kurtz, have their names inscribed in the annals of the British Chemical Industry.

Kurtz, operating at the Sutton Alkali Works, had gained the reputation of having the best equipped and managed works in the country, and although he did not make St. Helens his place of residence, Andreas Kurtz remembered the place to which he owed prosperity, and erected Public Baths, and founded the St. Helens Cottage Hospital.

* * *

The tremendous capital involved and the mighty organisation required to direct the preparation of the Alkali Products was a gigantic problem, and towards the end of the nineteenth century, to prevent overlapping in working, and for economical efficiency, the various manufacturers were compelled to consider some practical method of co-operation.

Already over thirty different firms were working processes throughout the Kingdom, and at length the triumph came. United under a central board, united in aim and purpose, joining hand in hand in fellowship, the United Alkali Co., Ltd., was founded and registered as a Company on November 1st, 1890, to render efficient the manipulation of so vast an industry, and to serve the highest interests of the Empire.

All that was serviceable in the old firms was retained, all that hindered was scrapped, but progress did not end there. New discoveries were still to be made, modern machinery was to replace the old, and new processes were to be installed.

* * *

The four cardinal points of the Alkali Industry's greatness are Salt, Limestone, Coal and Pyrites, and one of the earliest efforts of the new company was the purchase of interests from the Salt beds at Fleetwood to the Pyrites mines of Huelva in Spain, thus assuring an adequate supply of these four essentials.

Product after product has been added to the list of manufactured Chemicals, and after these years of travail, forth I go as an integral part of every industry.

The Tanner for his leather uses Sodium Sulphide, Sodium Hyposulphite, and Sodium Sulphite ; the Glass Maker uses Sodium Carbonate and Sodium Sulphate ; the Paper Maker, Bleacher, Dyer, Soap Maker, Confectioner, Photographer, Scullery Maid, and Monarch use the products of which I form part.

* * *

Electricity has played her part in the production of the Alkali Products. I shall never forget that adventure. Into a large cell with Electrodes the brine was poured ; the current passed with a strange dividing sensation, and

I was drawn to the negative pole while Chlorine passed away as gas at the positive. Free, I sought union with Hydroxyl, was heated in great pans until the water had evaporated, then passed through intricate pieces of mechanism, and issued forth as Petal Caustic Soda. Now, prouder than any other member of my race, I reside within a bottle bearing on its face—A RED HEART.

* * *

O fair Ship "The United Alkali Co., Ltd.," thou hast sailed over many seas and thy strong bows have ploughed through calm and troubled waters. A backward glance reveals rough, rude promontories safely rounded, or hidden rocks safely passed. Thou hast weathered the winds of adversity, of coal and railway strike, of transport difficulties and engineering problems, and to-day thou art still as strong. There are yet unchartered seas to explore, there are yet discoveries reserved for thy seeking, the voyage ahead is full of Hope, and promises to be yet more glorious than the past.

Sail on; sail on fair ship, and the pages of history will record the necessities, the joys, the comforts and pleasures of life that have come to the human race through "THE UNITED ALKALI CO., LTD."

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

The Chemical Industry Club

I ASKED last week why there are so many Chemical Societies and Associations and hoped that the Federal Council would supply the "missing adhesive." Now it happens that very occasionally I pay a visit to the Club and my impression is that a good deal of the co-ordination of chemical effort is going on in a very unobtrusive manner in the Club premises. In their relation to chemical societies everyone is, for the time being, bound to identify himself with the interests of some particular body. Professor X is, this year, or hopes to be next year, the President of the Chemical Society; Professor Y is, this year, the President of the Society of Public Analysts, and next year he is invited to be the Hon. Treasurer of the Biochemical Society, and, at the moment, Mr. Z is the President of the Association of British Chemical Manufacturers. Such time as these public-spirited gentlemen have to spare for the organisation of our science and industry is more or less concentrated on the Society they are specially keen upon at the moment. But in the Club they are dissociated or ionized or whatever is the proper term. Their co-valency disappears, as Professor Lowry has explained, they wander about in the state of ions and are ready to help along any movement which is for the public good. The individuals, however, remain the same; the club members are, in other places, Fellows of the Chemical Society or Members of the Society of Chemical Industry, or the Mineralogical Society or they represent the companies whose interests the A.B.C.M. looks after. It is in the Club that they make their corporate influence prevail and their weight felt.

America and Ourselves

I have just had some very interesting news from America and hasten to record it for the benefit of future historians of our Society. It appears that our American friends have been considering the question of the more frequent publication of their chemical journal, and it is most interesting to note how closely their ideas approximated to our own. A news edition of the Journal of Industrial and Engineering Chemistry is to appear on the 10th and 20th of each month. The new publication is to have the same sized page as the regular monthly issue of the Journal and is to be separately paginated. Hearty congratulations to the American Chemical Society!

The Old and the New

The attempt of the London Section to brighten their monthly meetings may be regarded as revolutionary by some of us, but I am more inclined to regard it with equanimity since receiving a notice of a meeting to be held by the Shawinigan Section in "The Electro Products Camp on Transmission Avenue." A sufficiently picturesque place to draw a crowd, I imagine; but should this fail to draw a good attendance, other inducements are offered. Occasionally the words, "Smoking permitted," are added to such notices, not so in the case of Shawinigan. "The meeting," so the notice reads, "will consist of a real old-fashioned Province of Quebec Smoker," and "people from Ontario and the United States will be admitted if they promise to behave."

Montreal *v.* Shawinigan

The London Section is really out of the running, but I am not sure whether Montreal will be left at the post. The Montreal Section does not meet at a camp, but at the Queen's Hotel, nor are such futilities as "refreshments will be served" countenanced for one moment. The member is bidden to "bring two dollars for the hotel and take an active part in the *best one* yet." They do not "dine" in Montreal, but the members "eat dinner together." Punctuality is insisted upon: "The first olive goes down at 6.15 p.m. At 6.20 the olives will be —all gone!" It is very nice indeed to see how our friends across the seas secure their audiences, and if the London Section can do the same they will have a very successful session.

FORTHCOMING EVENTS

Jan. 11. Optical Society, Imperial College, S. Kensington, at 7.30 p.m. "Stellar Photography," by C. Davidson. "Ultra-violet Light in Microscopy," by T. E. Barnard. "Pitch," by F. W. Preston.

Jan. 13. Society of Chemical Industry, *South Wales Section*, Visit to National Oil Refineries, Skewen, at 10.45 a.m.

Jan. 16. Royal Photographic Society, 35, Russell Square, W.C., at 7 p.m. "Manufacture of Paper for Photographic Purposes," by H. W. Greenwood.

Jan. 16. The Chemical Engineering Group. Hull Photographic Society, Grey Street, Park Street, Hull, at 7.30 p.m. "The Manufacture of Wood Extract," by Mr. J. Arthur Reavell, M.I.M.E.

Jan. 16. Society of Chemical Industry, *Edinburgh and East of Scotland Section*. Medical Chemistry Class-room, University Buildings, Teviot Place, Edinburgh, at 7 p.m. "The Chemistry of the Genus Eucalyptus," by Prof. R. Robinson, D.Sc., F.R.S.

Annual Informal Meeting, in the Tutorial Class-room, Medical Chemistry Department, the University, Teviot Place, Edinburgh. "The Combustion of a Volatile Hygroscopic Liquid," by Mr. J. B. Shoesmith, M.Sc.

Jan. 17. Society of Chemical Industry, *Nottingham Section*, and Society of Public Analysts, at University College, Nottingham, at 7.15 p.m. Joint Discussion on "The Detection of Small Quantities of Arsenic," opened by A. Chaston Chapman, F.R.S.

Jan. 17. The Industrial League, Caxton Hall, Westminster, S.W., at 7.30 p.m. "A Talk about Economics," by Sir Ernest Benn, Bt.

Jan. 17. Royal Society of Arts, John Street, Adelphi, at 8 p.m. "Hygienic Methods in Painting," by C. A. Klein.

Jan. 18. Institute of Mining and Metallurgy, Geological Society's Rooms, Burlington House, at 5.30 p.m. "Note on an Apparatus for Small-Scale Flotation Tests," by H. L. Sulman and H. F. K. Picard.

Jan. 19. Institution of Mechanical Engineers, Storey's Gate, London, at 6 p.m. "Problems of Engine Indicators," by L. Pendred. "New Form of Optical Indicator," by Prof. F. W. Burstall.

Jan. 19. Society of Chemical Industry, *Liverpool Section*, in the Muspratt Lecture Theatre, the University, Liverpool, at 6 p.m. "Patent Fuels," by Arthur Grounds, B.Sc.

Jan. 19. Society of Dyers and Colourists, *Manchester Section*, 36, George Street, Manchester, at 7 p.m. "The Behaviour of Titanium Hydroxide towards Dyestuffs," by Dr. J. K. Wood and A. M. Morley. "Investigations on the Constituents of Raw Cotton, IV.," by Prof. E. Knecht and G. H. Streat.

Jan. 22. The Institution of Rubber Industry, Midland Hotel, Manchester. "Patents: As they Affect the Rubber Industry," by H. E. Potts, M.Sc.

Jan. 26. Royal Institution, Albemarle Street, W., at 9 p.m. "The Machinery of Anti-Bacterial Defence," by Sir Almroth Wright, K.B.E., etc.

NEWS FROM THE SECTIONS

SOUTH WALES SECTION

The fifth ordinary meeting was held on December 15, at the Technical College, Swansea, with Professor C. M. Thompson in the chair, and Mr. T. A. Goskar read a paper on "Peat."

Mr. Goskar first discussed the mode of formation and occurrence of peat, and emphasised the difficulty of removing the 90 to 95 per cent. of water contained in the raw material, if conversion into briquettes was desired. Methods which have been tried in the past for drying peat were shortly described, the Ekinburg wet-carbonisation process in some detail. On mixing a small proportion of gritty dust (peat charcoal or coal) thoroughly with peat, and slowly applying a pressure of 2 tons per sq. in., the moisture content could be reduced to about 50 per cent. by one pressing, the remaining moisture being reduced to 8 per cent. by air-drying for 24 hours. Because the hydrocellulose had not been destroyed, material obtained in this way yielded hard briquettes, and also harder coke than that from peat in which the hydrocellulose had been destroyed, as in the Ekinburg process.

Other peat products were described, such as peat-moss litter, peat dust for disinfecting, paper and cardboard (insect and damp-proof), ammonia, alcohol, fuel oil, and charcoal or coke. The coke could be made soft or very hard at will (harder than coke-oven coke), and of specific gravity from 0·75 to 1·4; it was of exceptional quality for the iron-smelting industry, and the hard coke would sustain a greater burden in the blast-furnace than the hardest coke from coal. Charcoal of exceedingly fine quality for hardening steel could also be made.

Success in the peat industry was to be looked for in the production, not of the briquettes of low calorific value which have so often been the final product, but the more varied and valuable substances mentioned. A short discussion followed, and specimens were shown.

BIRMINGHAM AND MIDLAND SECTION

At the meeting held on December 19, Mr. A. E. Tucker, F.I.C., read a paper on the physics and chemistry of metal colouring.

Mr. Tucker showed many specimens of ordinary colouring in which the effects were produced by the deposition of minute amounts of other metals or by the alteration of the surface by etching, as in the case of French or Japanese art-work, etc. It was pointed out that the beauty of many such articles lay in their colouring, and also that a good deal of the commercial success of many foreign metal goods arose from their high finish in this respect. Such finish was often obtained by a very small outlay, but it implied much experience and technical knowledge. Demonstrations were given of new electrolytic processes—the Testini-Rondelli processes—in which no foreign metal was used for obtaining the colours, which depended solely on the alteration of the surface of the metals of which the goods were made. No measurable alteration was produced, and so the processes were applicable to the most delicate measuring instruments. In consequence, metal in the form of sheets, etc. could be worked up after such colouring without any scaling or other disturbance of the surface. The hardness of the surfaces produced and, in the case of iron, the increased resistance to rusting, were demonstrated by means of specimens produced on a large scale. Apparently, hitherto unknown oxides of extreme thinness were formed on the metals treated. After discussing the chemistry of the colour formation it was shown that the varying stages of treatment could be clearly indicated by means of electrical measuring instruments, so that very little experience was required for working the processes, which became routine production work, the output for a given plant being very high.

LONDON SECTION

"Micro-organisms and their Application to Industry and Research" was the subject of a discussion at a meeting held jointly with the Biochemical Society in the Institution of Mechanical Engineers on January 8, Mr. A. Chaston Chapman, F.R.S., presiding. In opening the meeting Mr. Chaston Chapman reviewed the industrial applications of microbiology, and said that the fermentation industry was in a backward state. The plea was renewed for the establishment of a National Institute of Industrial Microbiology, which should be a centre of research, provide specialised training, produce pure cultures, and constitute a home for British microbiological science.

Sir W. J. Pope, who opened the discussion, referred to the variety of organic compounds produced by micro-organisms and expressed surprise that the chemical mechanism of the cell—a subject for pure organic chemistry—had been so little studied by chemists. In view of the ever-growing cost of fuel and labour, the ability of micro-organisms to utilise low-potential solar energy and thus produce organic compounds very cheaply was most important. Many compounds could be produced by bacterial activity but the processes had not been properly worked out. More study of the chemical activity of micro-organisms would give results of far-reaching importance and he supported the suggestion that the foundation of a National Institute of Industrial Microbiology was desirable.

Prof. Gowland Hopkins also emphasised the great variety and cheapness of the chemical actions induced by micro-organisms. Some bacteria contributed but few products to the medium in which they grew, but by "educating" them more products could be obtained. Many of the products were intermediate, not end, products and would normally undergo further change in the cell. If the permeability of the cell were modified, and if the many species available were utilised, the already great variety of products could be increased. By selecting from an average population, special individuals could be obtained capable of carrying out reactions which the original culture could not perform. The selection of micro-organisms offered vast possibilities.

Prof. A. Harden said that no really quantitative work had been done on the chemistry of the changes produced by micro-organisms. Despite the range of products obtainable, there was practically always a stage at which most organisms yielded the same compound when acting on the same substance. Thus acetaldehyde was probably a preliminary product of the action of yeast, *B. coli*, the lactic-acid and many other organisms, on sugars. This suggested that there were only one or two ways of attacking the sugar molecule. To reduce complications due to growth, the need of food, etc., the possibility of utilising dead organisms required investigation.

The agricultural importance of micro-organisms was dealt with by Sir J. Russell. After describing the preservation of greenstuff by acetic acid produced by fermentation and the fermentation of cellulose to give methane and hydrogen (used for heating) or artificial manure, the various forms of nitrogen-fixing bacteria were discussed, and it was pointed out that although so much attention had been devoted to chemical processes for fixing nitrogen, nothing was known of the mechanism by which organisms could fix atmospheric nitrogen at low temperatures in the soil.

Prof. H. E. Armstrong opposed the proposal to found an Institute on the grounds that it would lead to centralisation and sterilise original work. What was wanted was work in purely organic chemistry. Mr. Chaston Chapman in reply supported the foundation of the Institute because the industrial applications of microbiology required study and this would lead to true organic chemistry through research on the cell.

The manufacture of antitoxins was described by Prof. G. Barger, who observed that Buchner's work on zymase required extending with the object of producing a solution of an organism which showed properties not possessed by the organism. An account of micro-organisms in the tanning industry was given by Dr. R. Pickard, who said that many problems still awaited solution, and that nothing was known of how tannin was produced in the tree, although enormous quantities of tannin were imported, only a small amount coming from the Colonies. Dr. Tyson claimed that an Institute for general microbiology would be preferable to one for industrial microbiology. Mr. E. R. Bolton spoke on the importance of microbiology in the manufacture of margarine, and Dr. R. Armstrong discussed the variability of micro-organisms, and suggested it was due to inheritance and segregation on Mendelian lines. In conclusion the meeting resolved that the foundation of a National Institute of Microbiology was desirable in the public interest.

PERSONALIA

Mr. H. S. Taylor has become professor of physical chemistry in Princeton University, U.S.A.

Dr. K. Fredenhagen has succeeded Prof. A. Sieverts as professor of physical chemistry and director of the school of chemistry of the University of Greifswald, and Dr. R. Pummerer has succeeded Prof. J. Meisenheimer in the chair of chemistry in the same University.

On December 20, Sir Max Muspratt, chairman of the United Alkali Co., Ltd., was entertained to dinner by representatives of the company's staff as an expression of pride in the honour conferred upon him by the King. Mr. T. W. Stuart, general technical manager, presided over the dinner. A piece of plate was presented to Sir Max as a souvenir of the occasion.

* * *

With regret we record the death on January 3, of Dr. Georg Lunge, aged 84 years, emeritus professor in the Federal Polytechnic, Zürich, and well known for his work on technical methods of chemical analysis.

MEETINGS OF OTHER SOCIETIES

INSTITUTION OF PETROLEUM TECHNOLOGISTS

At the meeting held on January 9, Dr. W. R. Ormandy and Mr. E. C. Craven contributed a further account (*cf.* J., 1922, 30 R) of their investigations into the physico-chemical significance of flash-point temperatures. The work described was part of the extended investigation on the physical properties of pure and mixed fuels undertaken at the joint request of the Distillers' Co., Ltd., and the Fuel Research Board. Heptane, toluene and ethyl alcohol were utilised as experimental material and the chief properties investigated were vapour tensions, flash-points at reduced or increased pressures, flash-points in mixed gases, and the effect of increasing temperature on the flash-points. Previous work had shown that at the flash-point in air all hydrocarbons possess approximately the same vapour tension, that increase of pressure raises the flash-point, and that the flash-point is lowered on replacing the air by oxygen. The present work was mainly an account of further investigations on these relations. The methods and apparatus used were described in detail, and numerous tables of vapour pressures and flash-points obtained under various conditions were given.

The importance of this work depends on the suggestion that from the determination of the vapour tension of a mixture of hydrocarbons at any temperature and pressure, it should be possible to deduce the point at which an explosive mixture of the vapour and air will be formed at some other temperature and pressure; so that the conditions for utilising the liquid as fuel in an internal-combustion engine could be rapidly calculated from the results of one or two experiments.

INSTITUTION OF RUBBER INDUSTRY

A meeting was held in Birmingham on December 20, when Mr. B. D. Porritt, M.Sc., read a paper on "Some Aspects of Science in the Rubber Industry," and introduced the subject by stating that Priestley, for many years an inhabitant of Birmingham, was the first to suggest the use of rubber for erasing pencil marks.

In most industries the output usually consists of a limited number of standard products manufactured from simple raw materials by processes that are generally to a great extent automatic. No such simplicity characterises the rubber trade. For example, a factory manufacturing spread goods will probably utilise over 100 formulæ composed of innumerable different ingredients, and keep a stock of cloths of every conceivable width, weight, and colour to provide the endless combinations required to satisfy popular fancy. The present lack of standardisation in the products of the industry is possibly detrimental both to manufacturer and consumer, but a body such as the Institution of Rubber Industry, which brings both parties into personal contact, may be preparing the ground for a better understanding in the future. There are few important industries which call for a greater proportion of skilled supervision and a higher standard of ability on the part of the individual than the rubber trade, not only on account of the variety of its materials, processes, and products, but also from the fact that the fundamental principles underlying its methods are as yet imperfectly understood.

After defining the term "science" in the widest sense as implying not only the possession of abstract knowledge, but also the power to apply it to some useful purpose, the lecturer discussed the technical direction of the rubber factory, emphasis being laid on the need for specialised knowledge. The works chemists and engineers are fully occupied in keeping production running smoothly, and the pressure of this onerous routine work is probably responsible for the fact that the technique of the industry has been so little altered since the time of Thomas Hancock, some 80 years ago. It is now time for greater use of technical research in the works, and with the co-operation of the chemist, the engineer, and the accountant, a systematic attack might be made on many sources of wastage of power, steam, time, and material to which the methods of manufacture in the rubber industry specially lend themselves.

To achieve success in such efforts a higher standard of education will be necessary for those who supervise the work of the factory departments. In this connexion, a series of popular lectures on rubber and rubber testing, for the benefit of the factory foremen, might be a profitable expenditure of time on the part of the chemist as a means of securing the interest of the practical man; and provision for the future might be made by filling works vacancies from promising junior assistants engaged on routine testing in the laboratory. The chemist can also be employed usefully on the commercial side of the works, as is done in the dyestuffs industry, and the physicist is becoming an important ally of the chemist in industrial laboratories. More attention, however, will have to be paid to the physical efficiency of the factory worker, and the services of the physician and dentist should play a greater part in the economy of the factory, whilst the technical staff could ensure that the conditions of work are such as to minimise fatigue and eliminate eye-strain.

In every industry scientific control is slowly but surely displacing rule of thumb methods, and machinery being substituted for hand work. These changes point to an increasing need for a high standard of technical efficiency in the administrative staff of a works and a higher level of education amongst the workpeople. To fill its technical posts, the rubber industry will have to look primarily to the universities and technical colleges for its "raw material." The importance to the industry of a supply of men combining scientific knowledge with technical experience has not been overlooked by the Council of the Institution of Rubber Industry, and the Honorary Technical Advisers are at present considering a scheme for providing a "hall mark" for all who have attained the necessary standard of proficiency. Whilst this scheme will help the manufacturer to select his technical staff, and indicate to the student the course of study he should follow, it will not in itself solve the problem of the supply of suitably qualified men, and for this reason it will be in the interest of the rubber trade to encourage and support any institution which affords opportunities for post-graduate research on its special problems and instruction in its technical methods. Hitherto, industries have relied largely on the universities for the development of the pure science which forms the basis of their technical practice, and in many cases this confidence seems to have been justified. Research in rubber, however, apart from its fundamental difficulties, can scarcely be undertaken without expensive experimental plant, and, in consequence, this otherwise attractive subject has received scant attention from the scientific world, whilst the results of what little work has been done are often almost valueless owing to the absence of information regarding the composition and methods of preparation of the samples employed.

The existence of the Institution of Rubber Industry is itself a proof that the conservatism of the past is rapidly disappearing, and the formation of a Research Association is a striking illustration of the importance now attached to trade co-operation in matters of fundamental importance. It is increasingly apparent that the future development of the rubber trade must lie mainly in the many potential markets overseas, in which the competition of other nations must be met by enterprise and up-to-date methods. To secure the position in the world's markets, therefore, to which his pioneer work would seem to entitle him, the British manufacturer will from now onwards have to make the fullest use of every aid which modern science can offer.

SCIENCE MASTERS' ASSOCIATION

(*From Our Special Correspondent*)

The meeting of this body, this year, at Cambridge, from January 2 to 5, has been remarkably different from other educational conferences. Instead of indulging in vaporous talk about "the glue which holds society together," still less of engaging in "research" into the value of the vulgar cinema-show, the science masters have abandoned themselves during a couple of days to intellectual debauchery of the highest order, thereby following the precedent set two years ago at Oxford. About three hundred members were present; they found agreeable lodging and refreshment in Trinity and St. John's Colleges.

It has been the custom of the Association to choose as President, each year, a scientific worker of distinction. This year, the President was Sir Ernest Rutherford, who delivered his address at the opening meeting on Tuesday evening. Very wisely, he said little on school politics; instead, he gave a most entrancing original discourse, tracing the historical development in the field of discovery he has made so entirely his own, and in which he is now the acknowledged leader. A modern knight errant, armed with the α-particle, an ultra-microscopic missile moving with incredible velocity, ho is steadily bombarding various elementary molecules, apparently with success in some cases: shattering them to their downfall into simpler materials; not knocking mere spots off them, but substantial hydrogen atoms. Speaking in simple and homely terms, clearly moved as he was by absolute honesty of purpose, with no desire to exaggerate or overclaim, on the contrary, always counselling caution, his address must have been a revelation to all who could appreciate the argument and its intricacies, and fathom the intensity of thought with which Sir Ernest has carried on his work. The simplicity of the methods used in arriving at results of an altogether transcendental character is most surprising; a more perfect illustration of the truly scientific use of the imagination could not have been given, perhaps never has been given. Had the Association enjoyed this opportunity alone, the visit to Cambridge would have been sufficiently rewarded.

It is worth while to think back to the days when the chemist Crookes was determining the atomic weight of thallium and observed a peculiar behaviour of his balance. This led him to the study of the electric discharge under greatly reduced pressure and at last to his epoch-making observations on the negative discharge. A wondrous structure of discovery has been built upon the foundations thus laid, and in place of the vague, perhaps unscientific, surmises of Crookes, we now have not only clear mass conceptions but are definitely started on the quest into the very structure of the atoms themselves—in no way an idea which is new to us, yet one which we had scarcely thought would be open to practical solution. That simple ballistic methods could play so great a part in chemistry was scarcely to be imagined as possible.

On Wednesday morning, a lecture was delivered by Professor Seward, on "A Summer in Greenland," and in the afternoon, Mr. A. Wood and Mr. F. C. Potts lectured simultaneously, the former on "The Acoustics of Public Buildings"; the latter on "Coral Reefs in the Pacific." In the evening, Sir William Pope gave an illustrated lecture on "Crystalline Liquids."

Thursday was a similarly crowded day. First, Sir J. J. Thomson discoursed on "The Electron in Chemistry." The afternoon simultaneous lectures were by Dr. Hartridge on "Physiological Limits to the Accuracy of Visual Measurements" and by Mr. E. K. Rideal on "Molecular Orientation on Plane Surfaces." At night, Mr. P. E. Priestly lectured on "Antarctic Exploration with Shackleton and Scott," during the course of a conversazione.

Sir William Pope's lecture was delivered with his well known lucidity and illustrated by a wealth of appropriate lantern demonstrations. He not only showed that the term "liquid crystal" is a misnomer but also gave a clear lead to the interpretation of the doubly refracting power of many liquids, suggesting that its origin might be found in the presence of complexes of associated molecules.

Sir J. J. Thomson came forward not as Master of Trinity but as Master Builder—as accoucheur of the Electron, the spermatic origin of which is to be found in Crookes's negative glow. He modestly said nothing of its delivery but much of its upgrowth and of the possible vagaries of its behaviour in association with nuclei of various dimensions. Necessarily, the arguments were highly speculative and they were not unduly controlled by facts. At the outset, the Master had something to say of the difference between chemist and physicist, without making it clear wherein it lay. The question may well be asked, whether there be any real difference. Is not the physicist perhaps the chemical Prodigal Son come home—with much to learn of the happenings since his departure In early days, when physics was taught with understanding and so that it could be understood by persons of moderate intelligence, it was taught as a branch of chemistry by the chemist. *Miller's Chemistry* was in three volumes and the first was devoted to *Chemical Physics*. It is a moot point, whether most so-called physical changes be not all changes involving alterations in molecular character or configuration—the changes in water certainly are; so perhaps are those involved in the production of an electric current by the revolution of a copper disc in a magnetic field. In fact, outside mechanics—which scarcely belongs to physics—and perhaps sound and some parts of light—which may well be regarded as belonging to mechanics—most physical phenomena are interlocked with those of chemical change. The electron is certainly the foundation stone of both physics and chemistry. The physicist would seem to be mainly an incomplete chemist, one afflicted not with water but with mathematics on the brain and possessed of a highly developed mechanical sense. The physicist is only beginning to distinguish atoms from molecules and developing a sense of molecular structure; his knowledge of the conditions which determine chemical change is nil—though in this latter respect, the average chemist is not much ahead of him. It was interesting to hear Sir J. J. Thomson talking of hydrogen and oxygen, as though it were possible to bring about their direct interaction; but doubtless, someday, the discharge of electricity through gases will be studied rationally, with due regard to the chemist's susceptibilities, not thought of as a mere drive of electrons.

Dr. Rideal's lecture was a lucid and comprehensive survey of recent inquiry, excepting that he omitted the section so largely developed by Cambridge workers, Hardy especially, that of lubricants. It was delivered with striking fluency and must have been of great interest to those to whom the subject was new. The tendency to romance was not altogether absent from the latter part of the discourse; but we learn most by going ahead, and the salt of scientific caution is a condiment, the taste for which mostly comes with age.

It is remarkable that problems of structure were dealt with in all four chemical discourses to which the science teachers listened. There is little doubt that the time is come to change Wurtz's well known definition into one of wider import. Chemistry, in all its ramifications, is now the Science of Molecular Structure, not merely a French science.

In addition to the lectures, various laboratories were open to inspection and many special demonstrations were given by leading members of the staff. The value of the visit, the stimulus it will be to teachers, must be very great; and many will have realised, more than they ever did before, what they are called upon to do by way of preparing their pupils to make proper use of the opportunities Cambridge will afford to them.

To spend such days in the University must have been an extraordinary revelation to not a few—the greatness of the school cannot but have impressed them; the evidence of activity and of progress was overwhelming. One grave mistake was made, however: the opportunity was lost, which the meeting afforded, for a discussion, between the University authorities and the teachers, on ways of breaking through the vicious circle within which the two parties have long been helpless wanderers. The University governs the schools, through its scholarship examinations, which are undeniably of a wrong type. Science, thus far, has been a practical failure in the schools, in no small degree because of the influence the examinations have had upon the teaching; on the other hand, as proper foundations cannot be laid under the present system in the schools, the teaching does not advantage the University.

CORRESPONDENCE

PRICES OF GERMAN BOOKS

Sir,—In a recent letter to *Nature* (Dec. 23, p. 845) I drew attention to the scandalous prices of German books. As some members of the Society of Chemical Industry may not have seen this communication, I wish to call attention to it in your columns, as it is only by united action that the perpetrators of this swindle can be suitably dealt with. There has been much comment in this country and in America on this subject, particularly by Prof. Noyes in the *Journal of Engineering and Industrial Chemistry* (1922, 99), and in editorial comments in the same Journal (1922, 475), from which the following is extracted:—"If there be any who still favour former sources for literature let them consider the last edition of Beilstein. There are to be seventeen volumes. To those who subscribed for the set, Volumes I and 2 were sold for $12 for the two. Volume 3 has appeared at $18, and it is understood that Volume 4 will cost about $28. Volume 17 . . . . !!! "

In this connexion, the attached correspondence may be of interest, bearing in mind the following prices, from the *Berichte* of July, 1922, charged to members of the German Chemical Society:—

	Beilstein				Stelzner		
	Bound volumes				Unbound volumes		
	I	II	III	IV	I	II	III
England, shillings..	40	38	102	110 ..	24	38	100
Germany, marks ..	110	110	280	330 ..	70	104	325

The subscriptions show a similar distinction, the charges being 10 marks for Germany, $2 for the United States, and 10s. for England. I wrote as follows to the Treasurer of the German Chemical Society, on October 31, 1922:—" Sir, I notice that members of the German Chemical Society who do not live in Germany are charged a much higher rate for their subscriptions than those who do reside in Germany. I also note that the charges for successive volumes of Beilstein are also much higher, and are steadily increasing. Much dissatisfaction has been expressed at this state of affairs, and I shall be glad, with others, to learn whether it is proposed in the future to maintain such a distinction in the charges made to various members, as I am sure you will agree that, under the present circumstances, it is not worth while for chemists living outside Germany to continue to belong to the German Chemical Society."

The reply, in translation, runs as follows:—" In answer to your letter of October 31, addressed to our Treasurer, the questions put by you have already often been discussed with our foreign members, including your countrymen, and we would refer you to the protocol of the general meeting of last year published in the *Berichte*. The prices of our journals were fixed after thorough discussion; they are not much higher than in 1914; and, in the case of the *Centralblatt*, are actually lower. Reckoned on the number of pages, the prices are much smaller than those of the publications of almost all foreign chemical societies. *The justice of our fixed prices was confirmed a few days ago from Switzerland.* [The italics are mine.] There can be no thought of making German and foreign prices equal so long as we Germans are compelled to spend unnumbered thousands of our depreciated marks to obtain English books. In relation to Beilstein I can assure you that a further rise in price of the volumes which are to appear in future will not occur. Finally, we may remark that many of our members in countries whose currency has depreciated little, appear to see things differently from you, for the number of foreign members is steadily rising. (signed) Dr. Jost."

It is amusing that Dr. Jost refers proudly to the bulk of his journal, which enhances its value so much in German eyes. The diffuseness of German publications is considered, in most countries, to be a disadvantage: recent complaints were about the quality, not quantity. The remark about Germans having to spend many marks to purchase foreign works is typical of Bosch mentality: they need not have printed such a lot of paper money. Was there not an article in the Treaty of Versailles by which Germany undertook not to impose on British subjects any other, or any higher, direct or indirect fees, dues, or taxes than are imposed on German citizens? Under the circumstances I am sure most chemists will agree that, until treaties with our recent enemy are something more than scraps of paper, money spent in subscriptions to the German Chemical Society is not much better expended than in buying their fraudulently depreciated paper marks. It is to be hoped that the English and American Chemical Societies will soon be in a position to publish a Dictionary of Organic Chemistry and other necessary works, at a fixed, reasonable price and in a terse and civilised language,—I am, Sir, etc.,

K. C. Browning.

16, Bridge Avenue Mansions,
Hammersmith, W. 6.
Jan. 1, 1923.

THE EXTRACTION OF GASOLINE FROM NATURAL GAS

Sir,—I wish to draw your attention to a mistake on page 525 r of the issue for December 15, 1922, ninth line from bottom of second column, where "James Young of Clippen, England," should read "William Young of Clippens Oilworks, near Paisley, Scotland.

James Young was known as Paraffin Young, and later became Sir James Young. He was the first to distil shale for mineral oil at Bathgate, Scotland, about 1850, Young's Mineral Oil Co. being formed subsequently.

In 1881, at Clippens Oilworks, a very small quantity of gasoline (there was then very little sale for it) was recovered from the spent gases from the shale retorts. Most of the spent gas was burned under the oil stills and steam boilers, and also through 2-in. vertical pipes to give light to the men charging the retorts, etc. I was engineer and draughtsman there. Mr. William Young was then experimenting with a new vertical retort for continuous distillation of shale. I made the drawings of the retort for the Patent Office, and this retort, later known as Young and Beilby's retort, gave fresh life to the shale-distillation industry. A lot more could be said on the subject, but I think this correction is necessary.—I am, Sir, etc.,

George Valentine, F.C.S.,
Chemical Engineer.

Research Laboratory,
13, Farm Avenue.
Streatham, S.W. 16.
Dec. 28, 1922.

NEWS AND NOTES

FRANCE

Industrial Notes

Metallurgy.—Prices of metallurgical products show a steady upward tendency, largely owing to the proposed rise in the price of coke and the dearth of scrap ferrous metals. Stocks of scrap ferrous metals are very much depleted owing to the growing demand from abroad: during the first ten months of 1922, 791,823 metric tons of scrap was exported, as against 547,645 m.t. during the whole of 1921. To meet this serious situation a decree, dated December 29 last, has been issued prohibiting all such exportation. It appears that in certain cases special export licences will be granted, particularly for consignments to Italy.

Chemical Industry.—Constant fluctuations in the money market make the transaction of business very difficult, owing to the difficulty of establishing cost and selling price with any degree of accuracy or certainty. Under such conditions business becomes a sort of gambling. Noteworthy is the shortage of sodium sulphate, which is very scarce, partly because several glass-factories in Belgium have been started again, and partly because the production of this chemical has suffered of late from the poor market that exists for hydrochloric acid, the by-product of its manufacture. Arsenious acid also is in short supply; deliveries are much delayed, and as the quantity available is small, prices have soared up to extraordinarily high levels. Many works are contemplating starting work again just to profit by the high prices. There is also a keen demand for antimony salts, especially for sodium antimoniate. Wood-distillation products tend to become scarcer every day, acetone being almost unobtainable. Stocks of acetone at consumers' works cover the next eight or ten months, and its price has more than doubled in the course of only a few weeks; consequently prices of acetic acid and the various acetates have increased in proportion. There is also a very good demand for methyl acetate and methyl alcohol; in fact, the methyl-alcohol industry, which about a year ago was seriously depressed, is now very prosperous.

GERMANY

The Health of Lead Workers

From an investigation into the measures for protecting the health of workers in lead-colour factories and of painters in Germany, K. B. Lehman (*Zentralbl. f. Gewerbehyg.*, 1922, **10**, 2) concluded that great care was taken to protect the workers. Approximately 70 to 75 per cent. of the workers displayed no distinct signs of lead-poisoning, although the age of 27 per cent. was 50 years. The cases of sickness and sick days have fallen from 15 per cent. and 3·3 sick days in the period 1912-1914 to 3·6 per cent. and 0·75 days in 1919-1920. This improvement is ascribed to the manufacture of pulp lead instead of lead ground in oil, dust protection, mechanical packers, educating the workers, and other measures due to legislative action, as well as to greater care in the diagnosis of lead poisoning. It is concluded that the dangers to white-lead workers have decreased, but could be still further reduced; and that painters run much less risk than appears from many statistics.—(*J. Ind. Hyg.*, *Nov.*, 1922.)

UNITED STATES

Production of Minerals and Metals in 1921

The United States Geological Survey has issued a preliminary summary of the country's mineral production in 1921. The following statistics show the output of metallic minerals and metals and of mineral products used in chemical industry:—

		1921	1920	Inc. (+) or dec. (—) per cent.
Gold	Fine oz.	2,422,006	2,476,166	— 2
Silver	,,	53,052,441	55,361,573	— 4
Platinum and allied metals	,,	56,370	41,544	+36
Aluminium	Value, dollars	10,906,000	41,375,000	—74
Antimonial lead*	Short tons	10,064	12,535	—20
Antimony	,,	1,589	2,785	—43
Bauxite	Long tons	139,550	521,308	—73
Cadmium	lb.	65,101	129,283	—50
Chromite	Long tons	282	2,502	—89
Copper	,,	225,708	539,733	—58
Iron ore	,,	26,652,528	69,281,341	—62
Iron, pig	,,	16,000,000	35,710,227	—55
Lead, refined	Short tons	398,222	476,849	—16
Manganese ore (35% Mn)	Long tons	13,531	94,420	—86
Manganiferous ore (5-35% Mn)	,,	97,099	767,664	—87
Nickel	Short tons	111	365	—70
Mercury	Flasks (75lb.)	6,339	13,392	—53
Mercury ore	Short tons	35,000	109,000	—68
Titanium ore (rutile)	,,	—	277	—100
Tungsten ore (60% conc.)	,,	—	216	—100
Uranium and vanadium ores	,,	8,540	35,076	—76
Zinc	,,	198,232	450,045	—56
Arsenious oxide	,,	4,786	11,502	—58
Asbestos	,,	831	1,648	—50
Asphalt	,,	920,632	898,993	+ 2
Barytes, crude	,,	66,369	228,113	—71
Borates	,,	50,000	120,320	—58
Bromine	lb.	711,953	1,160,584	—39
Calcium-magnesium chloride	Short tons	23,672	27,849	—15
Cement	Barrels (376 lb.)	95,820,997	97,079,200	— 1
Clay, raw	Short tons	1,716,746	3,116,212	—45
Coal, bituminous	,,	406,925,000	568,666,683	—28
Coal, Pennsyl. anthracite	Long tons	80,779,867	79,998,437	+ 1
Coke	Short tons	25,479,000	51,345,043	—50
Diatomaceous earth, Tripoli	,,	67,474	102,155	—34
Emery	,,	305	2,327	—87
Felspar, crude	,,	102,889	151,817	—32
Fluorspar	,,	34,960	186,778	—81
Fuller's earth	,,	105,609	128,487	—18
Garnet (abrasive)	,,	3,048	5,476	—44
Graphite, amorphous	,,	1,842	4,694	—61
Graphite, crystalline	,,	595	4,816	—88
Grindstones, pulpstones	,,	26,340	53,484	—51
Gypsum	,,	3,050,984	3,129,142	— 2
Lime	,,	2,531,000	3,570,141	—29
Magnesite, crude	,,	47,904	303,767	—84
Mica, scrap	,,	2,577	5,723	—55
Mica, sheet	,,	371	842	—56
Pigments, lead and zinc	,,	102,463	143,244	—28
Natural gas	1000 cb.ft.	807,670,000	798,210,000	+ 1
Natural-gas gasoline	Galls.	473,658,500	384,743,922	+23
Oilstones, etc.	Short tons	831	1,144	—27
Peat	,,	30,406	73,204	—58
Petroleum	Barrels (42 galls.)	469,639,000	442,929,000	+ 6
Phosphate rock	Long tons	2,064,025	4,103,982	—50
Potash (K_2O)	Short tons	4,408	41,444	—89
Pumice	,,	37,108	41,838	—11
Pyrites	Long tons	157,118	310,777	—49
Salt	Short tons	4,981,154	6,840,029	—27
Sand, glass	,,	1,256,000	2,165,926	—42
Sand, other, and gravel	,,	75,093,000	79,875,462	— 6
Sand-lime brick	1000	—	169,761	—
Silica (quartz)	Short tons	11,252	68,190	—73
Slate	Value, dollars	7,322,006	8,726,442	—16
Stone	Short tons	62,400,000	78,527,000	—21
Sulphur	Long tons	954,344	1,517,625	—37
Sulphuric acid†	Short tons	—	1,229,508	—
Talc and soapstone	,,	126,434	210,635	—40
Total value	dollars	4,056,000,000	6,951,410,000	—42

* From domestic and foreign ore. † Acid of 60 Bé. from copper and zinc smelters, including 23,728 t. of stronger acid, not converted to 60 Bé.

Statistics of the production of crude ores of copper, lead, copper-lead, gold and silver, zinc, etc. in 1921 are not yet available.

GENERAL

Honour to Senator Paternò

As Prof. Paternò will attain his 75th year in May, a committee of the Italian Association for Pure and Applied Chemistry has been formed under the presidency of Prince Ginori Conti to celebrate the occasion. In order to place on record the esteem in which Prof. Paternò is held both at home and abroad, the Committee has decided to raise a fund for the purpose of providing a "Paternò Medal," to be awarded annually, without distinction of nationality, to the author of the most important discovery in the field of chemistry. Subscriptions should be sent to Prof. D. Marotta, Associazione Italiana di Chimica Generale ed Applicata, Via Tre Novembre, 154, Rome, 1.

Industrial League and Council

This organisation, which has the object of improving the relations between employers and employed, has arranged for the following lectures on industrial topics to be given in Caxton Hall, Westminster, S.W. 1, on Wednesday evenings from January 17 to March 28, at 7.30:—Jan. 17, "A Talk about Economics": Sir E. J. P. Benn; Jan. 24, "Education as a Function of Management": H. H. Elvin; Jan. 31, "Industrial Liberty": Sir A. R. Holbrook; Feb. 7, "Some Obligations of Industry to Labour": F. O. Roberts; Feb. 14, "Home and International Labour": Sir L. Macassey; Feb. 21, "Economics of War and Peace": W. A. Appleton; Feb. 28, "Fundamental Causes of Unemployment": H. G. Williams; Mar. 7, "Control of Industry": A. Dalgleish; Mar. 14, "Functions of Works Committees": J. Murray; Mar. 21, "The Fallacy of Low Wages": T. E. Naylor; Mar. 28, "The Function of Capital": E. J. Garmeson. Admission to the meetings is free, and all those interested in these industrial subjects are invited to attend. Information on the work and objects of the League can be obtained from the General Secretary, 82, Victoria Street, London, S.W. 1.

German Research Institute for Fibre Chemistry

The dedication ceremony of the Kaiser Wilhelm Institut für Faserchemie at Dahlem, Berlin, was held on December 5. The textile industry, which forms such an important part of the national resources, has hitherto been but poorly represented as a co-ordinated unit in Germany's system of technical education, the branches of spinning and weaving being divided up between mechanical institutions and the departments of dyeing and finishing between chemical institutions. At the new research institute it is proposed to unite all the branches into an organised system for the study of the fundamental scientific problems of the inter-related fibre industries. The new building has been erected in close proximity to the parent Kaiser Wilhelm Institute. Preliminary activity extending over three years has already borne important fruit in the establishment of new methods of research, in particular the epoch-making discovery, by means of the Röntgen rays, of the crystal-like arrangement of all organised natural structures. Scientific treatment of the technology of all industries has its foundation in numerical standards and these will be established in intimate relations from the fibre to the yarn and from the yarn to the fabric, beginning with systematic researches on the industrial manipulation of the wool fibre.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for January 4)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina ..	Drugs, etc.	6920/F.L./C.C.
British India ..	Dry paint (tender for)	*
Canada.. ..	Drugs, soap	†
,, ...	Sodium sulphate	10174/E.D./C.C.
France	Gum arabic, gum lac	10
Mexico ..	Chemicals	25
New Zealand ..	Porcelain insulators	10267/E.D./E.C.
Serbia	Drugs (tender for)..	9733/F.E./C.C.
South Africa ..	Varnish, paint, iron and steel ..	3
,, ..	Industrial raw materials	4
Spain	Tinplate, soldering tin	16
,, ...	Fertilisers	17
United States ..	Tiles..	17824/F.W./M.C.

* Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E. 1.

† Canadian Trade Commissioner, 73, Basinghall Street, E.C. 2.

TARIFF CUSTOMS EXCISE

Australia.—In the issue for January 4, the attention of exporters is drawn to the protection of preference granted to goods from the United Kingdom.

Austria.—Increased customs duties are payable on beet and cane sugar, invert sugar, starch, grape, milk and other sugars, mineral, lignite and schist oils, vaseline, lubricating greases, perfumery, etc.

France and Algeria.—The duties have been increased on certain chemicals, tin, iron, and various paper products, and decreased on ferromanganese, ferrosilicon, plate glass, dextrin, magnesium chloride and sulphate, lead acetate, potassium and sodium chromates and bichromates, etc.

Germany.—New rates of monopoly tax have been applied to imported spirits, alcoholic products, ether and products containing ether.

Hungary—Latvia.—A commercial treaty has been concluded between these two countries.

Madagascar.—An import duty has been applied to ammonium sulphate.

Mexico.—Various fibres are affected by recent modifications of the import tariff.

Nyasaland.—Under the revised tariff the rate of import duty on cement, motor fuels, lubricating oils, and iron has been reduced to 15 per cent. *ad valorem*; drugs of the British Pharmacopœia imported by persons licensed to sell drugs and poisons, and printing inks have been added to the list of free goods; and the export duty on beeswax has been abolished.

South Africa.—Regulations have been issued prohibiting the importation, exportation, sales, etc. of specified habit-forming drugs or raw materials from which they can be extracted, except by authorised persons and under licence.

LEGAL INTELLIGENCE

ALLEGED DETERIORATION OF A DISINFECTANT IN THE TROPICS. *F. A. Langley* v. *The Milton Manufacturing Co., Ltd.*

In the High Court on December 18, Mr. F. A. Langley, trading as Langley, London, claimed damages against the Milton Manufacturing Co., Ltd., for alleged breach of an agreement under which the plaintiff undertook to market the defendant company's disinfectant "Milton" in South America, as well as damages for breach of warranty as to the quality of the disinfectant supplied.

Under the agreement, the defendant company undertook to sell "Milton" to the plaintiff at a minimum export price f.o.b., London, less 5 per cent., and commission for sale in Chile, Bolivia, Ecuador and Peru. Plaintiff sent an agent over to S. America to prepare the market for the goods, but the defendant company supplied goods that were not of the quality, strength, or description represented, and wholly worthless. The "Milton" was so weak that it would not remove ink stains on paper or fabrics; it failed to dissolve a piece of sponge; and, in fact, it was more than 40 times weaker than "Milton" of normal strength. In consequence, the goods could not be sold, and the plaintiff had not only lost profit but also money spent on advertising, freight, insurance, warehousing, etc. "Milton" was usually sold in brown bottles, but that shipped to plaintiff was in green bottles, and in hot countries the strong light had a deteriorating and disintegrating effect upon liquids such as "Milton." The defendant company wrote regretting that the disinfectant had been put in green bottles, as that might have had an adverse effect, and they offered to replace the whole of the shipments at their own cost.

Mr. R. H. Grimwood, analytical chemist, said he had analysed samples of "Milton" in green and in brown bottles. That in green bottles had no effect upon ink stains, whereas that from brown bottles removed it at once; the former also failed to dissolve sponge, but the latter dissolved it in less than 48 hours. Chlorine was the active ingredient in "Milton," and when he analysed the samples he found that those in green bottles contained only 0·012 per cent. of chlorine, whereas those in the brown bottles contained 1·08 per cent. He did not consider that the hot climate of South America would affect the disinfectant; and the question of actinic quality of the glass was not very relevant.

For the defendant company it was claimed that there was no warranty of any kind. The contract was f.o.b., London, and the disinfectant was perfectly good when shipped, so that what happened to it afterwards was of no importance. The company had sold over £20,000 worth of "Milton" in green bottles without a complaint, and none had been returned during the six years they had sold it.

In giving judgment, Mr. Justice Branson said that the plaintiff was suing the defendant company for breach of agreement, by virtue of which he was appointed for three years as its distributing agent in South America. He accepted Mr. Langley's account of what took place, and it followed there was a warranty that the goods were fit for importation in the countries in question. This warranty had been broken, and he therefore gave judgment for the plaintiff for £1630, and granted a stay of execution on the usual terms.

REVIEWS

The Petroleum and Allied Industries. *By* James Kewley. *Industrial Chemistry Series, edited by Dr. S. Rideal. Pp.* 302. *London : Ballière, Tindall and Cox,* 1922. *Price* 12*s.* 6*d. net.*

The large oil companies have for some time past appreciated the advantages which their non-technical staffs would derive from some general knowledge of oil production, oil products and their uses, and this led in the first place to the organisation of special lectures, and to the development of systematic instruction in petroleum technology elsewhere. Mr. Kewley has taken an active part in both, and in the preface to this volume he states that the book is primarily intended for non-technical employees of the companies among whom " there exists a very commendable desire to know something of the great industry with which they are associated, a desire which is shared by many others whose connexion with the industry is indirect." Certainly Mr. Kewley's book admirably fulfils such a purpose. It is not a technical treatise ; it is not a " popular " handbook, but a very judicious blend of the two, in which no phase of the subject escapes treatment, although necessarily restrictions of space have precluded in some instances more than a brief reference. Any inadequacy in this respect is largely overcome by references to original papers, or to other published works.

Mr. Kewley has divided his matter into nine parts, with several sections to each :—I.—Introductory (Terminology, History, Chemistry, Geology, and Theories of Origin) ; II.—Natural Gas : III.—Crude Petroleum ; IV.—Oils from Shale, Coal, Lignites, etc. ; V.—Natural Bitumens, etc. ; VI.—Mineral Waxes ; VII.—The Working-up of Crude Oils ; VIII.—The Characters and Applications of Petroleum Products ; IX.—Testing. It is impossible to consider in any detail these various parts, but certainly the sections on Natural Asphalts and Bitumens, and their applications for road-making, &c., are to be commended in view of the great development of the arterial road systems of the country and the rapidly extending use of these materials for road construction. The part on testing is covered by some eleven pages and detailed instructions are not attempted. References to the most suitable tests and useful comments on their value make it, however, quite sufficiently detailed for all except the analyst.

Here and there unforgivable errors have escaped correction in the proof ; thus in a table of fuel consumptions minimum " compression " per I.H.P. hour is given in lb. and pints ! Again, in dealing with coal-tar oils in Diesel engines, it is stated that as their ignition temperature is *lower*, pilot-jet ignition with petroleum oil is usual.

J. S. S. Brame.

MARKET REPORT

This Market Report is compiled from special information received by the Society from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acetic Acid 40% tech. has advanced in price to an average of £20 per ton owing to the increased cost of acetate of lime. This was inevitable and the surprising feature is that it did not take place earlier. Imported parcels are in short supply but still continue to be offered.

There is not much demand for **Nitric Acid**, and the price ranges from £25 to £27 for 80° Tw.

Sulphuric Acid 94% arsenical remains unaltered at £6 10s. per ton.

Sulphate of Alumina has recently been imported in large quantities and foreign competition is very keen. The demand for **Ammonia Alkali** is quite up to the average and the position is firm. Makers have reduced contract prices for 1923 delivery by 5s. per ton.

White Arsenic continues to be very scarce at £65-£70 per ton.

A slight improvement is reported in the market for **Bleaching Powder.** Manufacturers' prices for contracts over the whole of 1923 have been reduced to £10 10s. per ton.

Calcium Chloride at £6 per ton carriage paid is meeting with keen competition from German imports at low prices. There is not much change to report in the position of **Salt Cake**, except in respect of export inquiry which, as usual at this period of the year, shows a falling off. The price is firm at £4 10s. per ton. The manufacturers have made a substantial reduction in the price of **Caustic Soda** for contracts over the whole of 1923, but the tone of the market just now is none too cheerful. **Soda Crystals** are valued at £5 10s. per ton carriage paid, **Sodium Bicarbonate** at £10 10s. per ton, and **Salammoniac** at £32 per ton, and **Sodium Acetate 97—98%** at £23 per ton. **Sodium Chlorate** is a very unsatisfactory market and is being imported at about 2½d. per lb. **Sodium Sulphide** prices show a downward tendency and home manufacturers are evidently making an effort to meet the very keen foreign competition. **Bisulphite of Lime** £7 per ton packages extra and returnable.

Sodium Bisulphite Powder 60—62% varies from £19 to £20 10s. per ton, according to quantity f.o.b. or f.o.r. London, 1 cwt. drums included.

Sodium Sulphite pea crystals £17 to £17 10s. per ton, 1 cwt. wooden kegs included. **Potassium Bichromate** 6¼d. per lb. d/d.

Sodium Nitrite £30 per ton 100% basis delivered.

WOOD DISTILLATION PRODUCTS

The demand for Wood Distillation products has very considerably improved and there is a ready market for most products, particularly Miscible Wood Naphtha which at the present time is exceptionally scarce owing to non-arrival of shipments from America. Consequently, the price is again up to an artificial level which will undoubtedly come back as soon as imports again arrive, and these are expected in the near future. There is also a large demand for Grey Acetate of Lime and inquiries are arriving regularly from the Continent. Manufacturers' prices are as follows :—

Acetate of Lime brown	£8 per ton delivered
Acetate of Lime Grey 80%	£14 10s. per ton d/d.
Acetate of Lime liquor	9d. per gallon 32° Tw. delivered.
Charcoal	£9 10s. to £10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
,, ,,	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14—15° Tw
Wood Creosote	2s. 6d. ,, ,, Unrefined
Wood Naphtha, Miscible	7s. ,, ,, 60% O.P.
Wood Naphtha, Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£4 10s. per ton d/d.
Brown Sugar of Lead	£36 per ton.

TAR PRODUCTS

Amongst the products in this section **Acid Carbolic Crude 60's** is in good demand at the higher price of 2s. 5d.-2s. 6d. per gallon. **Acid Cresylic 97—99** varies from 2s. 1d. to 2s. 5d. per gallon, while **Acid Cresylic Pale 95%** is somewhat cheaper at 2s. to 2s. 2d., and **Acid Cresylic Dark** varies from 1s. 9d. to 2s. per gallon, with only a small demand. **Anthracene Oil, strained,** 8¼d. to 10d. per gallon, while **Anthracene Oil, unstrained,** can be bought for 7½d. per gallon. **Benzole, crude 65's** 1s. to 1s. 0½d. per gallon. **Benzole, Standard Motor,** 1s. 8d. to 1s. 9d. per gallon, **Benzole, Pure,** 2s. to 2s. 6d. per gallon, according to quality and district.

Toluole 90%, 1s. 10d. per gallon. **Toluole Pure,** 2s. to 2s. 6d. **Xylol,** 3s. **Creosote, Cresylic, 20—24%,** 10d. to 10½d. **Creosote, Middle Oil,** 7½d., **Creosote, Heavy,** 7½d., **Creosote, Standard Specification,** 6¾d. to 8¼d. per gallon, according to district. This market is very firm. **Naphtha, crude** 10d. **Naphtha, Solvent, 90—160,** 1s. 7½d. to 1s. 9d.

Naphtha Solvent, 90—190, 1s. 7d. **Naphthalene, Crude,** drained creosote salts is in good demand, but prices vary considerably from £5 to £7 in different districts. **Naphthalene Crude** Whizzed or Hot Pressed varies from £7 to £15 per ton according to quality and district. **Naphthalene Crystals,** £16 per ton, **Naphthalene, Flaked,** £14 10s. per ton, **Pitch, Medium Soft** again very firm at 120s. to 132s. 6d., according to district. **Pyridine, 90—140,** very firm at 10s. to 12s. 6d. per gallon, **Pyridine, Heavy,** 8s. 6d. to 9s. 6d. per gallon.

INTERMEDIATES AND DYES

The New Year has opened well for business in Dye-stuffs and orders are coming in very freely. Prices of the leading intermediates are as follows, carriage paid and packages included unless otherwise stated :—

Acid H.	5s. 3d. per lb. 100% basis.
Acid Naphthionic	2s. 8d. lb. 100% basis.
Acid Neville & Winther	6s. lb. 100% basis.
Acid Sulphanilic	1s. 6d. lb. 100% basis.
Aniline Oil	11½d. drums extra.
Aniline Salts	11½d. per lb.
Benzidine Base	6s. 6d. 100% basis.
Dinitrobenzene	1s. 3d. lb.
Diphenylamine	4s. 1d. lb.
α-Naphthol	2s. 9d. lb.
β-Naphthol	1s. 2d. lb.
α-Naphthylamine	1s. 7d. lb.
β-Naphthylamine	4s. 6d. lb.
p-Nitraniline	3s. lb.
Nitrobenzene	8d. lb., drums extra.
Nitronaphthalene	1s. lb.
Naphthionate Soda	2s. 8½d. lb. 100% basis.
Diethylaniline	4s. 6d. lb., packages extra returnable.
Metanitraniline	5s. 6d. lb.
Para Toluidine	5s. lb.
Para Phenylene Diamine	12s. lb. 100%
Meta Phenylene Diamine	5s. 6d. lb.
Meta Toluylene Diamine	5s. lb.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market has been temporarily quiet during the stocktaking and holiday period, but a renewed demand is expected in the near future. Prices generally tend to be harder owing largely to the advancing prices of German products. Current quotations are as follows:—

Acid Acetic 80%	£43 per ton.
Acid Acetyl Salicylic	3s. lb. for best makes. Higher prices are expected in the future.
Acid Benzoic	2s. lb. on a steady market
Acid Citric	1s. 8½d.-1s. 9d. less 5% market firm.
Acid Salicylic	1s. 4d. lb.
Acid Tannic	3s. 3d. lb.
Acid Tartaric	1s. 2½d. to 1s. 3d., market firm and fair demand.
Amidol	9s. per lb.
Acetanilide	1s. 4d. lb. stationary.
Amidopyrin	14s. lb.
Barbitone	12s. 6d. lb.
Benzaldehyde free from Chlorine	3s. 3d.
Chloral Hydrate	4s. lb.
Hexamine	3s. 3d. lb. for good free crystals. Market very firm.
Homatropine Hydrobromide	30s. per oz.
Menthol	40s. 6d. less 2½% original cases. Smaller quantities 41s. 6d. per lb. net.
Methyl Salicylate	2s. lb. in steady demand.
Paraldehyde	1s. 6d. to 1s. 9d. per lb.
Phenacetin	5s. lb. firmer.
Phenolphthalein	5s. 3d. lb. with little available on the spot.
Potassium Bitartrate, 99—100% (Cream of Tartar)	100s. to 103s., less 2½% per cwt. Market firm with good demand and prices well maintained.
Potassium Permanganate	8d. to 8½d. lb., with more inquiry.
Sodium Benzoate	2s. lb. for good make.
Sodium Hyposulphite, Photographic	£15 to £17 per ton according to quantity, delivery buyer's station.
Sodium Potassium Tartrate (Rochelle Salt)	85s. per cwt. net.
Sodium Salicylate	1s. 11d. lb. for powder unchanged.
,,	2s. 1d. lb. for crystal.
Sodium Sulphite, anhydrous	£27 10s. to £28 10s. per ton according to quantity, f.o.r. London, drums included.
Sulphonal	13s. 6d. lb., present value on a weak market.

Thymol	17s. to 19s. lb. according to quality.
Atropine Sulphate	12s. 6d. oz. is the present value, but higher prices are anticipated in the near future.
Pilocarpine Nitrate	22s. 6d. oz.

PERFUMERY CHEMICALS

There are very few changes to record this week among Perfumery Chemicals, business in which has been rather quiet. Current prices are as follows:—

Amyl Acetate	2s. 3d.
Amyl Butyrate	8s.
Amyl Salicylate	3s. 3d.
Anethol, melting point 21—22° C.	4s. 6d.
Benzyl Acetate from chlorine-free Benzyl Alcohol	3s. 3d.
Benzyl Alcohol free from chlorine	3s. 3d.
Benzaldehyde free from chlorine	3s. 3d.
Benzyl Benzoate 19·5° C.	3s. 3d.
Cinnamic Aldehyde, 98—100% Natural	14s. 9d.
Citronellol	22s. 6d.
Citral, 100%	10s. 6d.
Ethyl Phthalate	4s. 6d.
Eugenol, 100%	10s. 6d.
Geraniol (from Palmarosa)	32s. 6d.
Geraniol	5s. 6d. to 12s. 6d.
Iso Eugenol	16s.
Linalol ex Bois de Rose	21s.
Linalyl Acetate	22s. 6d.
Methyl Benzoate	8s. 6d.
Phenyl Ethyl Acetate	10s.
Phenyl Ethyl Alcohol	17s. 6d.
Rhodinol	52s. 6d.
Terpineol	2s. 10½d.
Vanillin, 100%	23s. 6d.

ESSENTIAL OILS

Among Essential Oils, **Bourbon Geranium, Clove** and **Japanese Peppermint** are all lower in price this week, while **Cananga Oil** is dearer at 9s. and **Citronella** continues its firm tendency.

Anise Oil, Red Ship Brand	2s. 1½d.
Bourbon Geranium Oil	23s. for shipment.
Cananga Oil, Java	9s. firm.
Cinnamon Oil, Leaf	4¼d. per oz.
Cassia Oil, 80—85%	8s. 7½d.
Citronella Oil, Java, 85—90%	3s. 6d.
Citronella Oil, Ceylon	2s. 6d.
Clove Oil, English, 90—92%	7s. 9d.
Eucalyptus Oil, 70—75%	1s. 10d.
Lavender Oil, Mont Blanc 38—40%	14s. 6d.
Lemon Oil, spot	2s. 10d., new crop for shipment, 2s. 7d.
Orange Oil, sweet spot	9s. 6d., new crop for shipment 8s. 3d.
Otto of Rose Oil, Anatolian	24s.
Otto of Rose Oil, Bulgarian	28s.
Peppermint Oil—	
English Mitcham	80s.
Wayne County	13s. 6d.
Japanese	7s. 6d.

TRADE NOTES

Papua in 1920-21

The annual report of the Lieut.-Governor of Papua states that the year 1920-21 was a difficult one, as prices of copra, rubber and copper fell below the cost of production. The total value of the exports decreased by nearly £100,000 to £172,672, shipments of rubber falling by 22 to 220 tons and of copra by 1096 t. to 2984 t.; other exports were: gold 5984 oz.; osmiridium 208 oz.; copper ore 255 t. The output of gold depends on the development of the Misima mine as the mining of alluvial gold has practically ceased. Shipments of copper will increase greatly if the Laloki mine proves successful. Imports rose in value by £62,000 to £484,770, largely owing, not to industrial activity, but to Government purchases.—*Ind.-Austr., Nov.* 16, 1922.)

Chemicals at the British Empire Exhibition, 1924

Arrangements have now been completed for organising the Chemicals Section of the British Empire Exhibition. The section will be on a very large scale, 25,000 sq. ft. of space having been alloted to it, and the organisation has been entrusted to a Committee of the Association of British Chemical Manufacturers, assisted by representatives of the Society of Chemical Industry and allied bodies. There is every indication that the exhibits will be fully worthy of the importance of the chemical industry. In fact, it may be said that this section stands next to the engineering, electrical, and transport sections of the Exhibition in its demand for space. A large number of the big manufacturing firms of the Kingdom have already applied. Part of the Section will probably be devoted to perfumery; and suggestions have also been received from firms desiring to show the whole process of soap making by modern machinery, with soaps of all descriptions, dentrifice and other toilet preparations. The secretary of the Section is Mr. W. J. U. Woolcock, of 166, Piccadilly.

PUBLICATIONS RECEIVED

The Life of Lord Moulton. *By* H. Fletcher Moulton. *Preface by Lord Birkenhead. Pp: xv.+287. London: Nisbet and Co., Ltd. Price* 15*s*.

Kolloidchemie der Gegenwart. *Reprint from the Kolloid-Zeitschrift. Vol. XXXI. Part* 5. *Pp.* 225—328. *Dresden and Leipzig: Theodor Steinkopff*, 1922. *Price* 2*s*.

Scientific Reports of the Agricultural Research Institute, Pusa, 1921–22. *Pp.* 96. *Calcutta: Superintendent, Government Printing, India*, 1922. *Price As*.14.

First Annual Report of the Director of the Commonwealth of Australia Institute of Science and Industry. *Pp.* 55. *Melbourne: A. J. Mullett*, 1922.

Memorandum to the Retrenchment Committee on Indian Public Expenditure. *Prepared by* Prof. K. T. Shah, *and submitted by the Central Labour Board, Bombay. Pp.* 75.

JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

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EDITORIAL

SIR ARCHIBALD GEIKIE a few years ago described the disintegrating effect of frost and rain on the surface of the earth and how the valleys are being continually cut deeper and deeper by these agencies. The process is slow but perceptible, and he explained that he himself found the hills he climbed in Scotland both steeper and higher than he did five-and-twenty years previously. The phenomenon is apparent in many other branches of knowledge. The small type, in which our Transactions, our Reports of Sectional Meetings, and our News from other Societies, have appeared for some years, is gradually becoming less distinct, the fine edges are occasionally blurred and it is less easy to read than it was formerly. We are therefore proposing to substitute a slightly larger type for all these, and we hope that our readers will approve of the change. Sometimes the older readers amongst us become the more conservative and the less inclined to endure a change from that appearance to which they are accustomed, but we trust that these also will acquiesce in the new departure even if they do not really approve of it.

* * *

The Society of Chemical Industry is more than a society for the diffusion of useful knowledge; it is a powerful stimulus to chemists all over the world to realise themselves, and help others to realise, how varied and how important are the points which Chemistry and Industry have in common. The Society aims at doing even more; it makes an honest endeavour to act as a bond between all those countries whose civilisation is so advanced that the chemist is regarded as an essential member of the community. It cannot be doubted that the Society has done much to promote a cordial feeling between French and British chemists, and it is a source of special pride to us that we maintain steady lines of communication with our kinsmen across the seas. We ought, indeed, to be grateful to the Canadian, American and Australian Sections who form so considerable a proportion of our members. One form our gratitude will take will be a readiness to accept news from them, another will be a zeal to supply them with an account of what excites interest in chemical circles in various parts of Europe. We are ambitious to acquire these items of information, to pick up from all quarters the newest ideas and discoveries, confirm the tidings as they roll and spread the truth from pole to pole. The correspondence we print between our President and our Ex-President has a special significance for us. Our recent Annual Meeting in Canada, and the recent visit of our Canadian President to us in Great Britain have enlightened us; some of us may have in a couple of years' time an exceptional opportunity of visiting our chemical friends in America, and we are quite sure that between now and then several of them will visit us. After all it is almost true to say that it is chemistry—and what chemistry can do—that stands as a barrier between us and a relapse into chaos and barbarism. Our duty is plain, and we English-speaking chemists must shoulder a large part of the burden.

* * *

Was it not Lord Rosebery who defined the two occasions when men make speeches, the first when they have something to say, the second when they have to say something? The same statement may be made of writing. We could—if professional etiquette did not forbid—mention several men of note, any one of whom may, at short notice, in virtue's cause once more exert his rage, his satire point and animate our page. The pursuit of knowledge and the *cacoethes scribendi* are Mendelian traits liable to appear in unsuspected individuals, and in general once they appear they continue so long as the organism has any unsatisfied energy. It seems to us that the desire for research is an extreme form of the desire to solve a puzzle, inherent in so many of us. Probably three-quarters of the population lose this desire in early youth, of the remainder, some love to pursue to the earliest period the intricacies of their pedigree and derive keen satisfaction from the discovery of the marriage certificate of some great-uncle in whom they have no interest; but this discovery fills a place in the jig-saw puzzle, and they are satisfied. The man with this desire for pursuit will take up an inquiry into solutions and go on, thinking only of the difficulties which appear, and how they can be made to fit in with the jarring pieces; finally he sees how these difficulties affect the study of valency and substitution and gives us a result such as the one we print this week. The suggestions are full of promise, but those who think as we do are not much concerned whether Prof. Lowry's views are correct or not: what is of supreme importance is that he shall continue his interest in such problems and continue to explore "nature for principle or cause, keenly with all the cunning pleasure and instinct of a hunter." In this way, and in this way only, is knowledge increased.

* * *

Since the Gas Regulation Act of 1920 came into force, the services rendered by the gas industry to the public have been the subject of much discussion. Complaints about the application of the admittedly logical system, introduced under the Act, of charging for gas by its thermal value instead of by volume have been many, and the Board of Trade has been induced to refer the matter for inquiry to a Committee, now in session. In addition, the decision of a previous Board of Trade Committee not to recommend any limitation of the proportion of carbon monoxide allowable in gas has been strongly criticised, in view of the danger due to the presence of this colourless, odourless and extremely poisonous constituent. Professor W. A. Bone, writing in *The Times* of January 12, points to the heavy death-roll due to gas-poisoning during the past year as "a sufficient comment upon the folly of that decision," and urges that the question should be re-examined by a Committee composed of disinterested and scientifically competent persons. The same question has also been faced in the United States, but apparently without reference to a committee, for the U.S. Chemical Warfare Service has, it is reported, obtained encouraging results in experiments on the admixture of "sneezing" gas with illuminating gas as a means of detecting an escape of the latter, the sternutatory ingredient being destroyed when the gas is burned. In this country, however, such technical matters have to be considered by committees which are so constituted that distinguished men of science have to plead for the appointment of at least some members with a scientific training. Yet there is no lack of able chemists in this country. The moral is obviously that Chemistry and its practitioners have not yet attained importance in the public eye and that the lesson "unity is strength" has still to be learned if chemists are to be consulted on questions in which their science as well as the public welfare are so vitally concerned.

THE CANADIAN SECTIONS OF THE SOCIETY OF CHEMICAL INDUSTRY

The following letter was recently sent by the President to the Chairman and Executive Committee of the Canadian Sections:—

Gentlemen,—I conceive it to be one of the main duties of the President during his period of office to visit as many as possible of the Sections of the Society, both for the purpose of interchanging ideas and realising local conditions and of ventilating, more or less publicly, some of the aims, difficulties, and achievements of the chemist. Unfortunately, distance—both in space and time—will prevent me from visiting the very active Sections in Canada, and I am therefore constrained to send this letter as a message of good will, testifying to the great interest which the Council at home has in the progress of Chemistry in the Dominion.

The real aim of the Society is the encouragement of the progress of Chemistry in Industry, and, believing as we must that chemical science is the foundation of all industry, of every manufacturing process and of every-day life, we feel sure that the trained chemist must play an ever-increasing part in the development of the natural resources, and indeed of civilisation itself, in your country.

Untrammelled to a large extent by the traditions, restrictions and mistakes of the past which play so large a part in the daily life in the old country, you have a unique opportunity to win for the chemist an all-prominent position and influence in the development of the Canadian nation. To achieve this, the chemist must so shape his activities as to be regarded above all as a shrewd counsellor and a constructive adventurer, in addition to his more generally understood *rôle* as an analyst and guardian of the public services.

Important as is the dual position of Chemistry as the detective and policeman among the Sciences, it is far more necessary that to-day, in what is perforce a utilitarian world, it should establish its real position as *the* constructive Science affording the foundation of theory and experiment on which engineering and physical science can achieve their conquests of nature.

If these objects are to be attained the chemist must be a man of broad and practical outlook, enthused with the noblest ideals and with a wide knowledge of his subject. We must aim at the highest standard of professional etiquette within our ranks and avoid the prostitution of our status by the unqualified. Above all, we must realise to the full the advantages of co-operation, believing that it is only by a united effort that the profession of Chemistry can attain to the goal of its desires.

If the ideals indicated in the foregoing are high they are all the more worthy of achievement, and we feel that our Society has done—

and can continue to do—the pioneer work towards their attainment.

The temptation to form a purely Canadian organisation must be often before you, but you will allow us to urge that the willing help without the interference, and the mature experience of the larger body at home is far too great a weapon in your armoury to be lightly abandoned.

During the last eighteen months the Society has had the advantage both of paying an official visit to Canada and of having as its President Dr. Ruttan, an eminent Canadian, who adds great personal charm to his shrewd character as a man of affairs. We feel, in consequence, that we know you more intimately than at any previous time, and that the link between us to-day is based on personal attachment as well as on loyalty to the Motherland. To-day, when it falls to the lot of the Anglo-Saxon nations to bring order out of the world's chaos and start civilisation once more in the path of peace, the opportunity for the individual chemist and for our Society is a great one and we must prove ourselves worthy of it.

I desire to assure you that the Council takes a very real and deep interest in the welfare of the Society in Canada, and that it appreciates very highly the efforts that you and our members in the Dominion have made to consolidate the work of the Sections and to develop their potentialities.

I need hardly say that we shall, at all times, be glad to render you such support as we can in your valuable endeavours. With very kind regards.—Yours sincerely,

E. F. Armstrong,
President.

The following reply was received :—

My dear Armstrong,—I received your letter conveying a greeting to the different Sections of the Society of Chemical Industry in Canada. I have had this letter manifolded and a copy sent to the Secretary of each Section to be read at the first meeting. I had the pleasure of reading your letter to the Montreal Section yesterday, which was the day on which it arrived.

I must congratulate you on the success which has attended your efforts to improve the Journal, and I also congratulate the Society on having a President who is able and willing to give so much time and attention to his duties.

I hope it is not impossible that you should make a flying visit to America. We should all be very much delighted to see you in Montreal. With kind regards, I am,

Sincerely yours,
R. F. Ruttan,
Chairman of Executive.

THE UNIQUENESS OF HYDROGEN

By PROF. T. M. LOWRY, F.R.S.

MORE than one author has recently expended his energies and tested the patience of his readers by discussing the question as to whether hydrogen should be regarded as a lower homologue of the univalent alkali metals or of the univalent halogens. This problem, which may be compared with the still older problem of whether liquid hydrogen would prove to be a metal or a paraffin, was of some interest 50 years ago, when the simple theory of octaves dominated the periodic classification of the elements. It is, however, curious that it should still survive at a time when the existence of periods of 2, 8, 18 and 32 elements has been so clearly established. In these circumstances the columns of Mendeleef's table have become a purely conventional framework, by means of which it is possible to economise space, and to diminish the effort of memory, as compared with a table in which the 32 elements of the longest series are set out on one horizontal line. This conventional form of the periodic table appears, however, to hold a remarkably firm place in the mentality of chemists in view of the fact that problems such as the one suggested above are still considered worthy of consideration.

A much clearer view of the relationship between hydrogen and the other univalent elements is obtained by means of the electronic theory of valency as enunciated by Lewis. To Lewis belongs the merit of providing for the first time a clear picture (together with a plausible explanation) of two distinct types of chemical affinity, the existence of which had been recognised in a confused way during a period of not much less than a century. Throughout this period inorganic chemists, following Berzelius, had postulated the existence of a polar type of chemical affinity, whereby *unlike* elements were held together by polar forces which were probably electrical in character. Organic chemists, on the other hand, in view of the remarkable experiments of Dumas on the substitution of "electro-negative" chlorine for "electro-positive" hydrogen, had postulated a non-polar type of affinity, whereby carbon could be linked indifferently either to hydrogen or to chlorine. The natural corollary to this facile substitution was that *like* elements could be linked together, *e.g.*, hydrogen to hydrogen, or chlorine to chlorine, by a non-polar valency passing symmetrically between two identically similar atoms of the same element. Chemists were, however, very slow to admit that chemical affinity could be of two types; and whilst the majority of organic chemists followed Kekulé in representing *all* the bonds between the atoms as non-polar, there were others such as Fry* who assumed that *all* the valencies were of the polar type suggested by Thomson and Ramsay, namely, a Faraday tube of force passing from a positive charge in one atom to a negative charge in another.

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* "The Electronic Conception of Valency."

According to the octet theory of Lewis, the elements owe their valency to the powerful but mysterious force which urges them to build up groups of 2, 8, 18 or 32 electrons. This force, which may be merely the effect of a second term in the inverse square law of electrostatic attraction, is evidently identical with what has been described during many generations as "chemical affinity," since it is this which determines chemical combination between atoms. The building up of the stable groups of electrons, which in the case of the elements from carbon to calcium are usually octets, can be done in two principal ways (i.) *by transferring electrons from one atom to another*, *e.g.*, from an atom which holds too many electrons to one which holds too few; or (ii.) *by sharing electrons between adjacent atoms*, so that two atoms which are both deficient in electrons may achieve a condition of completeness which neither could reach alone. In the former case the completion of the groups leaves the atoms oppositely charged, but held together by electrostatic forces, giving rise to a typical polar valency, which Langmuir distinguishes as electrovalence. In the latter case, since electrons may be shared by two identical atoms, the valency may be completely symmetrical and non-polar: this type of valency Langmuir distinguishes as covalence. This sharp distinction between two types of valency receives support from crystallographic data, since it appears that the distance between two atoms is less when they are held by covalency than when held by electrovalency.

In the majority of cases these two types of valency can be distinguished quite sharply, as in the typical cases of $\overset{+}{\mathrm{Na}}\,\overset{-}{\mathrm{Cl}}$ and Cl–Cl. In the case of the halogens, a question may indeed arise as to whether the dissociation of the molecule (*e.g.*, of chlorine in forming $\mathrm{Cl{\cdot}CH_2{\cdot}CH_2{\cdot}Cl}$ from $\mathrm{C_2H_4}$ and $\mathrm{Cl_2}$) takes place symmetrically, giving rise to two neutral atoms each carrying a septet of electrons as in (i) below, or into one atom carrying a complete octet (and therefore negatively charged) and a second carrying only a sextet of electrons (and therefore positively charged) as shown in (ii) below, where the symbols in heavy type represent the kernels of the atoms, *i.e.*, the atom minus its valency electrons.

(i) $:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}: \rightleftarrows :\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}\cdot + \cdot\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}:$ or $\mathrm{Cl_2} \rightleftarrows \mathrm{Cl} + \mathrm{Cl}$

(ii) $:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}: \rightleftarrows :\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}: + \ \overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}:$ or $\mathrm{Cl_2} \rightleftarrows \overset{-}{\mathrm{Cl}} + \overset{+}{\mathrm{Cl}}$.

But, until the division of the molecule actually takes place, there is no reason why the symmetry of the molecule should not persist, and with it the completely non-polar character of the bond between the atoms. It is, however, just here that the uniqueness of hydrogen becomes apparent, since the two types of valency cannot in this element be distinguished in this simple and easy way. Thus, in the case of hydrogen chloride, the electronic formula of the molecule is $:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}:\mathbf{H}:$ the electronic formula of the ionised acid is $:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Cl}}}:+\mathbf{H}$, where the hydrogen ion may be regarded provisionally as a mere naked nucleus—a single proton carrying no electron either in the nucleus or outside. When the hydrogen ion is remote from the chlorine ion the forces between them are evidently electrostatic, and polar in character, and the affinity between them is clearly due to electrovalency. But when the two atoms are close together, they may be regarded as sharing a pair of electrons and therefore united by a covalency. How can these two states be distinguished, and when does one pass into the other? This problem did not arise in other cases, since any other element attached to chlorine would either carry sufficient electrons to make two octets and so develop an electrovalency, or would not carry a sufficient number, and therefore be reduced to sharing electrons and thus give rise to a covalency. The unique behaviour of hydrogen is due to the fact that a stable configuration can be obtained either with no electrons, as in the hydrogen ion, or with two electrons, as in the hydrogen molecule **H:H**. In the case of chlorine the removal of two electrons has the effect of converting the octet—not into another stable configuration—but into a highly unsaturated sextet.

I am indebted to Sir William Bragg for a suggestion that appears to provide the necessary test for distinguishing between hydrogen nuclei acting as ions and hydrogen nuclei acting like organic radicals. He suggests that the difference depends on the directional (or anisotropic) character of covalency as contrasted with the approximately uniform distribution (or isotropy) of the field of force round an ion. A test case is that of water. The molecule of monohydrol is $\mathbf{H}:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{O}}}:\mathbf{H}$; but the type of valency by which the atoms are held together is not immediately clear. Bragg suggests that if we were really dealing with ions of hydrogen and ions of oxygen held together by electrostatic forces,

$$\mathbf{H}+:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{O}}}:+\mathbf{H},\ \text{or}\ \overset{+}{\mathbf{H}}+\overset{--}{\mathrm{O}}+\overset{+}{\mathbf{H}},$$

the immediate result would be that the crystals would assume a cubic symmetry, in which the ions would be arranged in precisely the same way as in

fluorspar, $\overset{-}{\mathrm{F}}+\overset{++}{\mathrm{Ca}}+\overset{-}{\mathrm{F}}$, or in
silver sulphide $\overset{+}{\mathrm{Ag}}+\overset{--}{\mathrm{S}}+\overset{+}{\mathrm{Ag}}$.

In all crystals of this type the ions, although relatively bulky, are closely-packed, whereas the structure of ice is of an open cage-like type into which many more atoms could be packed if they were free to slide about on one another like smooth spheres. In this respect ice agrees with diamond, and still more closely with the crystals of organic compounds, where the density is even less and the structure even more open than in the diamond. This low density and open structure are only rendered possible by the fact that the forces of covalency are limited to certain directions round the atom, along which (and not elsewhere) combination with other atoms must take place. The open structure of ice is therefore clear evidence that the hydrogen atoms are linked to oxygen by covalency, and this conclusion is in harmony with the very low conductivity of pure water as compared with fused salt.

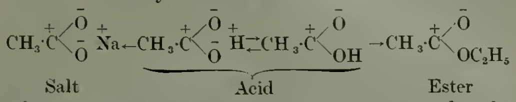
From the point of view of the octet theory, Bragg's distinction between the two types of union of hydrogen with other atoms may be expressed by saying that in the case of a hydrogen ion the free nucleus can attach itself to any one of the 12 edges of the cube, if that is the real form of the octet, or to any one of the 4 corners of the tetrahedron, if the 8 electrons of the octet are disposed as four symmetrically-arranged duplets; but in the case of a hydrogen radical the nucleus is specifically attached to one duplet only of the four which make up the octet. Mobility, and freedom to wander from bond to bond on an atom or molecule, are therefore the distinguishing features of an ion as contrasted with a radical; but in the case of hydrogen these may be developed gradually, as a result of the progressive change of one type of valency into the other.

The unique character of hydrogen is seen most clearly in the wide contrast which exists between the acids and all other classes of compounds, except perhaps the bases, which may be regarded provisionally as mere neutralisers of acids. In the case of a chlorine molecule the non-polar character of the bond is probably retained until dissociation actually takes place, when it may (or may not) dissociate with ions; if it does, the type of valency alters quite abruptly on dissociation. On the other hand, in the case of common salt, the neutral molecules are probably only pairs of ions held together by electrostatic attraction and the force between them is an electrovalency both before and after ionisation. But in the case of hydrogen there may be a progressive weakening of the hold of the molecule on the nucleus, which will convert the compound quite gradually from a neutral substance to a weak and then to a strong acid, as a larger and larger proportion of hydrogen atoms becomes mobile, as in the series

$$CH_3{\cdot}CH_3 \rightarrow CH_3{\cdot}CH_2{\cdot}OH \rightarrow CH_3{\cdot}CO{\cdot}OH \rightarrow CCl_3{\cdot}CO{\cdot}OH.$$

We therefore have weak acids and strong acids, as well as strong and weak bases, but not strong and weak salts where the bonds are always electrovalencies, nor strong and weak methyl derivatives where the bonds are always covalencies.

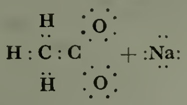
In the case of the carboxylic acids, Hantzsch has carried the idea of mobility so far as to assume that the acid can exist in a form in which the hydrogen ion is attracted equally by *both* oxygen atoms, as in the formula $CH_3{\cdot}C\left\langle\begin{matrix}O\\O\end{matrix}\right\}H$. Hantzsch's theory may be expressed in terms of the electronic theory of valency as follows :—



In the salt, the sodium ion is supposed to be equally attached to both oxygen atoms, but in the esters the alkyl radical is attached specifically to one. In the acid itself Hantzsch postulates the existence of both types, a true acid from which the salts are derived, and a pseudo-acid from which the esters are derived; but it is by no means clear that these could not also be regarded as the ionised and un-ionised forms of the acid. The absence of the ketonic property of unsaturation in fatty acids is easily understood if unsaturation is identified with electrical polarity, since in the ionised acid and its ionised salts the maximum of unsaturation is between the two ions, but gives rise only to an interchange of radicals, *e.g.*, between $CH_3{\cdot}CO{\cdot}\overset{-}{O}\overset{+}{H}$ and $\overset{+}{H}\overset{-}{C}N$ instead of to addition-compounds as in the interaction of hydrogen cyanide with acetone

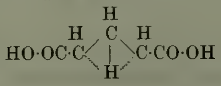
$$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\overset{+}{C}-\overset{-}{O} + \overset{+}{H}\overset{-}{C}N \rightarrow \begin{matrix}CH_3\\CH_3\end{matrix}\!\!>C<\!\!\begin{matrix}OH\\CN\end{matrix}$$

In the formulæ set out above, the carbon atom which is shown as positively charged is assumed to carry a sextet, the complete electronic formula of sodium acetate being

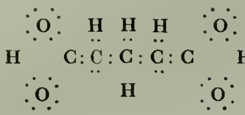


In this formula the total number of electrons will be found to be correct if two K-electrons (in addition to the L-electrons shown in the formula) are assigned to the kernel of each carbon and oxygen atom.

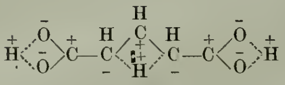
A similar formula may be given to glutaconic acid which Thorpe writes as

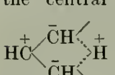
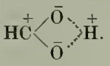
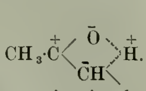
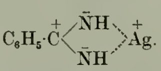


The corresponding electronic formula for this acid is



or



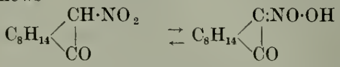
where again the kernel of each positively-charged carbon atom is surrounded by a sextet instead of an octet. In this formula the two acidic hydrogen atoms are shown as occupying a symmetrical position between the two negatively-charged oxygen atoms of the carboxyl-group, to which they are attracted by electrostatic forces—the "partial valencies" of Thiele. The third mobile hydrogen, to which glutaconic acid owes its special properties is, however, seen to occupy a precisely similar position between two negatively charged –CH– groups, so that there is a complete analogy between the central group of the glutaconic acids  and the carboxyl-group of formic acid . Ethyl acetoacetate contains the intermediate grouping . A similar group may perhaps exist in the amidines, *e.g.*, .

It is a remarkable fact that strong acidity is apparently developed only in mixtures and never in pure compounds. Even hydrogen chloride only becomes an acid when mixed with water. This can be explained by the extreme reluctance of a hydrogen nucleus to lead an isolated existence, although it is quite willing to attach itself to any octet that is not too unfriendly, or too fully occupied by other atoms to leave room for an additional nucleus. The effect of mixing hydrogen chloride with water is probably to provide an acceptor for the hydrogen nucleus so that the ionisation of the acid only involves the transfer of a proton from one octet to another.

$$:\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:H + H:\underset{\cdot\cdot}{\overset{\cdot\cdot}{O}}:H \rightleftarrows :\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}: + H:\underset{\cdot\cdot}{\overset{\overset{H}{\cdot\cdot}}{O}}:H$$

$$\text{or} \quad Cl\,H + H_2O \rightleftarrows \overset{-}{Cl} + \overset{+}{O}H_3$$

The ionised acid is then really an ionised oxonium salt. In very much the same way nitrocamphor and the two isomeric forms of ethyl acetoacetate, which in the presence of a trace of alkali undergo isomeric change as follows



$$CH_3{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}OC_2H_5 \rightleftarrows CH_3{\cdot}C(OH):CH{\cdot}CO{\cdot}OC_2H_5$$

are stable compounds when carefully purified. The mobile hydrogen atom acquires mobility only in the presence of a base, or other suitable catalyst, and unless this is present isomeric change does not take place.

It is commonly suggested that the alkalis or bases are as unique as the acids, and that the hydroxyl ion occupies just as peculiar a position as the hydrogen ion. This, however, is a narrow view, based on the fact that most of our chemical work is done in presence of water, if not actually in aqueous solutions. The real function of a base is that of an acceptor of hydrogen nuclei, and one of the simplest cases of neutralisation is the acceptance of a hydrogen ion by a molecule of ammonia, $NH_3+\overset{+}{H}\rightleftarrows\overset{+}{N}H_4$. If the base is sufficiently strong it may not merely accept the free hydrogen nuclei which have been driven away from the molecules of an acid, but it may even steal them from compounds in which they are only weakly held, *e.g.*, from water, as in the action $NH_3+HOH\rightleftarrows\overset{+}{N}H_4+\overset{-}{O}H$. In this case the strength of the base is manifested by the liberation of hydroxyl ions, and can be measured by the proportion of these ions set free by each equivalent of the base. The hydroxyl ion is itself a strong base, since it is capable of accepting and retaining a very large proportion of the equivalent quantity of hydrogen ions. The combination of hydrogen with hydroxyl is, however, almost confined to aqueous solutions, whereas neutralisation by acceptance of a hydrogen nucleus may occur in any solvent in which hydrogen nuclei can be produced. In the same way the most powerful catalyst for the isomeric change of nitro-camphor is not a hydroxide, but a nitrogenous base, such as piperidine dissolved in benzene. This appears to set up isomeric change by providing an acceptor for the hydrogen nucleus, which can thus acquire a mobility which enables it to leave the nitro-camphor and return to a different position in the molecule.

SUMMARY

1. It is suggested that hydrogen is unique amongst the elements in that it is sometimes difficult to determine whether the bond by which it is attached to another atom is a covalency or an electrovalency.

2. In the case of crystals, a clear distinction can be made in view of the fact that ions held

together by electrovalency give rise to close-packed crystals, whilst molecules held together by covalencies give rise to open structures of low density. Ice consists, therefore, of molecules and not of ions.

3. The essential difference between a hydrogen ion and a hydrogen radical is that the former possesses mobility, whilst the latter is attached not merely to a particular atom but to a particular region in the structure of the atom, *e.g.*, by sharing one particular pair of electrons. This mobility can, however, be developed gradually, *e.g.*, on passing from a very weak to a very strong acid.

4. The mobile hydrogen atom of glutaconic acid bears the same relationship to two negatively-charged –CH– groups as the acidic hydrogen of a carboxylic acid bears to the two negatively-charged oxygen atoms of the carboxyl group. In ethyl acetoacetate the mobile hydrogen wanders between one negatively-charged oxgyen atom and one negatively-charged –CH– group.

5. A base is best described as an acceptor of hydrogen nuclei. Even in the case of strong acids the addition of water, acting as an acceptor, is needed in order to develop acidity. A basic acceptor is also needed to promote the migration of a hydrogen nucleus in nitrocamphor and in the two forms of ethyl acetoacetate.

LEGISLATIVE AND DEPARTMENTAL INTERFERENCE WITH INDUSTRY AND THE COMMON WEAL

(*Continued*)

By PROF. H. E. ARMSTRONG, F.R.S.

Mr. Klein and I brought the subject up to date in a communication to the Royal Society of Arts in July, 1921. We have there given an historical account and specially drawn attention to a new danger to industry, arising from the creation of an International Labour Office at Geneva and the holding of International Labour Conferences under regulations laid down in the Versailles Treaty of Peace.

Our first paper had reference to proceedings before one of the two Home Office Departmental Committees, appointed in 1911, to inquire into the dangers supposed to be attendant on the use of lead compounds in paints. The reports of these Committees were published separately in 1915 and 1920. Both agreed in practically prohibiting the use of lead paints. The Committees were not expert bodies—as we have said elsewhere, " not a single member was versed in the use of scientific method." Their verdict was a foregone conclusion and probably that they were appointed to give. It should be mentioned also that no mere humanitarian considerations have been in operation throughout the struggle : Belgian and French interests in the Zinc White Trade have also played an important part. Such is life.

The matter came before the first International Labour Conference, held at Washington, U.S.A., in November, 1919. It was recommended that " the prohibition of the use of White Lead in painting should be placed upon the Agenda of the next Conference."

In preparation for the Conference at Geneva, last year, the International Labour Office, at Geneva, prepared and issued not long in advance of the meeting, a Red Book which has the distinction of being probably the most inaccurate, biased and unfair statement ever made in preparation for the discussion of a serious subject. If the decisions of International Conferences are ever to have binding force, there must be an honest endeavour to arrive at truth. So strong was the expression of opinion, that the Director thought himself impelled to come forward in palliation of the work of his subordinate : instead of regretting the issue of such a document, he defended it and even claimed that it was the duty of the Office to take sides. We know, therefore, what to expect from Geneva and from such Conferences.

Our English attitude towards the matter has been altogether astounding. Immediately before the Geneva Conference, the Home Secretary appointed a new (third) Committee, now sitting, to examine reports, which his Office had received, throwing doubt on the conclusions of the two Committees appointed in 1911. I may anticipate, and say, that the hope Mr. Klein and I expressed in our Society of Arts paper, " that persons competent to understand the technical issues would be appointed," has been fulfilled—but at what cost of protest ?

What had really happened was, that the Office of Works—which, under pressure from the Home Office, had abandoned the use of White Lead Paint—had mutinied and returned to lead. Unknown to themselves, two distinguished architects had made a delightful comparative experiment with Buckingham Palace. The Office of Works had painted the section in their charge with leadless paint ; Sir Aston Webb had used genuine White Lead on his part. The leadless paint flaked off, whilst White Lead stuck hard.

Although this was known, the two British Government delegates to the Conference were instructed to take no part in the Lead debate—perhaps this was not a disadvantage, as neither had knowledge nor feeling on the subject. Strange to say, however, Great Britain accepted a place on the Committee, a Scientific Advisor on the subject to our Government delegates was appointed to serve on it ; he did not influence the Committee beyond enumerating certain statistics ; but he again sat in the general Conference, and his impassioned appeal, made towards the close of the discussion, decided the vote given : so that, in effect, the English Government delegates actually led the way—though charged to abstain.

The issue was one of the first importance to Australia and Canada, as the interests of probably 70,000 persons in S. Australia, connected with the Broken Hill Mines, were most seriously at stake. Every vote was known to be of consequence, yet the urgent appeals made to the Home Government for their aid met with no response, and in the end, through English action, the vote taken was against the interests of the Dominions. "A Committee had been appointed to deal with the matter," was always the answer. No such Committee should have been appointed, when the Conference was pending. If we are to study the best interests of our Empire, it will not do to manage or mismanage things in this way; in future some concerted policy should be arrived at, in advance, between the several units.

I was present at all meetings and Conferences, during a month, in the capacity of Scientific Advisor to the Australian Employers delegate. Having travelled from Perth to Port Darwin, almost the whole way round the great island continent, I had feeling on the issue as affecting Australia, apart from my intimate practical acquaintance with the subject.

I gave my opinion of the Conference, soon after my return, in articles in the *Westminster Gazette* and *Morning Post*. I have never had a more interesting opportunity of studying human nature and its vagaries.

The Committee, at first, was a bear-garden, without leadership, without policy, composed of three disparate sections, representative of (1) Government (2) Employers (3) Labour, eight of each. Labour loudly proclaimed itself to be against the employer. Yet one of the British Labour delegates proved to be an exceptionally broad-minded, reasonable and reasoning man; another came forward in the Conference and was eloquent in counselling rational consideration of all matters under discussion. There was no reciprocal feeling of antagonism on the employers' side—on the contrary, every desire to discuss issues from all possible points of view and in the interests of labour. Like Governments, their representatives sat on the fence—especially in open Conference—but tended to come down on the side of sentiment. The advisors present could speak only when spoken to—by request from the chair.

At the end of the eight sitting I lost all patience and mutinied, and thus obtained leave to speak in Committee. I tabled the following motions:—

Inasmuch as no proof is given that a generally effective substitute for white lead in painting has been found;

Inasmuch as the diagnosis of the diseases incident to the painter's occupation is in a state of uncertainty and it is in no way established that the cases of poisoning by lead are exceptionally numerous;

Inasmuch as it is generally admitted that the chief source of risk to painters is dust and there is reason to believe that the production of dust will be overcome by a process of wet rubbing down, such a process having been devised and effectively used;

This Commission is of opinion that it is neither necessary in the interests of the painter for the protection of his health, nor desirable in the interests, either of users or of producers, to conclude an international convention for the prohibition of white lead in painting.

This Commission further considers that the risks incidental to the painter's occupation will be entirely overcome by the acceptance of a convention with the following objects in view:—

(*a*) The prevention of diseases arising from
    (1) Paint dust of all forms;
    (2) Vapour arising from volatile materials;
    (3) Uncleanliness.
(*b*) Medical examination.
(*c*) Notification and certification of all cases of lead poisoning.
(*d*) Distribution of information on the question of the special hygiene of the painting trade.

These represented the feeling in the minds of all the sane people present, who were possessed of the facts and prepared to deal with the issue in a reasonable manner. Ultimately, they were embodied in the majority report, which was carried, however, only by a small vote, no English Government vote being given and all the labour members abstaining. Consequently, in the Conference, the issue presented was contentious; but the report was only "not carried" by a single vote, in Conference—no English Government vote was cast.

The discussion in full Conference occupied nearly four sittings and was of a most discursive character, quite unsuited to the settlement of so important an issue. Gross exaggeration as to the evils of white lead was indulged in by some speakers, and sentiment was the ruling force. It was made clear, that the dust produced in dry rubbing down was the real source of danger. The medical evidence was hopelessly involved, the Germans especially showing themselves to be extraordinary conservative and behind the times; their resentment of non-professional criticism was amusing.

Several amendments, recommending either the total prohibition of the use of white lead or its restriction to external use were proposed and put to the vote; it was clear that even the latter could not be carried, and there was the possibility that nothing would be done and that the conflict would have to go on. At this stage, Dr. Legge made his appeal, advocating the adoption of an amendment prohibiting the use of white lead in internal painting, foreshadowing that this would put an end to the struggle. The compromise was agreed to, on the spur of the moment, without counting the cost to the public and forgetting that the United States of America, the largest producer and user of white lead, was not represented and had not been consulted. The published verbatim report of the Conference contains a full account of the proceedings other than those of the Committee, but the "atmosphere" in which we lived is unpainted.

(*to be continued.*)

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

OUR NEW PAPER has now received its first baptism of criticism and on the whole I do not think its promoters can feel other than gratified at its reception. It certainly is the staple subject of conversation when chemists meet, and this is all to the good. It has created fresh interest in the Society and its doings and no Society can hope to live unless from time to time some new stimulus is given to its activities. I have yet to hear anything in the nature of serious criticism. Some of my friends who might have been expected to view the change with some degree of scepticism are among the first to insist that such a change must not be judged hastily and that the new editor and his staff must be given time to adjust themselves to the new conditions.

THE THERM ENQUIRY drew me for an hour or so the other morning. I wanted to see the Committee described last week by Professor Armstrong as the "men who have no knowledge of the subject they are to consider." Be that as it may, advantageous or otherwise, they seem to have a "nose" for mendacity, and the evidence placed before the Committee is sifted with some care. Judging by what I heard I should be inclined to think that the balance of opinion will give a certificate in favour of the method of charging for gas by the amount of heat units which it contains. This was the question which I thought the Committee had to determine, but various subsidiary questions seem to be raised by many of the witnesses, and perhaps the Committee will have something to say about the price of the therm, which is really what the gas consumers want discussed.

INDUSTRIAL ALCOHOL

I never hear the question of the freer use of industrial alcohol being discussed without thinking of the great pioneer work done by the late Thomas Tyrer. It seems that at last after many years something may be done notwithstanding the added difficulty of the enormously high duty which has to be collected from spirits. Such a duty makes the relaxation of customs restrictions very difficult. On the other hand, the handicap imposed on chemical industry in this country has been so heavy that our continental rivals must have rejoiced in our shortsighted policy. What is really wanted is some alteration in the unduly restrictive regulations which are enforced in the most rigid manner. There are directions in which I think, subject to suitable financial safeguards, these might be relaxed. In the first it should be possible to allow a manufacturer a little more latitude when a new process just past the small experimental stage is being tried out on the works scale. In the second there should be a wider choice of denaturants in order that the cost of production may be kept down. To insist upon the use of a particular denaturant when it necessitates two additional processes in the course of manufacture of a chemical may be typically British, but it is not business.

THE MEETING AT STOREY'S GATE last week in which the London Section joined with the Biochemical Society pleased me immensely. We were not told very much which was new but the personality of the speakers and the intensely interesting nature of the subject held my interest to the end. I picked out two points, as journalists do, which I thought I would watch in future. One was introduced by Dr. Gowland Hopkins and referred to the possibility of "educating" the tiny bacteria to produce what was wanted. Perhaps "educating" is not the best word, because the Professor went on to explain that he got what he wanted by selecting the individuals in a colony which could best carry out his work. The other was mentioned by Professor Harden, who seems to be an economist as well as a biologist. He advocated an investigation into the use of dead organisms in order to avoid the need of food for the live organism and to reduce the complications due to growth. We must remember these two points.

THE BRITISH EMPIRE EXHIBITION which is not to be held until next year, is already being talked about in chemical circles, and I am wondering whether we shall rise to the height of our opportunity. The business side of the Exhibition is sure to be well done, you can trust the Association of British Chemical Manufacturers for that. But what about the science on which the industry is founded and without which the industry could not exist? Will the progress of the science be illustrated as well as the progress of the industry? Will the scientific societies combine in such a way as to make this possible? I hope so, indeed; and it seems to me that the best way to bring this about would be for our own Society to make a beginning by suggesting how the thing can be done. Every society could contribute something to the pot, and would do so, I think, if once a start were made.

[The Society of Chemical Industry has already appointed a Committee to consider this matter, as reported in the account of the Council Meeting appearing in this week's issue.—Editor, C. & I.]

FORTHCOMING EVENTS

Jan. 22. INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, Victoria Embankment, W.C. 2, at 7 p.m. "Insulators and Insulating Materials." Discussion opened by Mr. A. G. Warren.

Jan. 23. SOCIETY OF CHEMICAL INDUSTRY, *Birmingham and Midland Section*, the University Buildings, Edmund Street, Birmingham, at 7 p.m. "Some Aspects of the Fuel Problem," by Dr. C. H. Lander, F.I.C. "The Thermal Efficiencies of Manufacture of Different Grades of Gas," by Dr. A. Parker, F.I.C.

Jan. 23. THE ROYAL INSTITUTION OF GREAT BRITAIN, 21, Albemarle Street, W. 1, at 3 p.m. "Colloid Chemistry," by Prof. F. G. Donnan.

Jan. 24. ROYAL SOCIETY OF ARTS, 18, John Street, Adelphi, W.C. 2, at 8 p.m. "The New Methods of Crystal Analysis, and their Bearing on Pure and Applied Science," by Sir William Henry Bragg, K.B.E., D.Sc. The "Trueman Wood" Lecture.

Jan. 25. SOCIETY OF DYERS AND COLOURISTS, *London Section*, Dyers' Hall, Dowgate Hill, E.C. 4, at 7 p.m. "The Application of Colours to Leather," by T. E. Bradbury.

Jan. 26. ROYAL INSTITUTION, Albemarle Street, W., at 9 p.m. "The Machinery of Anti-Bacterial Defence," by Sir Almroth Wright, K.B.E.

Jan. 31. UNIVERSITY OF LONDON, University College, Gower Street, W.C. 1, at 5 p.m. "Radioactivity and X-Rays," by Professor Sir William Bragg, K.B.E., F.R.S.

Jan. 31. ROYAL SOCIETY OF ARTS, 18, John Street, W.C. 2, at 8 p.m. "The Relation Between Chemical and Antiseptic Action in the Coal-Tar Dyes," by Thomas H. Fairbrother, M.Sc., F.I.C., and Arnold Renshaw, M.D., D.P.H.

Feb. 1. SOCIETY OF CHEMICAL INDUSTRY, *Bristol Section*, Chemical Dept., The University, Woodland Road, Bristol, at 7.30 p.m. "The Necessity for a Change in the Milk Standard," by Edward Russell.

Feb. 1. SILVANUS THOMPSON MEMORIAL LECTURE, Technical College, Leonard Street, E.C. 2, at 7.30 p.m. "The Basis of Wireless Communication," by Sir Oliver Lodge, F.R.S. To be followed by a Conversazione and Reunion of Old Students.

Feb. 1. THE ROYAL INSTITUTION OF GREAT BRITAIN, 21, Albemarle Street, W. 1, at 3 p.m. "Photo-synthesis of Plant Products," by Prof. I. M. Heilbron.

Feb. 2. THE ROYAL INSTITUTION OF GREAT BRITAIN, 21, Albemarle Street, W. 1, at 9 p.m. "Fact and Phantasy in Industrial Science," by Mr. C. F. Cross, F.R.S.

Feb. 2. SOCIETY OF CHEMICAL INDUSTRY, *Manchester Section*, Textile Institute, 16, St. Mary's Parsonage, Manchester, at 7 p.m. "A New Process for the Manufacture of Sodium Thiosulphate," by Luke Hargreaves, Esq., and Dr. A. C. Dunningham. "Considerations Relating to the Choice of Materials for Stone Dusting of Mines, with special reference to Carbonate of Lime," by A. C. Dunningham, D.Sc. "Some Developments in Gas Producers," by T. Roland Wollaston, M.I.M.E.

SOCIETY OF CHEMICAL INDUSTRY

MEETING OF COUNCIL

The monthly meeting of the Council was held on January 12, 1923, under the chairmanship of the President, Dr. E. F. Armstrong, F.R.S.

The President reported that the section of the British Empire Exhibition (1924) allocated to the various chemical industries was to be organised and managed by the Association of British Chemical Manufacturers, which had set up an advisory committee to deal with these matters and also with scientific educational propaganda relating to the industries. It was agreed to appoint a sub-committee consisting of Dr. Levinstein (chairman), Messrs. Baker, Carr, Evans, and Hinchley to receive and consider suggestions from any members of the Council, and to submit to the advisory committee a scheme for organising such propaganda.

The Council heartily supported a proposal to hold joint meetings of the Local Sections of the Society and the Faraday Society.

The President was appointed representative of the Society on the General Council of Honour of the International Air Congress to be held in London in June, 1923.

The reports of the Hon. Treasurer and of various Committees of the Council, and other routine matters, were submitted and discussed. Forty new members (25 home and 15 overseas) were elected.

Owing to the difficulty experienced by many members in paying their subscriptions, through unemployment and stagnation in industry, the Council last year approved a scheme whereby members who had been unable to pay their subscriptions for 1921 are allowed to resume their membership at any time before the end of 1923 without payment of arrears of subscription or a second entrance fee. This scheme is now extended to include those who have been unable to pay their subscriptions for 1922.

It was intimated that an award of the Society's Medal will be made this year, and the matter will be discussed at the next Meeting of Council, which will be held on Friday, February 9.

The Council also considered a recommendation from the Publications Committee that the Transactions in future be printed in the large type which is already used for articles in this section of the *Journal*. After consideration of the extra expense involved and other matters it was agreed that the recommendation be adopted and the Editor was desired to make this change so soon as the Transactions already set up had been published.

NEWS FROM THE SECTIONS

OTTAWA SECTION

Mr. F. J. Hambly presided over the meeting held in the University Club on December 15 and read a letter from the President, Dr. E. F. Armstrong, which was much appreciated by those present. After discussing the question of obtaining publicity, the hon. secretary and Mr. Gilmore were appointed a committee to report on the possibility of co-operating with the local Press. The chairman invited the associate members to take up full membership, and urged that every effort should be made to increase the membership of the Society. Dr. Macintyre gave an outline of the decision to publish the Society's *Journal* weekly instead of fortnightly.

An address on "Indicators" was given by Prof. Waddell, who showed that acid indicators change colour at a hydrogen-ion concentration above 7 and basic indicators at a concentration below 7. The meaning of hydrogen-ion concentration was discussed and illustrative experiments performed. The speaker stated that, although the evidence was not conclusive, in some way the hydroxyl-ion acts when the hydrogen-ion concentration is above 7 and the H-ion when it is below 7.

Mr. C. H. Robertson showed apparatus used for determining hydrogen-ion concentration at the Farm Laboratory, described methods used in connexion with soils, milk, canned goods, etc., and suggested that a determination of the hydrogen-ion concentration of soils would give a more correct indication of the soil reaction and that there seemed to be a definite connexion between the hydrogen-ion concentration of flour and its baking value.

BRISTOL SECTION

The meeting held on December 7 was the first of the Joint Meetings under the scheme for co-operation with the Chemical Society. Prof. F. E. Francis presided over a good attendance and three papers were read.

Prof. Francis described the work on the composition of paraffin wax which is being carried out under his direction, and stated that investigation of the speed of oxidation had given curious results.

In a paper on "Bee Wine," Mr. J. H. Skelton, B.Sc., said it had long been known that certain types of wild yeast, such as those constituting the "wine beer" or "ginger-beer" plant, would produce alcohol from saccharine solutions. Careful examination of samples of the alcoholic liquor produced in this way showed that, contrary to the general opinion, it contained neither fusel oil nor methyl alcohol, the chief products present being alcohol, acetic acid, water, acetaldehyde, and acetone (traces). On keeping, the "wine" was liable to ferment, the alcohol content increasing under certain conditions to 17 per cent., or nearly double the average content. The organisms causing the fermentation consisted mainly of the spherical *Saccharomyces*, known in industry as the "bottom" yeast of wine, and the rod-shaped *B. aceti*.

In conclusion Prof. J. W. McBain gave an account of current chemical research at Bristol University.

MEETINGS OF OTHER SOCIETIES

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held on January 11, Sir Max Muspratt, Bart., in the chair. A letter was read from Dr. Charles Carpenter, the first chairman of the Association, intimating his desire to retire from the Council owing to pressure of other duties. The letter was received with the greatest regret, and the chairman informed the Council that he only acquiesced after ascertaining that Dr. Carpenter could not reconsider his decision. The Council placed on record the great debt of gratitude which the Association owed to Dr. Carpenter for the valuable work which he did in connexion with the formation of the Association and elected him an honorary vice-president for life. Dr. Clayton, M.P., was elected to fill the vacancy caused by Dr. Carpenter's retirement. Various routine matters were disposed of and the Anchor Chemical Co., Ltd., was admitted to membership.

A report from the general manager on the progress made in organising the chemical section of the British Empire Exhibition (1924), stated that over 20,000 sq. feet of space had already been earmarked for 44 firms and that the Society of Chemical Industry was taking a leading part in promoting a scientific portion of the section. Reports on the Dyestuffs Act and the Safeguarding of Industries Act were presented, the perennial question of alcohol for use in industry was discussed, and the use of tar on roads also received attention. In view of the inadequacy of the statistics available of the chemicals imported into this country the general manager was given instructions to endeavour to bring about an improvement. Transport matters were discussed and the Society's new venture, *Chemistry and Industry*, received attention.

ROYAL SOCIETY OF ARTS

At the meeting held on January 17, Dr. T. M. Legge presiding, Mr. C. A. Klein read a paper on "Hygienic Methods of Painting: the Damp Rubbing-down Process."

Dust is known to be the main source of lead poisoning in industrial work, and of the different operations carried out by the painter that of dry rubbing-down is the most productive of dust. A large number of determinations has been made of the quantity of dust in the air breathed by a painter engaged in rubbing surfaces covered with white-lead paint. These determinations were made in London, Manchester and Brimsdown during ordinary painting work and showed that the quantity of dust produced in the rubbing or subsequent dusting of the surface is dependent on a large number of factors, amongst which may be mentioned age of film, condition of surface, finish of paint, *i.e.*, whether flat or glossy, and in addition, variation in the personal factor of different painters. The variation in quantity of dust observed in no way affects the main issue, for it was shown that dry rubbing-down and all the operations connected therewith are dangerous, *i.e.*, give rise to dust in the vicinity of the worker's mouth, containing more than 2 mg. of lead per 10 cb. m. (the safety limit), and it is clear that the proposed prohibition of the process is entirely justified. Microscopic examination of paint dusts show the presence of appreciable quantities of ground abrasive in addition to the dust of the paint film, both being present in particles of varied size. It is suggested that in view of the high silica content of the dust of abrasive particles, particularly when flint is used, such particles as are less than 12μ may enter the lung and prove a contributory agent in causing the high incidence of respiratory diseases from which the painter is known to suffer.

Investigations were described leading to the development of a damp process for rubbing-down all painted surfaces, the process suggested being to sponge the surface with water, followed by rubbing with a waterproof sandpaper; the powdered paint dust is then removed by means of a wetted sponge and the surface allowed to dry prior to painting. The limited quantity of water used has proved to be an efficient dust preventative, and it also avoids the objectionable features of the old established wet process of rubbing-down in which large quantities of water were used, under conditions not suitable for general paint work. The process has been developed in consultation with master and operative painters and is regarded by them as wholly practicable for all classes of work. The waterproof sandpaper recommended is entirely unaffected by prolonged immersion in water, and arrangements are being made for its manufacture in this country at an early date. In collaboration with the Home Office, the Industrial Joint Council of Painters and Decorators has framed regulations in reference to the use of lead paints as required by the white-lead convention agreed at the International Labour Conference in Geneva, 1921. These regulations, which are designed to reduce the risk of lead poisoning amongst painters, provide that surfaces painted with lead paint shall not be rubbed down or scraped by a dry process. It is felt that proper observance of the regulations will adequately deal with the lead problem in painting, and further, it is suggested that having regard to the possible ill effects of the dusts of abrasives, the process of damp rubbing-down should be applied to all painted surfaces, irrespective of the character of the paint material.

MATTER AND ENERGY *

By SIR W. J. POPE, K.B.E., F.R.S.

A VERY serious difficulty usually confronts the individual entrusted with the onerous duty of delivering a commemorative address upon some great man who has long since passed away; the difficulty might at first sight appear particularly formidable in connexion with the James Watt Anniversary Lecture which, by the pious care of the Greenock Philosophical Society, has been delivered annually for nearly sixty years past. It might naturally be expected that so long a series of memorial lectures had thoroughly exhausted every aspect of the activities of the subject of the memorial and that nothing fresh remained to be said.

This, the ordinary source of embarrassment on occasions of this kind, does not exist in connexion with the Watt commemoration; Watt was a great pioneer, he created new and fruitful methods of applying science and scientific knowledge to practical purposes, and indeed left his own specific province as an engineer to make a valuable contribution to chemical science—the determination of the composition of water—which will ever retain a place in the history of chemistry. The inventive genius of Watt converted the rudimentary steam-engine of Newcomen into a prime mover with many obvious applications; it revealed for the first time that the potential energy resident in coal could be harnessed in such a way as to render prodigious quantities of power available for the replacement of human or animal labour. It paved the way, directly, for all the great developments of the steam-engine which have occurred during the last 150 years and, indirectly, for that vast expansion of the application of the energy resident in fuel which has resulted in the device and perfection of such forms of prime mover as the internal-combustion engine and dynamo-electric generators.

The history of scientific progess shows that from time to time the centre of most intense interest changes, and often changes very abruptly; a discovery of fundamental importance is frequently made which directs experiment and study into a new and fruitful province and a rapid expansion takes place in the scientific outlook upon the universe as a whole. Such new great acquisitions of knowledge do not invalidate previous knowledge. In view of this incessant accretion of knowledge it is very interesting to contrast our present situation with that of one or other of our great predecessors; such a comparison shows how Watt conquered a situation which was obscure to him, but is now quite clear to us and teaches how the obscure problems confronting science to-day may best be faced In the Newcomen engine steam was used merely for the purpose of producing a vacuum in the cylinder; the power was generated solely by the external pressure of the atmosphere forcing the piston down to the bottom of the cylinder. In his double-acting engine Watt was using the expansive power of steam to force the piston both up and down. He had succeeded for the first time in converting into useful work the energy resident in the fuel employed in heating the boiler. A new subject for study and a new principle for application to useful purposes had presented themselves to the practical engineer, namely, the conversion of heat into work, and there is much evidence to show that Watt pondered deeply upon the nature of the novel effect which he had obtained.

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* Extracted from the James Watt Anniversary Lecture delivered before the Greenock Philosophical Society on January 12, 1923.

The history of the development of the physical sciences up to the end of the nineteenth century shows that it has been very gradually and slowly realised that inanimate nature is built up from two utterly distinct kinds of things, namely, matter and energy. One of the favourite topics for discussion among philosophers of all ages has always been the problem of determining what are the primitive materials from which the universe is built up: stated in a simple form the problem resolves itself into the question of what elementary things would be required as the materials from which to construct a universe identical with the one in which we live.

The Greek philosophers considered this problem in the light of pure reason, and concluded that it could be solved by mere discussion. A definite stage in their treatment of the question was perhaps marked by Empedocles who, five centuries before Christ, declared that four elements or primordial materials can be distinguished, namely, air, water, earth and fire; the elements distinguished by the ancients represented the various conditions under which matter presented itself to them, namely, as solids, liquids and gases and the state of burning. This rudimentary conception of the ultimate constitution of the universe probably did not originate with the Greeks; the oldest Indian writers adopted the same four primitive elements with the addition of a fifth, which they termed the ether, whilst Buddha named consciousness as a sixth element. Ancient Greece probably had but little use for scientific thought, and may well have regarded it as an occupation for men of ability who were temperamentally incapable of promoting the general artistic tendencies of their race. The writings of the Greek philosophers concerning the constitution of the universe show that they perceived vaguely one defect in their views. They had fairly clear ideas about matter—matter is anything which possesses weight—but the something which is always associated with matter and by means of which matter makes its existence known. namely, energy, escaped their powers of definition. We now know that energy is just as much a part of the universe as is matter: its existence is just as real as that of matter: it can be measured, transferred from one material body to another, converted into various forms, and indeed can be bought and sold just like solid matter itself. Little further progress could be made until Francis Bacon at the end of the sixteenth century accentuated, though he did not himself discover, the principles of the modern method of scientific enquiry. Although Bacon himself was a philosopher and not an experimenter, and although he made the most ineffective use of the tools which he did so much to perfect, his authority as Lord Chancellor of England and his eloquence as a writer gave a tremendous impetus to the experimental method of scientific inquiry, and may be said, for all practical purposes, to mark him as the founder of modern science.

The inauguration of the experimental scientific method led to rapid progress and, by the middle of the eighteenth century. the conception of a chemical element was firmly established; it became evident that nature has provided a number of distinct unit materials to which the name chemical elements is given and from which the multitude of substances contained in the universe are compounded. At the same time, it was apprehended that something more than mere matter was included within the purview of natural philosophy, and the German chemist Stahl defined this something as the element phlogiston, the combustible principle. In the notion of phlogiston we can discern a striving after the modern conception of energy; the phlogiston theory was in its prime in the days of Watt but it was so defective, particularly in its view that phlogiston is a material element identical with hydrogen, that it was overthrown by the French chemist Lavoisier towards the end of the eighteenth century. The phlogistonists regarded heat as a ponderable substance, and this error which wrecked the phlogiston theory, was escaped by Lavoisier, who concluded from his experimental results that the transference of heat to or from a body involved no measurable change in weight. At the same time, and in spite of its imponderability, heat was to be understood as something which could be measured. Although James Watt lived throughout the period of greatest ascendancy of the phlogiston theory, he seems always to have been perfectly sound on the question of the essential character of heat; in fact, the modernity of his conception of heat is suggested by the contemporary law which bore his name. Watt's Law states that "the quantity of heat which is required to convert a pint of water at a temperature of zero into steam, is the same whatever be the pressure"; such an enunciation is hardly compatible with ardent faith in the phlogiston hypothesis of Stahl, and at the same time it is noteworthy that the statement presumes nothing concerning the nature of heat. In 1803 John Dalton enunciated the atomic theory; he accepted the view that nature has provided a certain number of distinct materials, the chemical elements, from which the material universe is built up, and stated (1) that every element is made up of homogeneous atoms whose weight is constant, and (2) that chemical compounds are formed by the union of the atoms of different elements in the simplest numerical proportions. We know now that the number of chemical elements is limited to 92 different species, but that the number of compounds is practically unlimited, some hundreds of thousands having been already prepared and examined.

The most searching experimental tests of the validity of the atomic theory have merely consolidated its position as the basis of modern chemistry, but it was long before equally clear conceptions were formed concerning the more elusive accompaniment of matter, namely, the phlogiston of Stahl or the energy of modern times. The fact that mechanical work could be measured was familiar in the eighteenth century, and indeed Watt assigned to one horse-power the very liberal estimate of 33,000 foot-pounds per minute, the foot-pound being defined as the work done in raising a weight of one pound through a vertical height of one foot; when looked at in this way mechanical work is seen to be a mode of motion. It was also known that a given output of mechanical work by a steam-engine necessitates a definite consumption of fuel, but no adequate conception had been formed of heat as merely another form of mechanical work. Many eminent scientific men, and among them Newton and Davy, believed that heat was not material but was a form of motion; the general opinion prevailed, however, that heat is a material fluid to which the name "caloric" was applied. The material theory of the nature of heat prevailed up to about 1850; even in 1848 Lord Kelvin reaffirmed his belief in it and stated that "the conversion of heat (or caloric) into mechanical effect is probably impossible, certainly undiscovered. In actual engines for obtaining mechanical effect through the agency of heat we must consequently look for the source of power, not in any absorption of conversion, but merely in a transmission of heat." Towards the middle of the nineteenth century Dr. J. P. Joule, the first of the Watt Anniversary lecturers showed that mechanical work can be converted into an equivalent quantity of heat; he showed experimentally that the amount of heat necessary to raise the temperature of one pound of water by one degree Fahrenheit is generated by the expenditure of 770 foot-pounds of mechanical work. The work of Joule led rapidly to the replacement of the material theory of heat by the mechanical theory of heat, to the realisation that all forms of energy—mechanical work, heat, light, and electricity—are interconvertible, and in fact to the development of the modern science of thermodynamics upon which is based all progress in the construction of prime movers. Lavoisier had shown long before that matter retains its mass unchanged throughout any series of chemical reactions and so established the principle of the conservation of matter: the work of Joule led to the establishment of the principle of the conservation of energy, namely, to the proof that whilst a given quantity of energy can be converted into various forms, such as heat, light, electricity and mechanical work, its quantity remains unchanged. In fact, neither matter nor energy can be either destroyed or created.

The story of this dramatic development in scientific knowledge has been told by Sir Dugald Clerk in the first Joule memorial lecture at Manchester in 1920; the fact that many of us were acquainted with men like the late Lord Kelvin, who in their younger days opposed the mechanical theory of heat, is a striking testimony to the rapidity of scientific progress during the nineteenth century. The first few years of the present century have brought even more startling developments in our knowledge of matter and of energy. Dalton put forward the atomic theory in 1803, stating that any chemical element consisted of very minute and similar particles which he termed atoms. Some 90 chemical elements are now known and the weight of the atom of each has been determined in terms of the weight of the atom of the lightest element, hydrogen; thus, the atomic weight of hydrogen being taken as 1, that of oxygen is 16, of iron 55·8, and so on. These chemical elements represent the 90 or so primitive forms of matter provided by nature from which all compound substances are built up; in accordance with the law of conservation of matter, a given weight of a particular element can be traced through innumerable chemical reactions, the weight never varying and the quantity of the element remaining unchanged. So far as could be seen, the atoms of the elements constituted the immutable and ultimate units of matter from which the whole universe was constructed.

(*To be continued*)

CORRESPONDENCE

SALVARSAN DIGLUCOSIDE

Sir,—A paper by A. Aubry and E. Dormoy, describing an arsenical glucoside, diglucosidodihydroxydiaminoarsenobenzene, appears in *Comptes Rendus,* November 6, 1922, pp. 819 to 822.

This paper calls for comment, as the preparation of the glucoside referred to is covered by a patent held by the writer and Boots Pure Drug Co., Ltd., Nottingham.

During the last two and a-half years extensive clinical trials of this compound have been carried out, and an account of the preparation and chemical characteristics, as well as of the therapeutic results obtained, will be given in a paper to be read shortly before a joint meeting of the Chemical Society and the Society of Chemical Industry in Nottingham.—I am, Sir, etc.,
Leonard Anderson

Fine Chemical Department,
Boots Pure Drug Co., Ltd.,
Nottingham
January 10, 1922

PERSONALIA

The University of Prague has conferred the degree of Doctor in Natural Science on Mr. J. G. F. Druce, M.Sc., A.I.C., who is the first Englishman to obtain this degree.

Dr. Charles Carpenter, a former President of this Society, and the first Chairman of the Council of the Association of British Chemical Manufacturers, has resigned his seat on the latter body owing to pressure of other duties, and Dr. Clayton, M.P., has been elected to fill the vacancy thus created.

Dr. E. C. Franklin, professor of organic chemistry at Leland Stanford Junior University, has been elected president of the American Chemical Society, in succession to Dr. E. F. Smith. In addition to his professorial duties, Dr. Franklin has had much industrial experience, and his work on liquid ammonia as an electrolytic solvent is widely known.

On the nomination of the Association of British Chemical Manufacturers the Board of Trade has appointed Mr. W. H. Dawson, manager of the British Alizarine Co., Ltd., to be a member of the Dyestuffs Advisory Licensing Committee in place of Mr. E. V. Evans, O.B.E., who has resigned. The place left vacant on the Dyestuffs Industry Development Committee by the resignation of Mr. Evans has been filled by the appointment of Mr. L. Blundell, of the North British Chemical Co., Ltd.

Dr. P. Freiberger has been appointed chief of the Dye Investigation Laboratory of the Customs Division of the U.S. Treasury. Prof. R. T. Haslam has succeeded Dr. R. E. Wilson as director of the Research Laboratory of Applied Chemistry of the Massachusetts Institute of Technology, and Prof. W. G. Whitman has been appointed assistant director of the same laboratory. Mr. Jerome Alexander has opened an office in New York as consulting chemist and chemical engineer. Messrs. J. M. Weiss and C. R. Downs, formerly director of development and chief chemist, respectively, to the Barrett Co., and recipients of the H. N. Potts medal of the Franklin Institute, have also established themselves in New York as consulting chemists and chemical engineers.

The Paris Academy of Sciences has made the following awards of prizes for 1922 :—Montyon Prize of 2500 francs to the late Charles Boulin for his researches on mustard gas ; an honourable mention (1500 fr.) to Louis Tampier for his work on the manufacture of poison gas ; the Jecker Prize to Marcel Godchot (5000 fr.), Marc Bridel (2500 fr.), and Georges Tanret (2500 fr.) for their researches in chemistry ; the La Caze Prize to Paul Thiébaud Muller for his researches in physical chemistry ; the Cahours Foundation to Andrée Chaudun for her physico-chemical work on the inversion of sugar ; the Houzeau Prize to René Dubrisay for his work on solutions ; the Victor Raulin Prize to Louis Longchambon for his researches on the relation between rotatory power and crystalline symmetry ; the Bellion Prize to Arthur Vernes for his researches on the measurement of flocculation by photometry ; the Philipeaux Prize to Costantino Gorini for investigations on lactic fermentation ; and the Alhumbert Prize to Charles Mauguin for his researches on liquid crystals. In addition the Jérome Ponti Foundation has been awarded to Pierre Mahler for his work on fuels, the H. le Chatelier Foundation of 5000 fr. each to Paul Riou, Ernest Torporescu, and Paul Mondain-Monval for researches on the manufacture of sodium carbonate by the ammonia process, and to Pierre Lafon for researches on the enamelling of iron.

* * *

From Germany the death is announced of Prof. A. Fischer, a well-known investigator and teacher, and author of a treatise on "Rapid Methods of Electroanalysis."

The deaths are reported from Italy of Prof. G. Parrozzani, professor of pharmaceutical chemistry in the Royal Technical Institute, Aquila, U. Cattaneo, director of the Research Institute of the Italian State Railways, and Prof. L. Marino-Zuco, professor of applied chemistry in the Royal School of Engineering, Pisa.

Out of a total of 90,000 students in German Universities, states the *Chemiker-Zeitung,* about 40,000 obtained employment in trade and industry during the summer vacation, and of this total 15,000 secured work in mines.

NEWS AND NOTES

SOUTH AFRICA

Development of the Iron and Steel Industry

Considerable interest attaches to the reported amalgamation of the Union Steel Corporation, of Vereeniging, and the South African Iron and Steel Corporation, of Pretoria, as with the removal of internal competition, the industry will be less handicapped in facing foreign competition. The Union Steel Corporation has been a producer for several years, but has utilised little South African ore; and recently it was announced that the Pretoria company intended to erect a plant at a cost of £2,500,000 to produce 75,000 tons per annum. As a Government bounty is granted of 15s. per ton on pig iron plus 15s. per ton on steel when the output from South African ore reaches 50,000 t., active development should result from the amalgamation.—(*Min. Mag.*, *Dec.*, 1922.)

UNITED STATES

Tin in 1919

According to the United States Geological Survey, the production of tin concentrates in the United States in 1919 was limited to Alaska, where concentrates with a recoverable content of 56 t. of metallic tin were won from gravels. Development work and prospecting for tin was continued in South Dakota and New Mexico, but no production was recorded. The output of metallic tin from the six smelting plants in operation was 12,236 t., almost entirely from Bolivian concentrates. Imports of ore and metal amounted to 19,196 t. and 44,849 t. respectively, and the export of tin was 306 t., so that 56,779 t. of primary tin was available for consumption.

GERMANY

Utilisation of Waste Heat

At a meeting of the Saxony and Anhalt branch of the *Verein Deutscher Ingenieure* held at Dessau on October 12, a paper on waste-heat utilisation was read by O. Brandt, director of the Abwärme-Ausnützung and Sauggas G.m.b.H. ("Abas"), referring particularly to plant made by this firm.

As the result of efficient ventilation and removal of dust from workshops the quantity of heat required to warm them in winter is greatly increased. For the supply of this heat, there is available the exhaust steam from engines and turbines, and the flue gases of boilers and furnaces. Flue-gas-air heat-exchangers can be used if the temperature of the flue-gas is about 500° C., *e.g.*, in conjunction with steam boilers, glass and porcelain furnaces, drying-ovens, etc. The "Abas" heat-exchanger is of similar construction to the radiator of a motor car, the air being forced by a fan through a number of narrow channels, and the hot gases passing through the intervening space in the reverse direction. The warmed air is then conveyed to the rooms to be heated through metal pipes. An even warmth is more quickly reached and uniformly maintained than with steam heating, ventilation being obtained at the same time.

For flue-gases with a temperature above 500° C., such as are produced in smelting ores, cement manufacture, various large-scale chemical processes, and by large gas engines, a waste-heat boiler should be used. The steam generated depends on the quantity of gas available and its temperature. A 3000 h.p. blast furnace gas-engine which worked 7200 hrs. per annum and was fitted with a waste-heat boiler, produced 18,360,000 kg. of steam at 15 atmospheres pressure and 350° C.

A heat-exchanger for warming air with exhaust steam is constructed of a battery of galvanised wrought-iron pipes through which the air passes, the steam passing between them. Air may similarly be heated with hot water derived, for example, from an economiser. Although the use of economisers of any kind in a boiler flue may impede the draught to such an extent as to render a fan necessary, the author said that the use of chimney draught alone was now always uneconomic.

GENERAL

Institution of Structural Engineers

With the advent of concrete, reinforced concrete, and special steels, a specialised profession, that of the structural engineer, has been developed during the past few years, so that civil engineering is now divided under three main heads—electrical, mechanical, and structural. Of these divisions the first two have long been represented by powerful professional institutions, and the structural division has been represented for many years by the Concrete Institute. By permission of the Board of Trade this Institute has now changed its title to the Institution of Structural Engineers, the more accurately to denote its special function as a professional society for structural engineers. The membership includes Members, Associates, Associate-Members, Graduates, and Students, and admission is by examination through the Graduate or Associate-Membership class. The address of the Institution continues for the present to be Denison House, Vauxhall Bridge Road, London, S.W. 1, but it is understood that in the near future the Institution may acquire premises of its own.—(*Bd. of Trade J.*, *Jan.*, 11, 1923.)

"Santoperonin"

In a recent number of the *Chemiker-Zeitung* (1922, p. 993), A. Marx describes under this name a new anthelmintic, which apparently combines in itself the virtues of all the anthelmintics already in use, and is unique in being effective against all the common forms of intestinal worms. There is no reference in the article to the drug having been patented, and the description given of its constitution is so vague that the probability of the assertions made regarding its therapeutic value cannot be judged. The inventor apparently began with the remarkable assumption that since methyl alcohol is toxic it must be the methyl groups in santonin that are the cause of this drug's toxicity. The next step appears to have been based on Karrer's work on filicic acid and its allies, and on Lautenschlager's proof that the vermicidal action of the santonin type of anthelmintic is associated with the presence of a lactone group (*cf.* J., 1922, 467 R), and it was assumed that, by the combination of these two types of structure, the ideal anthelmintic would be produced. The coupling of the two groups is said to be effected by a bridge which itself is vermicidal. All this does not take us very far, but a little more information has been published in other journals, chiefly medical and pharmaceutical, in Germany in which the drug is referred to as a complex derivative of "naphthalene phenolate" containing copper and aluminium acetate. β-Naphthol, phenol, copper sulphate, and aluminium acetate have all been used as anthelmintics before now. The inventor's reticence has already been adversely criticised in Germany, and in the current number of the *Chemiker-Zeitung* (No. 143, p. 1081) Dr. Herrmann states that a specimen of "santoperonin" examined by him yielded 37 per cent. of copper oxide, that the ash contained in addition iron, alkalis, and sulphur, but no aluminium, whilst by heating the drug under reduced pressure a sublimate of salicylic acid was obtained. The copper was easily extractable by 3 per cent. hydrochloric acid. It is difficult to reconcile these results with the vague synthetical picture of "santoperonin" drawn by the inventor, and it is to be hoped that the medical profession in this country will steer clear of "santoperonin" until the discrepancies are cleared up and the inventor has fully disclosed its composition in a patent specification or otherwise.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for January* 11)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Perfumery, rubber goods	65
Canada	Condensed milk plant	*
Cuba	Earthenware, crystal glassware	66
Egypt	Glassware, oil, paint, etc. (tender for)	9701 F.E./ G.P.
„	Photographic materials (tender for)	9726 F,E./ G.C.2
France	Iron and steel	39
„	Coal tar	18106 F.W. G.C.2
Italy	Thin black plate	41
„	Crystal glass	43
Cyprus	Earthenware, metal manufactures	32
Dominican Republic	Pottery, glass, glassware	225/70 F.G./ M.C.
Netherland E. Indies	Leather, glassware, crystal glass, crockery	63
Netherlands	Iron and steel	45
„	Hollow-ware, corrugated sheets, nickel cubes, candles	55
New Zealand	Pressed glassware	34
„	Hardware, china, earthenware	35
South Africa	Copper tubing (tender for)	10313 E.D./ E.C.2
Spain	Pharmaceutical products	58
United States	Drugs	18054 F.W./ T.C.

* High Commissioner for Canada, 19, Victoria Street, London, S.W.1.

TARIFF CUSTOMS EXCISE

Australia.—Under the Iron and Steel Products Bounty Act, 1922, a bounty may be paid, under certain conditions, on specified iron and steel products manufactured in the Commonwealth. Increased import duties are leviable on sugar and syrup. The prohibition on the importation of German books has been revoked and anti-dumping duties have been applied to eau-de-cologne, analytical balances, and gold leaf of German origin.

Austria.—The consumption taxes on alcoholic liquors and sugar have been increased.

Egypt.—Revised import duties have been applied to alcoholic liquors.

France.—From December 31 the export or re-export of scrap iron and steel is prohibited, save under licence, and except to Italy.

Germany.—Particulars of recent decreases in export duties may be obtained from the Department.

Italy.—The official valuations, for the levy of duty, of essential oils, synthetic perfumes, alkaloids, etc. have been revised. Articles which may be imported under the "temporary importation" scheme include paper and brass strips for covering electric cables, raw artificial silk, sheet glass for the manufacture of photographic plates, and sheet aluminium. The sales taxes on perfumes, medicinal specialities, and spirits have been modified.

Mexico.—A modified import duty has been applied to soap.

New Zealand.—Amendments in the Customs Amendment Act, 1921, provide that the duty of 25 per cent. *ad valorem* leviable on certain goods imported from countries whose currencies have depreciated more than 90 per cent., be replaced by an *ad valorem* duty to be fixed from time to time, by Order in Council; and that the nominal value of goods, not of British origin but competing with British goods, shall not exceed by more than 20 per cent. the cost of British goods to the importer if the importation of such goods is likely to prejudice any industry in New Zealand or the Empire.

Rumania.—Recent modifications of the import duties affect skins, leathers, starch and vegetable glues, glucose, vegetable fibres, electric lamps, iron plate, tartaric and citric acids, calcium carbide, and lamp black. Amended export duties have been applied to enamelled earthenware and caustic soda.

Tanganyika.—The customs tariff in operation in Kenya has now been enforced in Tanganyika.

REPORT

REPORT ON FINANCIAL, INDUSTRIAL AND COMMERCIAL CONDITIONS IN CANADA. DATED SEPTEMBER, 1922. *By* G. T. MILNE, *H.M. Senior Trade Commissioner in Canada and Newfoundland. Pp.* 82. *London: H.M. Stationery Office,* 1922. *Price* 2*s.* 3*d.*

During the last twelve months the economic situation in Canada has been marked by price readjustments, as in other countries. It is not anticipated that business will revive greatly this year, but a steady improvement is generally anticipated. Certain tariff modifications are now operative, and should favourably affect imports from the United Kingdom, although reductions in the customs tariff are practically neutralised by the increase in the sales tax. Regulations for the marking of goods to indicate the country of origin have been repealed, but goods specified by Order in Council can be ordered to be so marked.

The output of various minerals during the year was as follows:—

Mineral		Output	Inc. (+) dec. (—) per cent. compared with 1920
Coal	Short tons	15,000,000	— 12
Gold	Fine oz...	924,374	+ 20.8
Silver	,, ..	13,134,926	— 1.46
Copper	Lb. ..	53,500,000	— 33
Nickel	,, ..	less than 20,000,000	— 66
Lead	,, ..	67,000,000	+ 87
Zinc	,, ..	53,000,000	+ 32
Iron	Tons ..	43,000	—
Petroleum	Barrels ..	190,000	—

During the year ended March 31, 1922, the total imports of coal from the United States amounted to 17,162,897 short tons, compared with 20,245,347 t. in the preceding year. About 76·5 per cent of the total output of gold was mined in Ontario, British Columbia ranking second among the gold-producing provinces with a total of 149,397 fine oz., an increase of nearly 20 per cent. compared with 1920. The values of the imports and exports of copper and its products during 1921 were $9,612,526 and $13,314,089, respectively. The average monthly output of pig iron during 1921 was 50,000 long tons, which is less than the monthly average for any year since 1908. Imports of iron ore, chiefly from the United States, for the year ended March 31, 1922, were 656,902 short tons ($1,936,247), as compared with 1,950,291 t. ($5,995,038) in the previous year. For the first time Canadian finished steel products have successfully entered the foreign market. In 1920 the total output of paper pulp was 1,960,102 t. ($141,552,862) and of paper 1,184,225 t. ($136,639,921). The water-power resources of the Dominion are assessed at 18,255,000 h.-p., of which 2,500,000 h.-p. has been developed, and it is estimated that by 1940 the water power harnessed will amount to 5,600,000 h.-p. Practically all industrial centres in Ontario are now served with electric power through the agency of systems built by the Hydro-Electric Power Commission.

The establishment of branch factories in the Dominion is one of the most important factors confronting British manufacturers interested in the Canadian market. The number of United States branch works in Canada is reliably estimated at 675, of which 335 are in Ontario, 185 in Toronto, and 75 in Hamilton. It is anticipated that a comparatively large number of branch works will be established in the Dominion during 1923. Recent industrial projects include the manufacture of asbestos products, dyeing and finishing of textiles in Quebec, and the manufacture of optical and alloy-steel goods in Ontario.

The total imports of merchandise in 1922 were valued at $747,804,332 compared with $1.240,158,882 in 1921. The exports for 1922 were valued at $740,240,680 compared with $1,189,163,701 for the previous year. It is emphasised that owing to the contiguity of the United States, Canada stands in an entirely different position from the other self-governing Dominions in regard to its economic relations with the Mother country. The Canadian market is on this account more difficult for the British manufacturer to cultivate than any other in the Empire. Preference shown by Canadians for British goods is based on their repute for excellent quality, but the distribution of circulars and catalogues is insufficient to maintain this preference.

REVIEWS

GASWORKS RECORDERS. *By* L. A. LEVY. *Pp. xi*+246. *London: Benn Brothers, Ltd.*, 1922. *Price* 35*s. net.*

The author of the book under review is enthusiastic in his advocacy of the use of recording instruments in the control of gas manufacture and distribution. A picture of a gasworks equipped with all the recording devices referred to in this volume might possibly convey a wrong impression of the essential works operations: an impressive foreground would be occupied by recording instruments, gas making and distributing plant would be found somewhere in the hinterland.

Control of processes may be based upon the results of snap-tests or the indications of recording devices. Both methods have inherent disadvantages. It is often too readily assumed that the elimination of the personal element by the substitution of the latter method for the former must lead to increased accuracy and efficiency in the operation of the plant. This is not necessarily so. The value and trustworthiness of a recorder are to be determined by the "acid test": How far is the record influenced by and *only* by variations in the characteristic it is intended to record? The individual observer, more especially when, as sometimes happens, both operation and control of a plant are in his charge, suffers from what may be euphemistically described as his "personal equation." Recording instruments are not without their idiosyncracies. Their reliability increases as the effects of extraneous influences, *e.g.*, friction, temperature and the rest, are eliminated from the record. The lot of those responsible for control of processes would indeed be a happy one, were but one-tenth of the claims advanced on behalf of recorders justified beyond a doubt. Recorders would be everywhere installed, though possibly their cost of upkeep and repair might exceed that of the skilled labour they would displace.

Among the recorders discussed in the volume are pressure and vacuum gauges, pyrometers, gravitometers, gas analysis and volume recorders, densimeters, and volume recorders. The activity, born of the Gas Regulation Act, 1920, amongst makers of scientific apparatus is evidenced by the chapter devoted to recording gas calorimeters. Valuable chapters on the use of recording appliances and on recording mechanism in general are included in the volume. A considerable number of the devices described are due to Mr. J. F. Simmance. Considering that the platinum resistance thermometer is amongst the most accurate of all recording instruments, it is disappointing to find its calibration inaccurately described on p. 62. The concavity of the graph in Fig. 62 giving the relation of resistance to temperature is very much exaggerated and moreover is directed towards the wrong axis. The theory of the Simmance gravity governor developed on pp. 113-117 contains a number of errors, one of which, at the top of p. 115, invalidates the whole of the subsequent argument. The significance of the statement "Let the conditions be such that unit volume at N.T.P. becomes N under other conditions," on this page, is, to say the least, vague. An important feature of Boys's recording gas calorimeter which is not brought out by the statement concerning the chart, on p. 127, is that the calorific value is recorded in strict relation to the chart ruling, however the chart may be displaced on the drum.

The general get-up of the volume is excellent, and the type and illustrations leave nothing to be desired, the line drawings being particularly clear. A considerable portion of the descriptive matter is available gratis in the form of trade circulars. Owing to the extremely high price of the volume, these circulars will probably continue to be the main sources of information referred to by those interested in gasworks recorders. J. S. G. Thomas.

The Analysis of Rubber. *By* J. B. Tuttle. *American Chemical Society, Monograph Series. Pp.* 155. *New York: Chemical Catalog Co., Inc.* 1922. *Price* $2.50.

The finished products of the rubber manufacturer appear on the market in an infinite variety of forms and colours and possess widely different properties, results which are achieved by the incorporation of suitable filling materials or by careful control of the vulcanisation process. It is, therefore, desirable, if not essential, that the analyst who wishes not only to secure accurate data as to the elementary composition of an article but also to be able to interpret the results obtained, should be familiar with the physical and chemical changes occurring during vulcanisation.

The work under review is addressed primarily to those chemists who are engaged in the consumers' laboratories and to those who, without previous experience in rubber analysis, may be called upon to undertake work of this nature. This method of treatment involves the inclusion of much introductory matter not usually to be found in an analytical treatise, and chemists not connected with the industry will thereby be enabled to form a general idea of manufacturing principles.

The earlier chapters deal with the purpose of rubber analysis, with the nature and composition of various types of crude rubber, and with the testing of materials, including organic accelerators, employed in the preparation of rubber compounds. The theory of vulcanisation is briefly discussed and, after some notes on sampling, sections are devoted successively to extractions with acetone and other organic solvents, to the determination of rubber by direct and indirect methods, and to the estimation of sulphur, present in various forms. The book marks an advance on its predecessors in that it contains a brief description of suggested methods for the detection, in manufactured articles, of certain organic accelerators, some hitherto unpublished data being here included. The up-to-date character of the book is further emphasised by the short account of micro-sectioning and photo-micrography (referred to as microphotography), and by the inclusion of glue, in the chapter headed "Mineral Analysis," among the compounding ingredients. In an appendix there is given an account of manufacturing operations, including washing, drying, milling, mixing, calendering, and spreading. Methods of physical testing are also dealt with, and it may be remarked that the author favours the use of "dumb-bell" shaped pieces as recommended by the Bureau of Standards instead of the ring form which, although still excluded by the specification of some consumers, is the type more usually adopted in this country.

There is provided an excellent bibliography containing no fewer than 501 references, many of which are taken from unfamiliar sources; these are arranged according to the names of the authors and are also included in the general index under the appropriate subject heading. A comparison of the text with the bibliography suggests that the book is in no sense intended as a comprehensive treatise on rubber analysis, but it may be regarded as an exposition of the analytical processes favoured by the author. Mr. Tuttle, indeed, writes throughout as one wholly conversant with the methods he is describing, and it is by reason of the critical manner in which these are discussed that the book will appeal most strongly to the rubber technologist.

The style of the book is, on the whole, remarkably clear and incisive, but there are occasional lapses into colloquialism which are apt to be somewhat irritating; thus, we read (p. 70), "if we assume that . . . , we may get a fair line on the quantity of vegetable oils." There are, also, occasional evidences of hurried writing as (p. 40) "when formaldehyde combines with ammonia, instead of following the usual procedure, we get hexamethylenetetramine," or (p. 103) "When zinc oxide or sulphide are present."

Temperatures are quoted thus: 150 C., the sign for degrees being omitted throughout. The heading of some of the sub-sections might, with advantage, be altered. Thus, on p. 34, under "Tests for Cottonseed Oil" in Clarendon type, sub-sections with italicised titles are included which have no reference to the main heading; similarly, on p. 37, sulphur chloride is described under "Tests for Sulphur."

In spite of these minor faults, the book may well be said to have fulfilled its purpose as one of the American Chemical Society's monograph series, namely, "to co-ordinate and present in a concise, readable form" the facts relating to the subject dealt with. B. D. W. Luff.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The general tone gives promise of continued improvement in the chemical trade in spite of the unsettled state of foreign politics. Reports from the textile areas are various and conflicting, but an impartial view leads one to the conclusion that the future is not looked upon as showing any great change for some time. The comparatively small improvements shown during the last few months are fully maintained :—

Acetic Acid, 40% tech., at about £21. Price has a tendency to rise further. Position maintained and satisfactory under present trade conditions. Foreign supplies are in somewhat short supply.

Acid Hydrochloric, 4s. to 5s. carboy delivered. No change in demand.

Acid Sulphuric, average national price for crude tower acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations. The demand for Sulphuric Acid is gradually improving.

Ammonia Alkali, unchanged at about £8. Demand continues good. Home trade improving slightly.

Arsenic (White), £65-£75, shortage continues, although inquiries are not so numerous.

Bleaching Powder, £10 10s. to £11 10s. Slightly better inquiry at present, compared with other heavy chemicals much below normal.

Calcium Chloride, £6. Poor inquiry with continental make offered at lower figures.

Copper Sulphate, about £26 f.o.b., quite nominal.

Potash Caustic, £29 10s. to £30. Slightly better but very poor demand.

Salammoniac. Slight improvement with prices maintained.

Salt Cake, about £5 to £5 10s. Not much business passing. Manufacturers are not offering very freely and seem to anticipate a still further rise in prices as a result of increased demand.

Soda Caustic, 76%, £20 to £21. Home trade or export—position remains firm.

Soda Crystals.—£5 10s., carriage paid. No change.

Sodium Bicarbonate, £10 10s., carriage paid. No change.

Sodium Bisulphite Powder, 60-62%, £19 to £20 10s. per ton, according to quantity, f.o.b. or f.o.r. London, 1 cwt. drums included.

Sodium Chlorate, in slightly improved request. Foreign parcels offered at low prices.

Sodium Sulphide, solid at £16. Not much in demand. Keen foreign competition.

Sodium Sulphite, Pea Crystals, £17 to £17 10s., 1cwt. wooden kegs included.

Bisulphite of Lime, £7 per ton, packages extra and returnable.

Sodium Acetate, 97-98%, £23 per ton.

WOOD DISTILLATION PRODUCTS

There are no changes to report in this section. Manufacturers' prices are as follows :—

Acetate of Lime brown ..	£8 per ton delivered
Acetate of Lime grey 80%	£14 10s. per ton delivered
Acetate of Lime Liquor ..	9d. per gal. 32° Tw. d/d.
Charcoal	£9 10s. to £10 per ton
Iron Liquor	1s. 6d. per gall. 32° Tw.
,, ,, ...	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14-15° Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefined
Wood Naphtha, Miscible ..	7s. ,, ,, 60% O.P.
Wood Naphtha, Solvent ..	5s. ,, ,, 40% O.P.
Wood Tar	£4 10s. per ton delivered
Brown Sugar of Lead ..	£36 per ton

TAR PRODUCTS

Acid Carbolic Crude 60's ..	2s. 5d. to 2s. 6½d. Numerous inquiries and market strong
Acid Cresylic, 97-99 ..	2s. 2d. to 2s. 3d. Plenty of inquiry.
Acid Cresylic, Pale, 95%	2s.
Acid Cresylic, Dark ..	1s. 10d.
Anthracene Paste, 40% ..	7d. per unit per cwt. Price nominal — no business being done.
Anthracene Oil, strained ..	8¼d. to 10d., small inquiry.
Anthracene Oil, unstrained	7½d.
Benzole, Crude, 65's ..	1s. 0½d. to 1s. 2d.
Benzole, Standard Motor ..	1s. 9d. to 2s.
Benzole, Pure	2s. to 2s. 2d. No inquiry.
Toluole, 90%	1s. 10d. to 1s. 11½d. Small inquiry.
Xylol	3s. to 3s. 6d.
Creosote Cresylic, 20-24%	10d. Fair inquiries.
Creosote, standard specification	7d. to 8d. Demand very good.
Naphtha, Crude	9d.
Naphtha, Solvent 90-160 ..	1s. 9½d. to 1s. 10d. Fair business doing.
Naphtha, Solvent 90-190 ..	1s. 7d. to 1s. 7½d. Not much doing.
Naphthalene, Crude .. Drained Creosote Salts.	£5 to £6 10s. per ton with good demand and firm market.
Naphthalene, Crude, Whizzed or hot pressed	£8 to £10 per ton. Still receiving inquiries and market firm.
Pitch, Medium soft ..	130s. to 140s., market very strong. Prices are at the highest point for months past.
Pyridine, 90-140	11s. to 12s.
Pyridine, Heavy	8s. 6d. to 9s. No business at present.

INTERMEDIATES AND DYES

Business in Aniline Dyestuffs has been quite good during the past week. Prospects have so much improved that some makers are reported to be increasing their staffs. Prices remain unaltered. The chief intermediates are quoted below, carriage paid and packages included unless otherwise stated :—

Acid H.	5s. 3d. lb., 100% basis.
Acid Naphthionic	2s. 8d. lb., 100% basis.
Acid Neville & Winther ..	6s. lb. 100% basis.
Acid Sulphanilic	1s. 6d. lb. 100% basis.
Aniline Oil	11½d., drums extra.
Aniline Salts	11½d. per lb.
Benzidine Base	6s. 6d., 100% basis.
Dinitrobenzene	1s. 3d. lb.
Diphenylamine	4s. 1d. lb.
α-Naphthol	2s. 9d. lb.
β-Naphthol	1s. 2d. lb.

α-Naphthylamine	1s. 7d. lb.
p-Nitraniline	3s. lb.
Nitrobenzene	8d. lb., drums extra.
Nitronaphthalene	1s. lb.
Naphthionate Soda	2s. 8½d. lb., 100% basis.
Diethylaniline	4s. 6d. lb., packages extra, returnable.
Metanitraniline	5s. 6d. lb.
Para Toluidine	5s. lb.
Para Phenylene Diamine	12s. lb., 100%
Meta ,, ,,	5s. 6d. lb.
Meta Toluylene Diamine	5s. lb.
Dinitrotoluene, 48-50° C.	8d. to 9d.
,, 66-68° C.	1s. 2d. to 1s. 3d. naked makers' works.
β-Naphthylamine	1s. 6d. lb.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

There is but little doubt that owing to the French occupation of the Ruhr prices for most chemicals from Germany will shortly be dearer, and prices here must advance in sympathy.

Acid Acetic 80%	£43 per ton ex wharf.
Acid Acetyl Salicylic	2s. 9d. to 3s. per lb. Unchanged at, but the tendency is for higher prices.
Acid Benzoic	1s. 10d. to 2s. per lb. very firm.
Acid Boric, B.P.	£61 per ton crystals. £65 per ton powder, packaged in 2 cwt. bags. Carriage paid U.K.
Acid Gallic	3s. lb.
Acid Pyrogallic cryst.	5s. 6d. lb.
Acid Salicylic	1s. 5d. to 1s. 6d. lb., very firm owing to increase in price of phenol.
Acid Tannic	3s. 3d. lb.
Acid Tartaric	1s. 2½d. to 1s. 3d. lb. The market continues to be firm with a little more demand. Price unchanged. Raw materials have further increased in cost. Foreign manufacturers have now increased their prices for this product.
Amidol	9s. lb.
Acetanilide	1s. 4d. to 1s. 5d. per lb.
Amidopyrin	12s. 6d. to 13s. lb.
Ammonium Benzoate	2s. 6d. to 3s. per lb., according to quantity.
Ammonium Sulphocyanide, recryst.	2s. 6d. per lb., cheaper qualities are available at 1s. 9d.
Barbitone	11s. 3d., market firmer.
Benzaldehyde free from chlorine	3s. 3d. lb.
Benzonaphthol	5s. per lb., with little demand.
Bismuth Salts	Prices unchanged.
Bromides	Have a firmer tendency. Potassium Salt 7d., Sodium 7½d., Ammonium 8d.
Calcium Lactate	3s. 6d. to 4s. lb. for best quality.
Chloral Hydrate	4s. lb.
Formaldehyde 40%	£90 per ton, much firmer. Supplies scarce.
Guaiacol Carbonate	8s. lb. Neglected.
Hexamine	3s. to 3s. 3d. lb. Still very firm. Supplies from Continent are difficult to get.
Homatropine hydrobromide	30s. per oz.
Hydroquinone	3s. 3d. lb., good demand.
Iron Ammonium Citrate	B.P. 2s. 5d. lb. for cwt. lots.
,, ,, ,,	Green, 3s. 1d. lb. for cwt. lots.
Iron Perchloride	£20 to £25 per ton.
Menthol	39s. 6d. per lb. less 2½% for original cases. Smaller quantities 41s. per lb. nett.
Metol	10s. to 12s. for foreign make with rather higher prices for English product.
Methyl Salicylate	2s. 2d. lb., slightly firmer.
Methyl Sulphonal	12s. 9d. lb.
Paraformaldehyde	3s. lb.
Paraldehyde	1s. 4d. to 1s. 9d. lb., in steady demand.
Phenacetin	5s. lb., with more inquiry.
Phenazone	7s. lb.
Phenolphthalein	5s. 3d. lb., still very firm.
Potassium Ferricyanide	4s. lb.
Potassium Iodide	15s. 8d. lb. for cwt. lots, jars and cases free.
Potassium Metabisulphite	6d. to 8d. lb.
Potassium Permanganate	8d. to 8½d. lb.
Salol	2s. lb.
Silver Nitrate	1s. 10$\frac{3}{16}$d. with metal at 41$\frac{11}{16}$ for 1000 oz. lots.
Silver Proteinate	10s. 9d. to 12s. lb.
Sodium Benzoate	1s. 11d. to 2s. lb. Unchanged.
Sodium Citrate B.P.C.	2s. lb. for 1 cwt. lots.
Sodium Hyposulphite, Photographic	£14 15s. for 4 ton lots.
Sodium Salicylate	1s. 11d. lb. powder, 2s. 1d. lb. crystals. In steady demand.
Sodium Sulphite anhydrous	£27 10s. to £28 10s. ton, according to quantity, f.o.r. London, drums included.
Sodium Sulphite crystals	£17 to £17 10s. per ton, according to quantity, 1 cwt. kegs included.
Thymol	19s. lb. for good white crystals.

PERFUMERY CHEMICALS

Amyl Acetate	2s. 3d.
Amyl Butyrate	8s.
Amyl Salicylate	3s. 3d.
Anethol, melting point 21-22° C.	4s. 6d.
Benzyl Acetate from Chlorine free Benzyl Alcohol	3s. 3d.
Benzyl Alcohol free from Chlorine	3s. 3d.
Benzaldehyde free from Chlorine	3s. 3d.
Benzyl Benzoate, 19·5° C.	3s. 3d.
Cinnamic Aldehyde, 98-100% Natural	14s. 9d.
Citronellol	22s. 6d.

Citral, 100%	10s. 6d.
Ethyl Phthalate	4s. 6d.
Eugenol, 100%	10s. 6d.
Geraniol (from Palmarosa)	32s. 6d.
Geraniol	5s. 6d. to 12s. 6d.
Iso Eugenol	16s.
Linalol ex Bois de Rose ..	21s.
Linalyl Acetate	22s. 6d.
Methyl Benzoate	8s. 6d.
Phenyl Ethyl Acetate ..	10s.
Phenyl Ethyl Alcohol ..	17s. 6d.
Rhodinol	52s. 6d.
Terpineol	3s.

ESSENTIAL OILS

Business generally is inclined to be better. There are more inquiries for export. Home trade may still be called dull.

Almond Oil	12s. 6d. lb. f.o.r. P.A. quality.
Anise Oil, China star ..	2s. 1d. to 2s. 2d. lb. Flat to arrive, can possibly be bought at 1s. 10d. c.i.f.
Bergamot Oil	12s. to 14s. lb., quotations for forward shipments at 11s., 11s. 6d. c.i.f., due to depreciation of the lira.
Bourbon Geranium Oil ..	25s. lb. Very firm.
Camphor Oil	80s. lb. for white in tins and cases.
Cananga Oil, Java ..	8s. to 10s. lb., a quantity of very inferior quality is on the market.
Cinnamon Oil, Leaf ..	5s. 8d. lb. for Ceylon, very quiet.
Cassia Oil, 80-85	8s. 9d. lb. on spot, inclined to be easier.
Citronella Oil, Java ..	3s. 4d. lb., very firm.
Citronella Oil, Ceylon ..	2s. 6d. lb., very firm and higher prices talked.
Clove Oil	6s. 9d. lb. Very firm in harmony with the spice which is an excited market.
Eucalyptus Oil	1s. 6d. to 1s. 7d. lb. Steady.
Lavender Oil, Mont Blanc, 38-40%	14s.
Lemon Oil	2s. 8d. to 2s. 9d. lb., inclined to be easy owing to depreciation of lira.
Lemongrass Oil	2⅝d. oz. Steady.
Orange Oil, sweet	8s. 6d. lb. on spot, forward about the same.
Otto of Rose Oil	20s. to 30s. per oz. A great deal of rubbish on the market.
Palma Rosa Oil	17s. 6d. lb. spot, 16s. forward, c.i.f. for good brands.
Peppermint Oil—	
English	70s. lb. Steady but quiet.
Wayne County	13s. 6d. lb., firm and talked higher, but difficult to find the reason.
Japanese	7s. 9d. spot. Very firm, buyers should hesitate about purchasing large quantities.
Petitgrain Oil	6s. 6d. lb. Flat with practically nothing doing.

TRADE NOTES

The Norwegian Pyrites Industry in 1921

According to an article in *Die Chemische Industrie* (December 27, 1922), 1921 and 1922 were bad years for the Norwegian pyrites industry. The demand declined heavily and the keen competition that ensued led to large reductions in prices. Before the war, Norwegian pyrites, which is mainly exported, had Spanish pyrites as its chief competitor in the world's markets, but since the development of the Frasch process for winning sulphur, the sulphur deposits in Louisiania and Texas have become dangerous rivals. The strength of American competition in Europe is shown by the fact that sulphur has been substituted for pyrites even in certain Norwegian sulphite-pulp factories. Some of the Norwegian mines suffer from the disadvantage that the pyrites contains copper which must be extracted by a process under German control before the roasted ore can be sold. Recently, Norwegian pyrites has been unable to find a market in England, and exports are now restricted to Germany, Sweden, Belgium, and the north of France. Prices have consequently been forced down almost to the pre-war level, although production costs have doubled, and many mines have had to close down. This tells heavily on the country, because pyrites-mining, which is largely in foreign hands, was one of the chief Norwegian industries. The situation is not quite hopeless, however, for the demand will probably increase with improving economic conditions, and in the division of markets due to Spanish-American competition, Norway will probably be left to compete mainly with Spain, where production costs are increasing owing to high wages and a new export duty.

PUBLICATIONS RECEIVED

Kleines Praktikum der Kolloid Chemie. *By* Prof. Wolfgang Ostwald, *with the collaboration of* Dr. P. Wolski *and* Dr. A. Kuhn. *Fourth edition, revised. Pp. xii.+172. Dresden and Leipzig: Theodor Steinkopff,* 1922. *Price 3s. 4d.*

Notes on Glass Manufacture. By C. S. Fox. *Bulletin of Indian Industries and Labour. No.* 29. *Pp.* 73. *Calcutta: Superintendent, Government Printing, India,* 1922. *Price* 1 *rupee.*

Official Directory of Members of the Association of British Chemical Manufacturers, Inc., and Classified List of their Manufactures. *Pp.* 319. *London: Association of British Chemical Manufacturers,* 1923. *Price* 10s. 6*d.*

Blanchiment, Teinture, Impression, Apprêts. *By* P. Lederlin. *Grandes Encyclopédies Industrielles, edited by* Prof. C. Matignon. *Pp.* 543. *Paris: J.-B. Baillière,* 1923. *Price, paper* 45 *francs, bound* 55 *francs.*

Fifty-fifth Annual Report of the Dominion Laboratory, New Zealand. *By* Dr. J. S. Maclaurin. *Pp.* 64. *Wellington: W. A. G. Skinner,* 1922.

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EDITORIAL

THE DISCOVERY of a new element is an event of first-rate interest and importance and the University of Copenhagen and Professors Coster and Hevesy are to be very warmly congratulated on the discovery of the latest addition, Hafnium. This is the first element to be discovered by means of its X-ray spectrum, and the method may easily be fruitful in other directions. There are not many elements yet to be discovered (if modern theories are correct), and two of these are homologues of manganese; a detailed X-ray examination of manganese minerals might reveal something of interest. The Scandinavian minerals seem to be as rich in elements as are their men of science in genius. Chlorine, yttrium, tantalum, cerium, selenium, lithium, thorium, lanthanum, erbium, terbium, scandium, thulium, and possibly oxygen were first discovered by the Scandinavians, and there may be some other instances which we have forgotten.

* * *

We are glad to print a communication from Sir Arthur Colefax, dealing with the decisions of the Referee on the definition of organic compounds. Our columns are, of course, open to him and to Sir William Pope, and any others who care to join in the discussion. *Uno averso non deficit alter.* We, who do not profess any great knowledge either of the chemical or the legal aspect of the discussion, are not sure whether these distinguished champions occupy the same platform; it may be they are appealing to different audiences, the one to an audience which is not accustomed to weigh the definitions of chemistry with that precision which Acts of Parliament are assumed to attain (though in fact these Acts are occasionally imperfect in places), the other to an audience, trained to scientific accuracy, but as Professor Bone has recently said, thrust into this wicked world without knowing the difference between a ten and an ace. The one audience, comprising a fair proportion of the ordinary users of chemical terms, has no clear-cut idea of a definition; it means not, but blunders round about a meaning; the other compensates for what may be its lower numerical strength by its superiority in learning and precision. We are entitled to remind our legislators and the lawyers who interpret their phrases, "how fallacious it is to judge of the nature of things by the ordinary and inconstant use of words."

* * *

Since 1912, when an International Opium Convention was signed at the Hague, many attempts have been made to prevent the growing abuse of habit-forming drugs, such as opium, morphia and cocaine. Some of these attempts have merely resulted in shifting the centres of the drug traffic to uncontrolled regions; and the check on the cultivation of the opium poppy in China has lapsed during the present disturbances, for cultivation of the crop has apparently been resumed over one-tenth of the former area. The Committee of the League of Nations, which is considering methods of controlling the drug traffic, has been unable to collect complete statistics of the amounts of habit-forming drugs actually required for medical and scientific use, but it is certain that the production is far in excess of the quantity required for legitimate purposes. That there is this excess is shown by the fact that hundreds of thousands of pounds of opium and many tons of morphia are produced annually, whereas it is estimated that ten large London hospitals, which treated over 70.000 in-patients, and 550,000 out-patients in 1921, consumed less than 42 lbs. of opium, 5½ lbs. of morphia, and a little over 9 lbs. of cocaine, during the year. It is therefore to be anticipated that the inquiry by the League of Nations will lead to the enactment of more stringent regulations. Unfortunately, the existence of the drug evil is very real; attempts to suppress it cannot but meet with approval. But Regulations such as those issued under the Dangerous Drugs Act in 1921, however laudable may be their intent, cannot be approved when they restrict scientific research even slightly, by preventing the genuine research worker from obtaining, without delay, reasonable quantities of the drugs in question, which are in constant use in chemical, physiological, pharmacological and other laboratories. It therefore behoves all chemists to unite so that when more stringent Regulations are issued, they may be able successfully to insist on modifications that will safeguard the interests of research without prejudice to measures designed to protect the unfortunate people who are addicted to the drug habit.

* * *

We are glad to find that Viscount Leverhulme's suggestion, that the human element in chemistry and industry should receive special attention, is already being acted upon. We have received—although too late to insert in this week's issue—an interesting communication from the genial Secretary of the Chemical Employers' Federation, and we hope that we shall be favoured by some communications dealing with the chemical industry from the point of view of the great labour organisations. No one can easily look at a problem from someone else's point of view. Even with the aid of Einstein's conception, whereby every straight line is curved, we cannot persuade our brains to show facts in the perspective which is at once apparent to our friend across the table. This is very noticeable in the grave international complications which now confront us. Some of our newspapers are able to look at this threatening position from the point of view of this country in relation to Germany, others have put forward the appearance which we imagine is visible to the Germans in relation to the world at large, but how difficult it is for us to see the problem as between France and Germany. Every chemist knows that prolonged friction produces heat. This is the cause of international troubles, of strikes and many other disagreeable events. The free ventilation of grievances before they become too acute to be borne is the best remedy and we hope that our columns, by no means large, will yet be wide enough to welcome a frank expression of opinion on all those affairs which interest us as a chemical community. We appeal to all those who have special knowledge of, or experience in the human side of industry to give the chemical public in all the English-speaking communities the benefit of their views, and to send us their impressions in order that we may duly publish them. There are some interesting developments in co-partnership, insurance, profit-sharing, and so on, which have received scant notice in scientific and technical publications; and as we have a large circulation outside Great Britain, an account of these might be of considerable interest.

AN ATTEMPT TO RESOLVE QUATERNARY PHOSPHONIUM COMPOUNDS

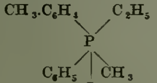
L. G. RADCLIFFE, M.Sc.,Tech., F.I.C. AND
W. H. BRINDLEY, B.A., M.Sc.Tech.

ALTHOUGH the history of stereoisomerism covers but a few years this study now holds not only an exalted, but a revered place in the annals of chemistry. That a large measure of credit must be assigned to Pasteur for the creation of this branch of chemistry can scarcely be questioned, for although the subject was not placed on a really satisfactory basis until Van't Hoff and Le Bel independently enunciated their theory in 1874, it is to Pasteur that we are indebted for opening before us so fruitful a source of investigation. A perusal of the literature shows that the period between 1860 and 1874 is, comparatively speaking, a barren one in the field of stereochemical research. This study required a fresh impetus and that was given by the Van't Hoff-Le Bel hypothesis. A brief survey of the past history of stereochemistry will at once reveal the fact that science owes a debt of gratitude to the discoverers of optically active compounds; the monumental researches of Ladenburg and Emil Fischer were made possible by the genius of the founder of stereochemical theory.

Whilst the name of Le Bel is perhaps best remembered by his publications of 1874, it must not be forgotten that he was the first to show that carbon was not the only elementary body possessing what has been aptly termed "the seal of noblesse," i.e., optical activity. The year 1891 stands out in bold relief in the history of this branch of chemistry, for it is the year in which a nitrogen compound of the type abcdNX was first resolved into its optically active isomerides; the compound in question being methylethylpropylisobutylammonium chloride (*Compt. rend.*, 1891, **112**, 724). The result of this investigation demonstrates very clearly how a problem which one worker finds little difficulty in solving becomes an impossibility in the hands of a subsequent investigator, for Marckwald and von Droste-Huelshoff (*Ber.*, 1899, **32**, 560), failed to confirm the results obtained by Le Bel, whilst Pope and Read (*Trans.*, 1912, **101**, 519) showed that Le Bel could not have had in his hands the nitrogen derivative he supposed he had resolved. Wedekind (*Ber.*, 1899, **32**, 517) attempted a resolution of *a*-benzylphenylallylmethylammonium hydroxide, but was also unsuccessful. Pope and Peachey (*Trans.*, 1899, **75**, 1127), on the other hand, resolved a tetralkyl-ammonium salt, *a*-benzylphenylallylmethylammonium iodide, and arrived at the conclusion that the failures recorded by previous workers were due to the fact that they had neglected to recognise the possibility of such a body being decomposed by dissociating solvents into the tertiary base and alcohol. This research by Pope and Peachey led to much new work in the field of stereochemistry, and the time was near when the atoms of various elements, other than carbon and nitrogen, would be found to act as centres of optical activity.

ASYMMETRIC PHOSPHORUS COMPOUNDS

The earliest available information connected with this particular type of research emanated from the laboratory of Michaelis (*Annalen*, 1901, **315**, 54). In this publication he describes the preparation of quaternary phosphonium compounds of the type :—$P.R_1.R_2.R_3.R_4$.Halogen, and he obtained (1) *p*-tolylphenylethylmethylphosphonium iodide, and (2) *pseudo*-cumylphenylethylmethylphosphonium iodide.



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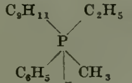
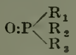


(2)

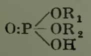
These asymmetric bodies he attempted to resolve, in the first place, by means of optically active acids, but found that crystalline salts could not be obtained ; he was likewise unsuccessful in effecting a cleavage by means of micro-organisms, and pointed out that the phosphonium compounds appear to have a "restraining influence" on the organisms.

In the following year Caven (*Trans.*, 1902, **81**, 1362) showed that the configuration of the phosphorylchloride molecule is tetrahedral, that compounds of the type :—



$$O{:}P\begin{cases}R_1\\R_2\\R_3\end{cases}$$

do not contain a plane of symmetry, and that, notwithstanding the double linkage, they are asymmetric. Caven pointed out that on theoretical grounds it should therefore be possible to prepare optically active derivatives of phosphoryl chloride, a prophecy which was fulfilled a few years later. At that time all recorded instances of optical activity of compounds showed that this property was due to the presence of one or more fully saturated asymmetric groups, and in no case had it been shown that this phenomenon depended on the presence of an unsaturated complex in the molecule. The first instance of the splitting of such a compound was recorded by Meisenheimer (*Ber.*, 1908, **41**, 3966); this was a nitrogen compound of the type abcN:X, namely, methylethylaniline oxide. Following closely upon this successful effort Luff and Kipping (*Trans.*, 1909, **95**, 1993), and Kipping and Challenger (*Trans.*, 1911, **99**, 626) investigated phosphorus compounds of the type :—



$$O{:}P\begin{cases}OR_1\\OR_2\\OH\end{cases}$$

with a view to their resolution. Although they were not completely successful it would seem that an externally compensated mixture was present. The preparation in the free state of the optically active components was not found practicable owing to the stability of their salts.

When Meisenheimer succeeded in resolving the doubly-linked nitrogen compound he turned his attention to the closely related phosphine oxides, and was again successful in effecting a resolution. In conjunction with Lichtenstadt (*Ber.*, 1911, **44**, 356), he prepared methylethylphenylphosphine oxide, and carried out the resolution by means of *d*-bromocamphorsulphonic acid. The following year records two attempts to resolve phosphorus compounds of the type $P.R_1.R_2.R_3.R_4$.Halogen. Pope and Gibson (*Trans.*, 1912, **101**, 735) prepared :—(1) phenyl - *p* - tolylmethylallylphosphonium iodide, and (2) phenyl-*p*-tolylbenzylmethylphosphonium bromide. Attempts to resolve the iodide by means of optically active acids resulted in viscid residues which could not be crystallised. Crystallisation of the bromide was effected, but no evidence of a resolution was obtained. The publication of this work caused Wedekind (*Ber.*, 1912, **45**, 2933) to announce the results of a similar investigation in which he successfully crystallised the body phenyl- *p*- tolylethylmethylphosphonium - *d* - camphorsulphonate, which, when examined polarimetrically, gave :—

$$[\alpha]_D = +21{\cdot}9° \text{ and } [M]_D = +103{\cdot}85°.$$

From these readings Wedekind assumed that he had been successful in bringing about a fission of the quaternary phosphonium base, this assumption being based on the fact that the molecular rotation of the *d*-camphorsulphonic ions amounts to +51·7°. Had he regenerated the base and found it active then, there would have been more concrete evidence that a cleavage had been obtained. It is evident that owing to lack of material he was unable to carry this investigation to a really satisfactory conclusion. In the meantime it has been generally accepted that a resolution of asymmetric phosphorus compounds of this type has not been effected.

In the present work the compound *p*-tolylphenylmethylallylphosphonium iodide, first prepared by Pope and Gibson (*loc. cit.*), was obtained, but whereas in the Pope and Gibson synthesis phosphenyl chloride was the initial stage, in this work *p*-tolylphosphine dichloride was employed.

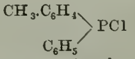
EXPERIMENTAL

p-Tolylphosphine dichloride, $CH_3.C_6H_4.PCl_2$.—This body is obtained by heating a mixture of toluene and phosphorus trichloride in the presence of freshly prepared aluminium chloride (Michaelis, *Annalen*, 1882, **212**, 203).

$$C_6H_5.CH_3+PCl_3=CH_3.C_6H_4.PCl_2+HCl$$

Considerable difficulty is experienced in obtaining this substance in a perfectly pure state ; only after fractionating several times and freezing the resulting oil out of contact with air can the impurities be removed. The yield is unsatisfactory, for under the most favourable conditions it rarely exceeds 10 per cent. of the theoretical.

p-Tolylphenylchlorophosphine,



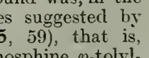
$$\begin{matrix}CH_3.C_6H_4\\ C_6H_5\end{matrix}\!\!>PCl$$

The preparation of this compound was, in the main, carried out on the lines suggested by Michaelis (*Annalen*, 1901, **315**, 59), that is, by heating the primary chlorophosphine, *p*-tolylphosphine dichloride, in excess with mercury diphenyl.

$$2(C_6H_4Me)PCl_2+(C_6H_5)_2\ Hg=2(C_6H_4Me)\ (C_6H_5)PCl +HgCl_2$$

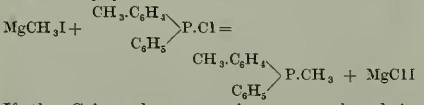
To isolate the *p*-tolylphenylchlorophosphine the brown, resinous mass was refluxed several times with water-free benzene, the solution filtered through kieselguhr and distilled in an atmosphere of carbon dioxide.

p-Tolylphenylmethylphosphine,



$$\begin{matrix}CH_3.C_6H_4\\ C_6H_5\end{matrix}\!\!>P.CH_3$$

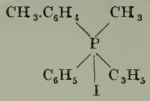
In preparing the tertiary phosphine the Grignard reagent was employed in preference to a zinc alkyl and this method gave good results, though only by using a very considerable excess of magnesium methyl iodide could satisfactory yields be obtained.



$$MgCH_3I+\begin{matrix}CH_3.C_6H_4\\ C_6H_5\end{matrix}\!\!>P.Cl=\begin{matrix}CH_3.C_6H_4\\ C_6H_5\end{matrix}\!\!>P.CH_3 + MgClI$$

If the Grignard reagent is not employed in large excess there results a jelly-like mass from which the tertiary phosphine is removed with difficulty; the best yields were obtained by using 4 molecular proportions of Grignard reagent to 1 of secondary chlorophosphine.

p-Tolylphenylmethylallylphosphonium iodide



This body was obtained by treating an ethereal solution of the tertiary phosphine with an ethereal solution of freshly-distilled allyl iodide. On mixing these ethereal solutions turbidity ensued, and after standing for a short time there resulted a small quantity of oil. The ether was removed, the oil dissolved in the least quantity of absolute alcohol and anhydrous ether added until there was a pronounced turbidity. On standing for some time the quaternary phosphonium iodide was precipitated in the form of fine crystals.

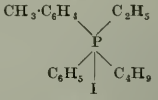
It became evident that a very small proportion of the iodide had been precipitated in the crystalline state, and it was decided to examine the alcohol-ether solution. On distilling there remained a viscous oil which could not be induced to crystallise, so that the yield was far from satisfactory. The crude *p*-tolylphenylmethylallylphosphonium iodide was recrystallised from alcohol, and was obtained in the form of small, colourless, glistening needles, which, on exposure to light, become yellow. It melts at 175° with decomposition.

0·1896 gramme gave 0·1162 gramme AgI
C_{17} H_{20}PI calculated I 33·24
" found I 33·12

p-Tolylphenylmethylallylphosphonium - d - bromocamphorsulphonate

The quaternary phosphonium iodide was treated with an equivalent quantity of the silver salt of *d*-bromocamphor-sulphonic acid dissolved in dilute alcohol. The precipitated silver iodide was filtered off, the filtrate evaporated to low bulk and placed in a vacuum desiccator. After standing for some weeks a jelly-like mass resulted, but no indication of crystallisation was observed; eventually the compound assumed the condition of a resin.

p-Tolylphenylethyl - n - butylphosphonium iodide



On mixing ethereal solutions of *p*-tolylphenylethylphosphine and *n*-butyl iodide there was no apparent change, a marked contrast to the result obtained in preparing *p*-tolylphenylmethylallylphosphonium iodide. In the hope of bringing about more perfect combination the mixture was warmed for some time, allowed to cool, and anhydrous ether added. Eventually there was obtained an oily precipitate, but this could not be crystallised. A similar failure has to be recorded for *p*-tolylphenylethyl - *n* - propylphosphonium iodide.

CONCLUSION

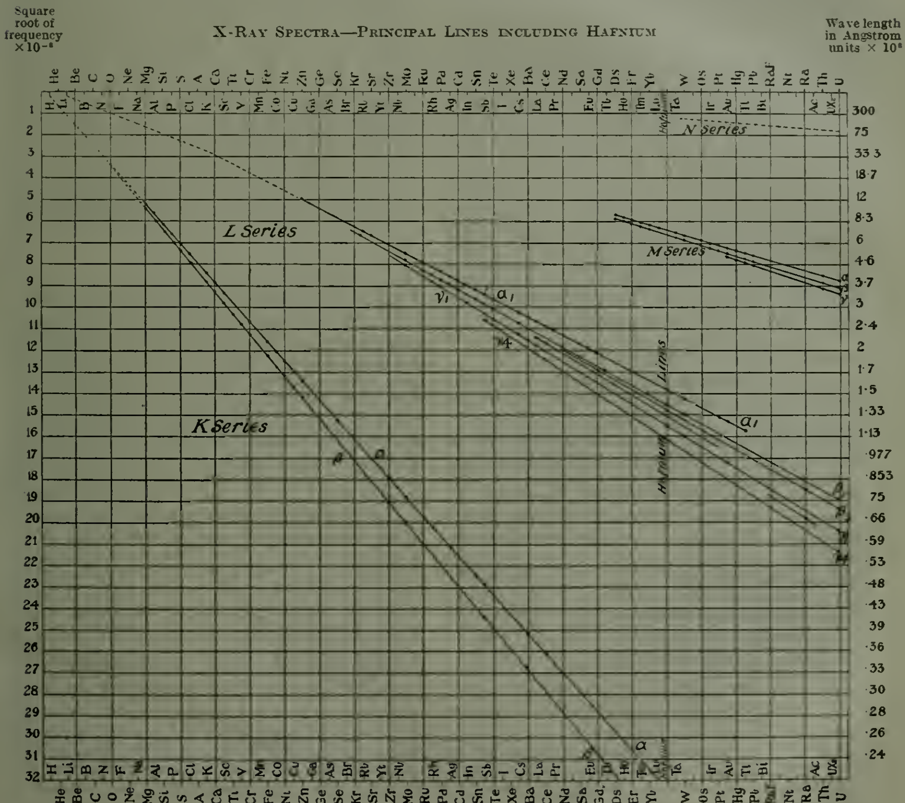
Whilst the original idea of proving that the completely asymmetric phosphonium base, $P.R_1.R_2.R_3.R_4.OH$, exists in optically active forms has not been realised, it is felt that the results obtained should be recorded. The outstanding difficulty was the creation of a sufficient amount of material, the poor yields preventing one from making an extended study of the fission problem. It is felt that the choice of compounds is somewhat limited, since it does not appear to be convenient that the last group introduced shall be other than methyl, allyl, or benzyl. Thomas and Jones (*Trans.*, 1906, **89**. 280) pointed out that the iodides of the above radicles are the only ones, as a rule, which react extensively with tertiary amines containing aromatic and other large alkyl groups. Perhaps the difficulty of introducing the butyl and propyl radicles is analogous to the stereochemical obstruction noticed in the case of tertiary amines.

Municipal College of Technology,
Manchester.

THE NEW ELEMENT HAFNIUM

Professors Coster and Hevesy of Copenhagen announce in *Nature* of the 20th inst. the discovery of a new element which they call Hafnium, after Hafniae, an ancient name for Copenhagen. The new element is homologous to zirconium and is apparently present in specimens of zirconium minerals to the extent of possibly one per cent. It has been discovered by means of its X-ray spectrum and the diagram we print above shows how the principal lines of the X-ray spectra of the elements fit into a scheme which enables any element, whether known or unknown, to be identified by its X-ray spectrum. The lines of Hafnium which have been measured are: $L\alpha_1=1565$, $\alpha_2=1576$, $\beta_1=1371$, $\beta_2=1323$, $\beta_3=1350$, $\gamma_1=1177$ X. u. Our diagram, necessarily very hurriedly prepared, shows the wave lengths in units which are a thousand times larger than the X-units used by the discoverers of the new element.

The University of Copenhagen has taken a very important place of recent years in both Chemistry and Physics; the theories of Professor Bohr as to the structure of the atom and the calculations he has made of the orbits of the revolving electrons are known all over the world and seem to have provided a clue to unravel the difficulties of the emission of ordinary bright-line spectra. The output of accurate determinations of X-ray spectra by Professors Hjalmar, Coster and others has been considerable, and these workers and their French colleagues, Professors Urbain, de Broglie and Dauvillier, have now made nearly a complete survey of this interesting field of research. The claims of Urbain and Dauvillier to fill the space belonging to the atomic number 72, with a rare earth element celtium, must be borne in mind, and we hope to be able to publish a full account of the subject at a later date.


X-Ray Spectra—Principal Lines including Hafnium

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

THE TROUBLE IN THE RUHR

is causing anxious thought to those engaged in the chemical industry, and in particular, to manufacturers of dyestuffs and fine chemicals. I have spoken to many of our leading authorities during the past week, and not one of them seems able to tell me what is likely to happen in that unfortunate part of the Continent. At the moment of writing it seems clear that the economic pressure of France is to be met by the passive resistance of the Germans. How the affair will end the event alone will show, but it will not be in comedy. It is not the way of the French. The Anglo-Saxon may hesitate, compromise, and decline to co-operate and employ gestures of friendship. The French, however, are careful above all, of their national dignity, and when committed to an enterprise do not care to draw back. So the die is cast, and the play must be played out to the bitter end. The end we cannot foresee, but one or two results appear to be inevitable.

GERMANY CANNOT CONTINUE

to purchase the chemical raw materials which she has been in the habit of obtaining from us. Those heads of Universities and Schools who have obtained their research chemicals and their glassware from Germany may find themselves once more having to rely on British makers. Then there is the question of dyestuffs. It would be too unkind if, just after the Manchester Chamber of Commerce had decided that the Dyestuffs Act must go, the colour users of Lancashire and Yorkshire found themselves glad to use products of their own country. And what about Reparations ? At the present time I am told we are taking quite a substantial quantity of German dyestuffs under the provisions of the Treaty of Versailles. Will this continue ? It is a nice problem. Suppose the Germans decline to give any of the Allies the dyestuffs demanded, or, worse still, suppose they agree to furnish England with her quota but no other Ally. Is England compelled to share her quota with the other Allies ? Nobody knows, but the position opens up a very interesting speculation.

THE EDITOR'S FOOT-NOTE

to my paragraph last week, on the British Empire Exhibition betrays that prescience which is so essential to an editor. (This will not secure more space for our contributor—Editor, C. and I.) I now hear that there is to be a meeting of the representatives of the chemical societies this week, at which it is hoped a plan will be devised for a really comprehensive exhibit illustrating the progress made during recent years. It seems to me this exhibit should answer a question which will be in the minds of many visitors from abroad, who will look at the Chemical Section with critical eyes. They will see the progress which chemical industry has made, but what they will endeavour to estimate is whether we have behind it all a stream of new inventions flowing from the research workers in our Universities and Colleges, and in the laboratories of the chemical manufacturers themselves. That will be the question which will have to be answered, for on its answer there largely depends the attitude which our competitors will adopt towards us. I therefore greatly hope our scientific leaders will seize a unique opportunity of impressing the world at large that in this matter Britain maintains, and even surpasses, the honourable reputation she has so long enjoyed. And I am fully convinced that they will take this opportunity and provide us with an interesting and convincing exhibit, shewing the recent achievements in pure chemistry in this country.

THE "SCIENTIFIC AMERICAN"

is among the papers which I regularly read—I think I remarked before that my reading is wide rather than deep—and it set me wondering about recent discoveries. I wondered what was the ontstanding discovery in chemistry or physics of the past decade. I hear my friends talk of Rutherford's prowess in smashing the atom and of Professor Morgan's ingenuity in turning Tellurium to new uses, and a host of other pieces of great original work by men with equally well-known names. In America work of this character is immediately communicated to the thinking public in a most readable form, and the public is thereby educated. Nothing of the sort, as far as I know, is ever attempted in this country, and yet I am convinced there is a large number of intelligent members of the public who have received the rudiments of a scientific education who would be only too ready to avail themselves of such a publication. One has only to think of the number of amateurs who know a great deal about motor cars and wireless apparatus to realise this. I suppose the trouble is that it is difficult for some of our most learned scientists to express themselves in sufficiently simple language to be understood by the people. I hope they will try. As an old journalist I know how difficult it is to prepare a weekly journal which will be palatable to both experts and the general public, but whether we are Fellows of the Royal Society, or merely humble hewers of cellulose and drawers of hydrone, we like to know the new inventions which are coming along. In the meantime, which is the outstanding discovery of the past decade ? Will some of my readers tell me, please ?

FORTHCOMING EVENTS

Jan. 29. Society of Chemical Industry, *Yorkshire Section*, the Queen's Hotel (Room 100), Leeds, at 7.15 p.m. "The Colour Measurement of Brown Solutions," by H. R. Proctor, D.Sc. "Note on the Separation of Propionic Acid from Pyroligneous Acid," by G. W. Douglas.

Jan. 31. University of London, University College, Gower Street, W.C. 1, at 5 p.m. "Radioactivity and X-Rays," by Professor Sir William Bragg, K.B.E., F.R.S.

Jan. 31. Royal Society of Arts, 18, John Street, W.C. 2, at 8 p.m. "The Relation Between Chemical and Antiseptic Action in the Coal-Tar Dyes," by Thomas H. Fairbrother, M.Sc., F.I.C., and Arnold Renshaw, M.D., D.P.H.

Feb. 1. Society of Chemical Industry, *Bristol Section*, Chemical Dept., The University, Woodland Road, Bristol, at 7.30 p.m. "The Necessity for a Change in the Milk Standard," by Edward Russell.

Feb. 1. Silvanus Thompson Memorial Lecture, Technical College, Leonard Street, E.C. 2, at 7.30 p.m. "The Basis of Wireless Communication," by Sir Oliver Lodge, F.R.S. To be followed by a Conversazione and Reunion of Old Students.

Feb. 1. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Photo-synthesis of Plant Products," by Prof. I. M. Heilbron.

Feb. 1. The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "The Maintenance of Voltage on a D.C. Distribution System by means of a Fully Automatic Substation," by P. J. Robinson.

Feb. 1. Society of Dyers and Colourists, *West Riding Section*, the Midland Hotel, Bradford, at 7 p.m. "The Treatment of Coal for the Production of Smokeless Fuel, Motor Spirit, and Fuel Oil," by H. P. Hird.

Feb. 1. The Chemical Society, Burlington House, W. 1, at 8 p.m. Ordinary Scientific Meeting.

Feb. 2. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 9 p.m. "Fact and Phantasy in Industrial Science," by C. F. Cross, F.R.S.

Feb. 2. Society of Chemical Industry, *Manchester Section*, Textile Institute, 16, St. Mary's Parsonage, Manchester, at 7 p.m. "A New Process for the Manufacture of Sodium Thiosulphate," by Luke Hargreaves, Esq., and Dr. A. C. Dunningham. "Considerations Relating to the Choice of Materials for Stone Dusting of Mines, with special reference to Carbonate of Lime," by A. C. Dunningham, D.Sc. "Some Developments in Gas Producers," by T. Roland Wollaston, M.I.M.E.

Feb. 5. Society of Chemical Industry, *London Section*, Engineers' Club, Coventry Street, W., at 8 p.m. "The Estimation of Fat in Casein," by G. T. Bray and F. Major. "Explosions in Liquid Air Rectification Plant," by Dr. E. Fyleman.

NEWS FROM THE SECTIONS

SOUTH WALES SECTION

By the courtesy of the Directors of the Anglo-Persian Oil Co., Ltd., members of the South Wales Section had the unique opportunity of inspecting the new National Oil Refineries at Llandarcy, near Skewen, on January 13. About forty members assembled at the works at 10.45 a.m. and were conducted round the works by Dr. Thompson (chief chemist) and Mr. Wrench. In turn the members visited the offices, the laboratory and the boiler house, in which automatic coal-firing and oil fuel are used.; the power house was then inspected, followed by the plant for distilling crude oil, the bauxite filters, the compressor house (in which by-products are extracted), the experimental laboratory, and the benzine refinery and rectification plant.

The party was afterwards entertained to lunch on the premises, and Mr. W. R. Bird proposed and Mr. J. H. Wells seconded a hearty vote of thanks to the Directors for their permission for the visit and to Dr. Thompson and Mr. Wrench, who had so fully explained the various plants and operations to the members.

LIVERPOOL SECTION

A paper on the "Manufacture of Patent Fuels" was read by Mr. A. Grounds, B.Sc., at the meeting held on January 19. The centre of the briquetting industry in Great Britain is in South Wales, the main works being situated in Cardiff, Swansea, Newport, and Llanelly. Roughly 3 million tons of patent fuels is produced annually by these works, so that the magnitude of the industry will be realised. The choice of coals for briquetting depends on the ultimate destination of the fuel and the purpose for which it is to be used. For domestic fuel, the coal blend consists chiefly of anthracite with a little bituminous coal (usually about 10 per cent.), and about 10 per cent. of medium soft coal-tar pitch. The bituminous coal is added so that when the pitch has burnt off on igniting the fuel, the fine anthracite duff does not fall to powder in the grate but is bound together by the bituminous coal, which must, of course, be of the caking variety. For fuel intended for steam raising, the coals used are generally those from the "steam coal" seams, with the admixture of anthracite and bituminous coal in proportions to correspond to any desired specification. Briquettes intended for use in boilers may vary in size from a small 2 lb. block to one weighing about 28 lb. The 28 lb. block was originally made because it corresponded to the weight which could be carried by a native coolie. The largest consumers of British patent fuel are France, Italy, Switzerland, Egypt and the Scandinavian countries.

Careful control of manufacture is essential since the cost of the pitch used to bind the fuel together is so high. With pitch at its present price of about £7 per ton, the cost of pitch alone in a ton of briquettes amounts to 14s., so that with the cost of the raw coal, labour, establishment charges, etc., very little margin is left for profit, and it is really doubtful at the present time whether patent fuel can be made profitably. Other binders have been sought for during the last forty or fifty years, but no material has been found which is a completely satisfactory substitute for pitch. The materials proposed have been either too dear or too scarce to be seriously considered. Research is required in order to solve this problem and numerous others which have arisen. Thus, there is a prejudice against briquettes or ovoids for domestic fuel consumption because the extremely light and flocculent ash which remains when the fire has gone out gives rise to dust and causes extra work for the housewife. Probably this problem could be successfully solved by adding some easily fusible material to the coal in quite small proportions in order to render the ash fusible, so that after a fire had burnt out, the ash would not be powdery but in the form of clinker which could be removed without creating dust. In steam-raising practice, clinkering is a serious problem, and since more bituminous coal is used in the manufacture of the type of fuel used for this purpose, the ash tends to form clinker more easily than that from the domestic type of patent fuel. Careful blending is essential in order to secure a non-fusible or difficultly fusible ash, and the ash of the coals in regular use should be examined. No systematic research has ever been carried out in this country on the chemical side of briquette production.

Briquettes are usually compressed under a pressure of the order of 30 cwt. to 2 tons per sq. in., but it has been found possible to briquette coal without adding a binder by increasing the pressure up to 10 to 12 tons per sq. in. This process has been carried out by Pure Coal Briquettes, Ltd., and the results have been described by E. R. Sutcliffe and E. C. Evans in a paper read before the London Section of this Society (*cf.* J., 1922, 196 T). The circular briquettes made by this process have the appearance of a piece of finely turned and polished ebony. Very fine grinding is essential, and only certain coals can be treated by this process. Coals with a low content of volatile matter have to be blended with coals containing a higher percentage of volatile matter. A new process has been devised by Minerals Separation, Ltd., in conjunction with the Powell Duffryn Collieries, in which the coal is washed by the froth-flotation process, simultaneously coated with the requisite quantity of binding agent, and then pressed direct. Excellent briquettes are said to have been obtained, and the water from the flotation cells is eliminated without any trouble.

EDINBURGH AND EAST OF SCOTLAND SECTION

The annual dinner of the Edinburgh and East of Scotland Sections of the Institute of Chemistry and the Society of Chemical Industry was held in the Royal Hotel, Edinburgh, on January 20.

Dr. H. E. Watt, chairman of the local Section of the Society of Chemical Industry, presided over an attendance of about 50 members, and the guests included the President and Secretary of the Society of Chemical Industry, the President and Registrar of the Institute of Chemistry, Sir James Walker, President of the Chemical Society, and Lady Walker. Apologies for absence were intimated from Lord Provost Hutchison and Mrs. Hutchison, Principal Sir J. Alfred Ewing and Lady Ewing, and Dr. T. R. Duggan, of New York.

The toast of "Chemistry and Industry" was proposed by Mr. R. B. Pilcher, and replied to by Mr. A. Chaston Chapman and Dr. E. F. Armstrong. Dr. L. Dobbin, chairman of the local Section of the Institute of Chemistry, proposed the toast of "The Guests," which was responded to by Dr. J. P. Longstaff. An excellent musical programme was rendered by various members of the local Sections, and an enjoyable evening closed with the toast of "The Chairman," proposed by Dr. T. W. Drinkwater.

MONTREAL SECTION

Les membres de la section montréalaise de la "Society of Chemical Industry," apres avoir été les hôtes de la "Société de Chimie industrielle de France" (succursale de Montréal), au café Kerhulu, se sont réunis le 12 décembre à l'Ecole Polytechnique. Des discours furent prononcés en anglais et an français. Au nombre des hôtes d'honneur au dîner, on distinguait S. G. Mgr. Georges Gauthier, recteur de l'Université de Montréal et M. Paul-E. Naggiar, consul général de France. La santé "aux hôtes de la soirée" fut proposée par M. W.-B. Woodland, qui parla en français. Mgr. G. Gauthier y répondit en anglais, et M. Naggiar, en français.

Il y eut en suite une séance au cours de laquelle on présenta des travaux scientifiques. M. LeCointe présenta une étude sur une méthode rapide d'estimation du gras dans la crème glacée ; M. le professeur L. Bourgoin lut un travail très intéressant sur l'action catalytique des rayons ultra-violet ; puis M. le professeur J. Flahaut lut une étude sur la chimie physique et la formation des ingénieurs chimistes. Ces diverses études furent écoutées avec intérêt et fort applaudies.

Uu concert de radio, dirigé par M. le professeur Villeneuve, fut très apprécié. M. le consul général de France au Canada avait bien voulu mettre à la disposition des professeurs de l'Ecole Polytechnique un film instructif illustrant la fabrication de la porcelaine de Sèvres. Les diverses vues qui se déroulèrent sur l'écran permirent aux spectateurs de se renseigner sur l'une des plus intéressantes industries de France.

La réunion se termina par un échange de compliments entre chimistes de langue anglaise et chimistes de langue française, tout joyeux de contribuer ainsi à promouvoir la belle cause de la bonne entente entre les cercles qui s'occupent de chimie industrielle.

MEETINGS OF OTHER SOCIETIES

THE FARADAY SOCIETY

On January 15 a meeting was held in Burlington House, the President, Sir R. Robertson, occupying the chair, and Mr. E. W. J. Mardles presented four papers dealing with the physical properties of non-aqueous systems of sols and gels.

Mr. Mardles' first paper, entitled "The study of the reversible sol to gel transition in non-aqueous systems," was divided into two parts. The work in all four papers was carried out with different concentrations of cellulose acetate in benzyl alcohol, which produces no disturbing chemical change. In the first part, on the change in viscosity with time, the results of observations made using the Ostwald capillary tube pattern, the falling sphere, and rotating cylinder and disc types of viscometers, were given, and it was stated that the shapes of the viscosity-time curves obtained depended upon the methods by which the viscosity was measured. During gelation, the sols being a heterogeneous system, the viscosity readings were very irregular, but under optimum conditions the viscosity-time curve was similar to an exponential curve. The empirical equation $\eta — \eta = ae^{kt}$ was submitted for determining the change in apparent viscosity during gelation; the temperature *t* when *k* the rate of gelation becomes zero being taken as the maximum gelation temperature, above which the sol was relatively stable, with time, and below which a part or the whole of the dispersed particles aggregated to form a gel structure.

The second part of this paper dealt with the reverse problem, namely, the viscosity changes associated with the gel to sol transition. From experiments made on different concentration systems at various temperatures, it was found that when the gel was warmed there was a rapid decrease in viscosity but the rate of change rapidly diminished with time, until a fairly constant viscosity was reached. The time taken to attain this constant viscosity was affected by the age of the gel and its previous treatment; mechanical treatment preventing gelation and hastening solation. Sometimes with an apparently fluid system an abnormal viscosity indicated the continued existence of the gel structure in the system. The viscosity-time curves of the gel to sol transition resembled to some extent the mirror images of the viscosity time curves obtained during gelation.

The next paper treated of the scattering of light by organosols of cellulose acetate in benzyl alcohol. On cooling the sol the intensity of scattered light at first gradually increased, until a temperature termed the maximum gelation temperature was attained. After this the rate of change of the intensity began to increase rapidly, and the system became opalescent, and in some cases translucent. At a lower temperature a point of inflexion occurred in the curve, the system set to a firm gel, and from this point onward a steady decline in the rate of change of intensity of scattered light was observed, with diminishing temperature. When a gel was warmed a practically identical curve was obtained, but having a definite shift in position corresponding to the hysteresis effect between "setting" and "melting." It was also found that the Tyndall number was affected by mechanical treatment, rate of gelation, and time.

In his last paper Mr. Mardles discussed the changes of volume and refractive index associated with: (*a*) the formation of organosols and gels, and (*b*) the reversible sol to gel transition, and concluded that:—The volume changes were smaller than those observed by other workers, using hydrosols and gels, and were largest (1) at the lower concentrations; (2) at higher temperatures; and (3) with the best solvents and optimum solvent mixtures. A small volume change varying with time was associated with the reversible sol to gel transition, during which there were indications of a change in the refractive index corresponding to changes in volume and Tyndall number. During the discussion, in which the president, Professor Porter, and Messrs. Hatschek and Highfield took part, it was suggested that Arrhenius's formula should be used instead of the empirical one given above, and that since the substances used introduced no disturbing chemical changes, the volume changes would be purely physical and might be found to agree with a formula of the type

$$V = Am_1^2 + Am_2^2 + Bm_1m_2.$$

Prof. J. R. Partington and Mr. W. G. Shilling submitted a paper on the variation of the specific heat of air with temperature, an investigation which they were led to undertake on account of the great difference in results obtained by previous experimenters. The method adopted was to measure the wave lengths of sound of constant frequency in a gas maintained at the required temperature. The authors found that by plotting molecular heat against temperature a linear curve was obtained up to 700° C. Above this temperature the tube used was too short to give results upon the accuracy of which they could depend. Arrangements, however, were being made to repeat the experiments with a longer tube, and it was hoped that reliable results would be obtained with temperatures up to 1000° C. and above. The gas used in the experiments consisted of air free from carbon dioxide, but the authors pointed out that the apparatus could be equally well used for other gases, and stated that it would be used in this way in the near future.

THE CHEMICAL SOCIETY

At the meeting held on January 18, Sir James Walker, who presided, announced that the Council had nominated Prof. W. P. Wynne as the next President, and Prof. J. F. Thorpe as the Treasurer of the Society. Four papers were presented.

The first Paper, entitled "The Estimation of Acetone in Methyl Alcohol and the Purification of Methyl Alcohol by Sodium Hypoiodite," by H. H. Bates, L. M. Mullaly and H. B. Hartley, embodied experiments on the application of the well-known Messinger method for the estimation of acetone. Mr. H. B. Hartley, who communicated the paper, emphasised the fact that a small quantity of iodine was used up even when the methyl alcohol was perfectly free from acetone, and accordingly a standard procedure had been worked out which took account of this fact. Further, the action between hypoiodite and acetone had been developed by the authors as a means of obtaining acetone-free methyl alcohol. In the discussion which followed Prof. J. C. Philip stated that experiments carried out in his laboratory some time ago indicated a slight disappearance of iodine in the Messinger process, even when organic substances were entirely absent. Mr. Hartley stated in reply that their blank experiments did not suggest such disappearance of iodine.

The second paper, on "Rhythmic Crystallisation," by W. E. Garner and F. C. Randall, dealt with this curious phenomenon as observed in the case of undecylic, myristic, lauric, and caprinic acids, the crystals being due to the formation of a solid skin on the surface of the liquid acid which wrinkled after the passage of the wave of crystallisation. The paper led to some interesting remarks by Prof. C. H. Desch, from which it appeared that records of such crystallisation are fairly frequent in the literature, the phenomenon being exhibited perhaps most effectively by potassium dichromate. It was further suggested that rhythmic crystallisation and the formation of Liesegang's figures were due to the same causes and might be similarly explained.

Two other papers were also read, "The Densities of Dilute Solutions of Potassium Salts and the Volume Changes occurring on Solution," by H. B. Hartley and W. H. Barrett, and "The Chemistry of the Glutaconic Acids. Part XIV. Three-carbon Tautomerism in the Cyclo-propane Series (Addendum)," by F. R. Goss, C. K. Ingold and J. F. Thorpe. Mr. Hartley stated that for the determination of solution densities, a 25 cc. Ostwald pyknometer was used, and at nearly constant temperatures it was possible to obtain an accuracy within 2 or 3 units in the 6th decimal place. The usual contraction on solution of a salt was 20–30 per cent., but potassium iodide presented an exception compared with the other halogen salts of potassium.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

At the meeting held on December 20, an interesting paper on industrial syntheses starting from acetylene was read by Prof. A. Guyot, director of research to the Compagnie des Produits Chimiques et Electro-métallurgiques d'Alais, Troyes et Camargue.

Of the syntheses using acetylene as a starting point, those of acetaldehyde, acetic acid, and chloro-derivatives had found industrial application, others offered hopes of success, and some required to be perfected before they could compete with other processes. After describing the production and uses of tetrachloroethane and trichloroethylene, the lecturer discussed the problem of liquid fuels and explained that although the industrial synthesis of alcohol was not yet economically possible, the catalytic condensation of aldehyde to metaldehyde and paraldehyde offered possibilities. Metaldehyde manufactured by this process was sold in small tablets as a substitute for "solidified" alcohol, but the process had the disadvantage that the yield, as would be expected from theory, was small. The yield of paraldehyde, however, was higher and this product should eventually become an important liquid fuel, as it could be produced more cheaply than alcohol derived from calcium carbide. Processes were being studied on a semi-large scale to utilise the ethylene from coke-ovens for the manufacture of alcohol.

MATTER AND ENERGY

(*Continued*)

BY SIR W. J. POPE, K.B.E., F.R.S.

During the latter part of the nineteenth century many isolated experimental observations were recorded, which indicated that our knowledge of the nature of matter and energy was far from complete and that new, but obscure, domains of science were continually obtruding themselves. In 1896 the French physicist, Becquerel, discovered the phenomena of radioactivity; he observed that compounds of the element uranium have the property of making the surrounding air a conductor of electricity. Shortly after, Madame Curie found that this property is exhibited much more strongly by a new element, radium, of atomic weight 226, which she had discovered; from any material containing radium a continuous stream of a gaseous substance perpetually emanates and renders the surrounding space an electrical conductor. In 1903, Ramsay and Soddy proved that when this gaseous emanation from radium is preserved, the element helium, of atomic weight 4, is produced. Further investigation showed that this remarkable behaviour of radium is due to the disintegration of the atom of the element, and that as a result of this atomic disintegration radium becomes converted into other elements.

Radium, in whatever form present, is perpetually emitting two kinds of rays, distinguished as α-rays and β-rays; it is, indeed, giving out a third kind, the γ-rays, but these are of minor importance to our present object and need not be further discussed. The α-rays consist of helium atoms carrying a positive electric charge and are expelled from the radium atom at a speed of roughly one-twentieth of the velocity of light, namely, about 12,000 miles per second; each gram of radium throws off about 145,000 billions of α-particles per second and each of these during its rapid flight through the surrounding air becomes converted into an atom of the element helium. When a radium atom ejects an α-particle it becomes itself converted into an atom of another element, the radium emanation or niton; the process thus consists in the radium atom, of atomic weight 226, expelling a positively charged helium atom of atomic weight 4, leaving an atom of niton of atomic weight 222. It must be noted that all the atoms of radium are not undergoing transmutation at the same moment; certain of the atoms in the mass explode from time to time, yielding positively charged helium and niton, and it has been found possible to determine the frequency with which these explosions occur; they occur at such a rate that one-half of any given mass of radium will undergo transmutation into helium and niton in about 1600 years. The reflection will immediately arise that if an atom of a radioactive element is born into the world, lives, dies and leaves a succession, it must have ancestors or progenitors; experimental investigation shows that this is the case. The element radium is but one phase in a long series of radioactive transmutations, in which the most distant ancestor, so far as we are as yet aware, is uranium, and the last descendant, as yet traced, is the metal lead. Uranium, of atomic weight 238, has an average life of about 7,000,000,000 years, and by discharge of an α-particle becomes converted into its successor, of atomic weight 234, and helium; the successor in turn lives and dies and the genealogical table has up to the present been investigated through some seventeen generations.

Many radioactive transmutations occur with the emission, not of an α-particle, but of a β-particle; the β-ray has been identified by Sir J. J. Thomson as the particle of negative electricity, the electron, discharged from the atom with a velocity which varies between one-third of the velocity of transmission of light and the velocity of light. It has been already pointed out that the α-particle has the mass 4 compared with the hydrogen atom as unity; the β-particle has a mass of about 1-1800th of that of the hydrogen atom. A radioactive transmutation, which involves the expulsion of an α-particle thus leads to the production of helium and an element four units less in atomic weight than the parent element; one brought about by the shooting off of a β-particle or a negative electron leads to no appreciable or measurable change in atomic weight.

Each radioactive transmutation which has been studied, is found to proceed at a definite rate, which is invariable, and quite independent of the state of chemical combination of the element and of the physical state of the material.

Sir Ernest Rutherford has thus been able to devise a model of an elementary atom. The atom, as he has imagined it, consists of a nucleus in which is concentrated the greater part of its mass; the atomic nucleus thus contains all the particles of positive electricity present in the atom and in most cases it also includes a definite number of particles of negative electricity. The positively charged nucleus is the centre of an external atomic domain, which is of much greater dimensions and in which the remainder of the electrons making up the atom are distributed. The atom is thus imagined as built up entirely of particles of positive and of negative electricity, the positive particles being all concentrated in the atomic nucleus; the nucleus carries a positive charge, which is equal to the difference in number between the positive and negative particles of which it is composed. This positive charge is a very important characteristic of the element and is represented by the *atomic number.* The external atomic domain is large in size compared with the nucleus—in the case of the element gold, for instance, the volume of the nucleus is about 1-20,000th part of the volume of the whole atom—and it contains electrons equal in number to the atomic number, that is to say, its negative electric charge is just sufficient to neutralise that of the positively charged nucleus. Since the atomic shell carries most of the negative particles and the nucleus contains all the positive particles it is obvious that the shell would collapse on to the nucleus unless the electrons were in vigorous motion. The atom must therefore be pictured much as a miniature solar system in which the sun is represented by the positive nucleus and the planets by the electrons in the external atomic domain; the β-particles are thus moving in orbits around the positive nucleus. The conception of atomic structure formed by Rutherford has been extended and developed by others and its mathematical treatment has led to rapid progress in the interpretation of the spectra of the elements; in accordance with it the atom of hydrogen is represented by a nucleus consisting of one particle of positive electricity and an external exterior atomic domain in which revolves one electron, or particles of negative electricity.

We know, however, that the hydrogen atom minus one unit of negative electricity is the hydrogen ion of the chemist, the carrier by which an electric current is transported through an aqueous solution; the ion or positively charged hydrogen atom thus appears to be merely the atomic nucleus of the hydrogen atom deprived of the exterior domain and to be identical with the particle of positive electricity.

Consider the bearings of the conclusions resulting from the mathematical interpretation of experimental observations made on radioactivity, upon such a question of general interest as the age of the earth. The earth receives heat from the sun, and it may be noted that, in general terms, all animal and vegetable life on our planet is perpetuated by the continual flow of energy from the sun at a perfectly definite rate; it is known that on the average each square centimetre of the earth's surface receives per minute two calories of heat, that is, sufficient heat to raise the temperature of two grams of water by 1° C. The mass and the distance of the sun being known, it follows from calculation that each gram of the matter contained in the sun emits annually about two calories. This emission of energy has gone on for at least a thousand million years, as is shown by geological records, and was probably going on ten thousand million years ago, before the moon came into existence and when the terrestrial day was only three or four hours long. During this period each gram of the sun's mass has thrown off something like ten thousand millions of calories, a quantity far greater than could have been supplied by energy of impact with satellites or by any known chemical reaction. We see now that in our solar system the energy required to keep up this rapid flow of heat from the sun to the earth must have been supplied by radioactive transmutations.

Until a few years ago it had always been supposed that each of the 90 or so chemical elements known to us consisted of identical atoms; this indeed was one of the postulates of Dalton's atomic theory. It was supposed, and this was confirmed by accurate measurements, that the atomic weight of an element—namely, the mass of the atom compared with the mass of an atom of hydrogen as unity—was invariable and represented one of the fundamental constants of nature. Further, experiment showed that the atomic weights of the elements were, in general, fractional numbers and were only in a few cases whole numbers within the limits imposed by possible experimental error; these observations and conclusions do not accord with the subatomic theory of matter and energy. The energy changes which occur throughout a series of radioactive transmutations are small when measured in terms of mass, and a radioactive transmutation brought about by the emission of an α-particle should result in a diminution of the atomic number by just two units and a fall in atomic weight of almost exactly four units. The emission of a β-particle, or electron, should raise the atomic number one unit and leave the atomic weight practically unchanged. This indicated change of atomic weight by almost precisely four units which should occur so frequently in radioactive series and the indication that the mass of an atom is, but for a minute fraction, measured by the whole number of particles of positive electricity contained in the atomic nucleus, suggests that the atomic weights should be whole numbers, the mass of the positive particle, the electrically charged hydrogen atom, being taken as unity. It was indeed stated by Prout early in the nineteenth century that the atomic weights are whole numbers, that of hydrogen being unity, but Prout's hypothesis did not withstand the test of experiment and was rejected.

On applying these considerations to the two chief radioactive series, the one beginning with uranium and the other with thorium, it would appear that each should end with the element of atomic number 82, lead, but that the atomic weight of the lead produced from uranium should be 206, whilst the lead formed by the radioactive disintegration of thorium should have the atomic weight 208. This has been shown to be true by Aston's work on isotopes. The latest mode of transmuting the elements is due to Rutherford, who, by using the α-particle as a projectile, has split nitrogen into helium and hydrogen.

ARTS AND SCIENCES

This is one of the toasts *de règle* at Royal Society Club dinners. What may not be included under such label it is difficult to say. As a student of both, I attended at the *Arts* on Wednesday, the 17th. The fog outside was perfect—the night was truly one for Lord Newton and the Smoke-abators. Inside, the dish provided was *Hygienic methods of Painting*, white lead being understood—a suitable enough topic for the newly whited sepulchre of pious opinions in which we met. A summary of the paper was given last week. The question debated was whether it were better to rub down dry or wet—the wets had it.

The chair was most appropriately occupied by Dr. Legge, whose services to industrial hygiene are well known. He spoke in terms of high praise of the constructive aid given by Mr. Klein, not only to the paint industry, but also in connection with lead frits to the pottery trade and more recently to the rubber industry by the introduction of a dustless litharge-rubber mixture, which is easily incorporated. In concluding, Dr. Legge dealt with the difficulty of dealing with the human factor. A competent psychanalyst—if such there be—might have based an interesting study upon his remarks. Primarily, he appeared to be humanitarian, swayed by sentiment; secondarily, the Government Departmental Officer and Factory Inspector, desiring to minimise the work and cost of inspection: a lurking subconscious desire to prohibit, rather than to regulate, seemed to flicker through the plea he put forward in this latter capacity that the Englishman's house is his castle, and that the Inspector can claim no right of entry. Such tendency is very dangerous, and may easily lead to the interests of industry being overlooked.

The discussion was discursive and of no practical value. One humorous speaker, the purpose of whose remarks was in nowise clear, implied that our salvation was to come from the great country where everybody is seeking to protect himself against himself and proclaim himself untrustworthy.

Professor Armstrong referred to the important constructive work done by Mr. Duckering, a Home Office Inspector, in devising an economic method of sterilising anthrax-infected wool, together with that of Mr. Klein as showing how much better it was to deal with problems of industrial hygiene by constructive remedial action, rather than by laying down regulations penalising the manufacturers' liberty and interests.

On Friday I studied skating on films far more tenuous probably than the thinnest ice can ever be, in Faraday's home. The veteran successor of the great philosopher, now in his eighth decade, gave the opening Friday evening discourse and dealt with the work on soap films to which he has devoted his attention during the last four of the fourty-four years of his Fullerian professorship. Those who attend the R.I. lectures are aware that Sir James Dewar's lectures are always the occasion for the masterly, daring and entrancing displays of an experimental dexterity and resourcefulness entirely his own, the lecture being for the most part verbal linkage and by-play.

He dealt with the problems of vortex motion, produced by air currents projected at the surface layer floating on the black film to which soap solutions are ultimately reduced by drainage. The effects following the discharge, through a pinhole orifice, of a current of clean air, at various rates, upon an upright film were projected greatly enlarged upon the screen During at least twenty minutes a large audience witnessed probably the most fascinating display of patterned interference-colours ever given. Those who could in any way picture the complexity of the figures the dancing molecules were forming, in the light of recent work on the orientation of molecules on plain surfaces, had full opportunity to wonder.

A Wanderer in Society

CORRESPONDENCE

SAFEGUARDING OF INDUSTRIES ACT: THE CALCIUM CARBIDE INQUIRY

Sir,—I beg of you to allow me to submit the following remarks upon Sir William Pope's article upon the Calcium Carbide Inquiry and your Editorial reference thereto.

No one will question that in Acts of Parliament, at any rate, it is desirable that language which has a clear and definite meaning should alone be used. If an expression such as "synthetic organic chemicals" occurs in an Act of Parliament, it is desirable that its meaning should be so definite that the public, assisted by properly qualified advice, may know with reasonable certainty whether it does or does not include any particular chemical compound. As the expression "synthetic organic compound" is essentially a scientific term used by chemists, its meaning and, accordingly, the fact whether a substance, *e.g.*, calcium carbide, is or is not such a compound, should be determined by the evidence of chemists. The above-mentioned inquiry unfortunately disclosed the fact that the chemists were divided in their opinion upon the question whether calcium carbide is a synthetic organic compound. "The master minds in chemistry have the right to lay down the definitions of their science"—as your Editorial rightly maintains—but the learned Referee had the duty of deciding whether the evidence established the applicant's contention that the expression "synthetic organic chemicals" so clearly includes calcium carbide that the substance was improperly excluded from the Board of Trade list. He considered the evidence and held that the applicants had failed to establish this position.

All will acknowledge the respect due to and the value of the opinion of so distinguished a chemist as Sir William Pope upon the meaning of the expression "synthetic organic compound." If, however, it be assumed that the learned Referee came to a conclusion with which the majority of chemists would disagree, such expressions as "the proceedings degenerated into an orgy of misapprehension and misinterpretation," and "these Board of Trade inquiries have become ridiculous farces played to the shame of British methods of legal procedure," would not, I submit, be justified thereby. Sir William's article appears to me to confuse the issue which I ventured to raise in my letter to *The Times*. I was not concerned to express, and did not express, any opinion upon the question whether Calcium Carbide is a synthetic organic chemical. I was concerned with his criticisms of the conduct of the inquiry.

Sir William in his letter to *The Times* gave his reason why "these Board of Trade inquiries have become ridiculous farces "—I need not further quote his words. He stated that it was because the Referee was not given the assistance of a chemist as assessor. I may, I think, claim to speak with some experience of legal proceedings in which questions of scientific fact have been the main issue. Under the Patents, Designs, and Trade Marks Act, 1883, as also under the Patents and Designs Act, 1907, in any action or proceeding for infringement or revocation of a patent, the judge might, if he thought fit, and on the request of either party to the proceedings was bound to, call in the aid of an assessor, specially qualified, and to try the case wholly or partially with his assistance. The Act of 1919 has substituted the word " all " for " either " of the parties, but otherwise has left the provision unchanged. During the period of almost forty years that these statutory provisions have been in force, there are probably not more than half-a-dozen reported cases in which the assistance of an assessor has been called in aid. The reason for this is that, in the opinion of those best qualified to judge, the true determination of the issues of scientific fact is not facilitated by adopting such a course. I wonder whether Sir William thinks that the learned Referee would have had the assistance he regards as desirable, had the assessor been one of the eminent gentlemen who gave it as their opinion that calcium carbide was not a synthetic organic compound.

In his letter to *The Times* Sir William stated that the learned Referee on a false translation of a German definition declared calcium carbide not to be an organic chemical and on this erroneous translation rejected the application. I am unaware that the Referee went so far as to declare Calcium Carbide not to be an organic chemical. He certainly did not do so nor reject the application on any false translation of any definition. The definition referred to occurs in Meyer and Jacobson's *Lehrbuch der organischen Chemie*. I agree it was wrongly translated by one of the chemists called on behalf of one of the opponents. It was one element but only one in the evidence, upon which as a whole the Referee decided to reject the application. Sir William is further in error in stating, as he does in his article, that this mistranslation was used to contradict the definition in Richter. The Referee rejected Richter, who says in terms calcium carbide is an organic compound, because he also states that carbon monoxide and dioxide are organic compounds, whereas the bulk of the witnesses called were not prepared to go so far. If the conduct of the inquiry is to be criticised, it is important that the reasons for the decision should not be misstated.—I am, Sir, etc.,

Arthur Colefax

The Temple, London,
January 18, 1923

THE JOURNAL

Sir,—Three technical chemists, each having different interests, met recently and the conversation turned to the new publication of the Society of Chemical Industry. These chemists are not beginners in technical chemistry, having in two cases been engaged for 20 years each, and in the other case for 10 years, and it was felt that their opinions might be useful as representing the views of members to whom the chemical literature of applied chemistry is an important matter. All three were specialists and were well acquainted with the current literature dealing with their particular interests, but all confessed a wider interest than this and generally agreed the necessity of a readable and authoritative journal, embracing pure and applied chemistry in all its branches.

As it now appears that this want will be fulfilled by the new *Journal*, it was decided to offer you the following suggestions for improvement as a basis for discussion, in the hope that something useful might result :—

1. The present abstracts contained in the *Journal* do not cover a sufficiently wide range of contemporary literature ; in many cases trade journals are entirely ignored.
2. The absence of abstracts dealing with pure chemistry is a serious deficiency, and it was felt that some arrangement should be possible whereby members of the Society of Chemical Industry could obtain abstracts dealing with pure chemistry such as those issued by the Chemical Society.
3. There should be some agreement between the various societies by which it would be possible for members of any one society to purchase, at a reasonable price, abstracts relating to all branches of pure and applied chemistry. These should be issued, not only in book form, but also in the form of single printed slips, suitable for use in a card-index filing system—a method already adopted by the Institute of Metals. The present multiplicity of societies, journals and abstracts means much duplication and is costly—the latter point being by no means unimportant to-day.
4. The new *Journal* should preach and preach again the desirability for the unification of existing societies and the Federal Council should make some real effort to materialise the dreams of a central palace of chemistry.
5. The human side of chemistry and chemists should receive more attention than in the past, and the literature should be made lighter and not so indigestible as it is to-day. The activities of the Council should be recorded in the *Journal* in such a way as to sustain the interest of the members in the doings of those who have been elected to look after the interests of the Society, and the curtain should be occasionally drawn aside to show that the Society does more than merely produce a journal.

6. The columns of the *Journal* should become a recognised medium for the exchange of views on matters concerning chemistry and industry, giving the broadest meaning to chemistry and industry.

We all congratulate the Council on its decision to produce a weekly *Journal*, for this is a sure sign that the Council realises the necessity of moving with the times, because in these days when the chemist is almost submerged in a sea of technical literature, he is prepared to take small doses of general chemistry at frequent intervals, but when he receives his literature *en masse*, lack of time frequently compels him to read only in the narrow channel in which his immediate interests lie. With best wishes for the future success of the *Journal*, I am, Sir, etc.,

London, "ONE OF THE THREE."
January 17, 1923.

PRICES OF GERMAN PERIODICALS

Sir,—Professor Browning's letter in your last issue is opportune but does not expose the true import of the great disparity between the charge for Beilstein and German chemical periodicals within and without Germany. This and a number of chemical periodicals now appear under the auspices of the "Verlag Chemie, G.m.b.H.," a publishing combine of the chief German chemical societies.

A list issued in June, 1922, shows that home members of the German Chemical Society were paying 110 marks per annum for the *Berichte*, whilst English members were paying 55 shillings per annum; the English member was thus paying about 40 times as much in gold values as the native. Early in December, 1922, a notice was issued fixing the price of volume 430 of *Leibig's Annalen* at 170 marks in Germany and 2·15 dollars for the foreigner; the ratio in gold values is roughly as 1 to 90. A recent statement on the finances of the German Chemical Society (*Ber.*, 1921, **54** A, 27) notes that about one-thirteenth of the members reside outside Germany.

Calculation from the above data shows that the small number of foreign members of the German Chemical Society are contributing a total of the order of eight times as much in gold as the home members in subscriptions to the society. The policy has thus been adopted of maintaining the home membership of the society by making the foreigner pay nearly the whole of the annual subscriptions.

Data for 1923 are not available because the inset stating the cost of the Society's publications is now withheld from exported journals; but a recent note in the *Berichte* indicates that a new method of fixing subscriptions is to be adopted. The cost will now be the "Grundzahl 20 x Schlüsselzahl des Verlager-Vereins (am 9. XII. 22 : 400)"; this cryptic formula doubtless expresses renewed confidence in the maxim that Heaven helps those who help themselves.

No exact figure can be assigned to the ratio between internal and external subscriptions to German scientific societies because payments are demanded from the foreigner in his national currency according to a stated scale; this facilitates the retention of balances abroad, but must cause vexatious complications in book-keeping. When the mark has been repudiated, and all internal and external German indebtedness thereby discharged, Germany will be in an excellent position for introducing a scientific currency, based upon a unit of ten grams of gold worth about thirty shillings, with which to express the capital value of her vast industrial concerns. Such a currency should quickly become international.

Since Germany has been permitted to pay her national debts by selling paper marks abroad and has persuaded the foreigner to pay the subscriptions of her nationals to her learned societies, it follows as a natural sequence that the plea, put forward by Professor von Harnack in the *Nation* and the *Athenæum* for December 2 last, that foreign resources for the support of scientific education and research should be shared with Germany, is a logical and indeed a moderate one. The eminent signatory of the notorious manifesto of the 93 in 1914 tells us that civilisation is doomed unless scientific research in Germany is subsidised from the outside; the catastrophe may be averted if the resources of the Research Fund Committees of the Royal Society and the Chemical Society, of the Belgian, French and American Academies, and of the Department of Scientific and Industrial Research are placed at the disposal of the Kaiser Wilhelm Institut in Berlin.

Dr. Browning expresses the hope that the English and American Chemical Societies will soon be able to issue a compendium of organic chemistry. The German Chemical Society, which with the outside aid described above, has just reached a record membership of 3,500, issues a very comprehensive work of this kind —Beilstein—and its present flourishing circumstances have recently justified it in undertaking a further great effort in the production of a compendium of inorganic chemistry. Our Chemical Society, with a membership of 3,900, our Society of Chemical Industry, with a membership of 5,600, and the American Chemical Society, with a membership of over 15,000, command a revenue enormously greater than that of the German Society and include many men with more pronounced talents for organisation and lexicography than are available in Germany. There is but one reason which hinders the production of Anglo-Saxon chemical compendia which avoid the many imperfections found in the German ones, namely, the need of capital; this is easy to find in Germany and it remains to be seen whether the recent appeal for funds for this purpose issued by the

Federal Council will furnish the money required for launching a British or an Anglo-American publishing scheme.

During the last few years the chemical abstracts available outside Germany have been greatly improved. The American "Chemical Abstracts" are more complete, and the English abstracts issued by our two large societies are more carefully compiled than those of the *Chemisches Zentralblatt;* the French abstracts are also much more comprehensive than they were a few years ago. There seems now no reason why the *Zentralblatt* should circulate outside Central Europe.—I am, Sir, etc.,

William J. Pope

The University, Cambridge.
January 15, 1923.

LEGISLATION AND THE MILK SUPPLY

Sir,—Prof. H. E. Armstrong, in his article on "Legislative and Departmental Interference with Industry and the Common Weal," states, *inter alia:* "The Ministry of Health has secured the passing of a measure, . . . which will legalise the application to milk of an unnatural treatment known to have a most definite and, without hesitation be it said, detrimental effect upon its food value."

I feel that this statement cannot be allowed to pass unchallenged as it is, I believe, not in accordance with the evidence that we possess.

The regulation referred to, in addition to establishing a bacterial standard, requires all milk sold as pasteurised to be heated to 145° F. for 30 minutes. This was undoubtedly prescribed upon scientific advice because it ensures practical destruction of pathogenic organisms *without causing any chemical change.* Milk pasteurised in this manner shows neither precipitation of albumin nor phosphates; no coalescence of the fat globules—*i.e.*, the cream line is unaltered; the time required for rennin coagulation is not increased; the enzymes remain intact; and the anti-scorbutic properties are undiminished. So far as I am aware, there is no chemical or biochemical test by which milk, pasteurised according to the regulations, can be distinguished from the raw product.

Practical feeding tests on a large scale have been carried out in the depots established by Nathan Strauss in New York, and by Geo. Oyster, Jr., in Washington, D.C., and the results showed that pasteurised milk (milk heated to 145°F. for 30 minutes) was not inferior to good-quality raw milk in any way.

I must also confess to being unconvinced as to the connexion between dental caries and legislative interference with milk. Milk, whether raw or pasteurised, will not tend to develop either teeth or jaw as its imbibition demands no effort from these organs.

Joseph Race

Hafod Road, Hereford, Jan. 19, 1923.

THE LATE DR. LUNGE.

Dr. Lunge completed his scientific education in Germany, and after gaining the degree of Ph.D. he came to the Tyne, where I first met him about the year 1870, with the object of obtaining an appointment as chemist in one of the twenty-six alkali works then in full operation there. He told me at that time that he made personal application to the senior partner of one of the largest of the Tyne manufacturers, who offered him a post as chemist in their very large works at £1 per week, which Dr. Lunge naturally refused, as the suggested remuneration was only 2s. per week above the rate of wages paid to labourers at that time. Although much discouraged by his first attempt to obtain an appointment in which his wide scientific knowledge and training might be put to good use, he persevered in his personal applications to the numerous other chemical manufacturers, and finally secured an appointment as chemist, and afterwards as manager of the Tyne Alkali Co., whose works were situated in South Shields. It was in these works, over a period of some years, that he obtained his practical knowledge of the management of alkali works and also of the control of workmen, who were at that time beginning to give trouble, as the first Trade Union in the chemical industry was formed on Tyneside about 1870. The Tyne alkali works were owned by Messrs. Baily Bowron & Co., and eventually Dr. Lunge married Miss Bowron, by whom he had several sons and daughters.

During his sojourn on the Tyne he took a most active interest in the proceedings of what was then called the Newcastle Chemical Society, which was eventually merged in the Society of Chemical Industry. He read many scientific papers before the members of that society, and became well known to all the scientific men and manufacturers on the Tyne, where his extraordinary energy, force of character, and high scientific attainments were soon fully recognised. He became so prominent in the Tyne chemical industry that, when a successor was required for the chair of technical chemistry at Zurich, he was chosen as the best man in Europe to fill that important position.

From 1870 to the time of his death, Dr. Lunge and I were close friends, and I have in my possession many letters received from him during his long sojourn in Zurich. These letters display his personal charm, as the following extracts indicate. Writing me on December 2, 1901, he said, "I am hard at work at a new edition of my book on 'Sulphuric Acid.'. . Looking at my age and the state of my health I must consider this book (which will be to a great extent quite new) as my last great work." Then again in April, 1907, he wrote me: "I have passed a very indifferent winter—no actual illness, but a general falling off of bodily strength and working power. Well, at my age I must be prepared to pay Nature its tribute." On November 15, 1908, he wrote: "Since I have been obliged to retire from my office, on account of my failing health, my literary work has been the main occupation of my life, and I strongly desire to finish it with a new edition of Vols. II. and III. of that work (Sulphuric Acid and Alkali), Vol. I. having appeared a few years ago." On December 2, 1908, he wrote me: "My dear friend,—So I surely may call you since you say yourself that we have been on an unbroken friendly footing for 40 years past. Your more than kind words on the value of my literary work, and your equally warm wishes for my well-being will be remembered by me to my dying day. They will greatly contribute to lessen the mental depression under which I have been frequently suffering since I have been compelled to give up my office by my declining health. Thank you, thank you, and accept my reciprocating wishes to the fullest extent."

Then again on April 4, 1911, he writes: "I cannot sufficiently express my feelings on receiving your letter of March 29th. This appreciation both of my person and my work on the part of a man on whom I have always looked not merely as one of my oldest friends, but also, as one of the very foremost in that branch of technical chemistry to which I have devoted the best part of my life, is simply priceless to me, and the greatest comfort I could have in the present rather precarious state of my health. That state as well as my advanced age (I am in my 72nd year) make it difficult for me to accede to the wish of my publishers to prepare a new edition of Vol. I. of 'Sulphuric Acid and Alkali,' the edition of 1903 being nearly exhausted. During the years following its publication I have collected a vast amount of material for a new edition, but I have now been so long away from really *practical* work in that field, that I strongly wish for the co-operation of a gentleman who is actually employed at one of the leading establishments and who could contribute information on what is the present practice of the best managed factories in the manufacture of sulphuric acid and of anyhydride. If you could point out such a man (who must, of course, be fully competent and acquainted with every part of the field), you would add another to the numerous tokens of friendship I have received from you for so many years past. Meanwhile take my heartiest wishes for your health and happiness and be assured of the everlasting friendship of your devoted G. Lunge."

I cannot claim that Dr. Lunge was as successful as a works manager as he was professor of technical chemistry in Zurich, but his great work in Zurich is well known to the chemical world, and many distinguished leaders of chemical industry received their chemical training under him. He is well known for his valuable improvements in analytical methods and for his research work, but his chief fame rests upon his books in connexion with the chemical industry, upon which he spent many years of his life. On these books he concentrated all his knowledge, brain power and wonderful industry, almost to the exclusion of all social life. These books are so rich in knowledge that when one refers to them on any subject in the alkali industry one never goes empty away, but always finds in them a wealth of information. In deploring the death of Dr. Lunge, who has lived more than the usual span of human life, the chemical industry of the whole world appreciates to the full the importance of his life work, and the great value of his books, which will be handed down from one generation to another. Dr. Lunge was an indefatigable worker, and although of a somewhat excitable temperament, had a charming personality. The world is considerably poorer for his death, and those engaged in the industry fully recognise and appreciate the great work of his life, whilst they also extend to the members of his family the expression of their sympathy for the loss of such a distinguished man, who has done so much for the chemical industry of the world.

Thos. W. Stewart

PERSONALIA

Dr. R. A. Peters, Fellow of Gonville and Caius College, Cambridge, has been elected to the Whiteley Professorship of Biochemistry in the University of Oxford.

Dr. Percy May has joined the staff of Reeves and Sons, Ltd., manufacturers of artists' colours and materials, as chief chemist and director of the laboratories.

Prof. A. Haller has been elected president of the Académie des Sciences for the year 1923.

At the annual meeting of the Union of Scientific Workers Prof. Dame Helen Gwynne-Vaughan was elected president of the Union.

The following awards have been made by the Geological Society:—Wollaston Medal, W. Whitaker; Murchison Medal, Dr. J. Joly; Lyell Medal, G. F. Dollfus; Bigsby Medal, E. B. Bailey; Wollaston Fund, H. H. Read; Murchison Fund, T. H. Withers; Lyell Fund, Dr. W. T. Gordon and Dr. W. N. Benson.

The Gold Medal of the Royal Astronomical Society has been awarded to Prof. A. A. Michelson, of the University of Chicago, for his application of the interferometer to astronomical measurements.

The death is announced of Dr. Carl Paul Goerz, the founder of the well-known firm of optical-instrument makers of the same name.

NEWS AND NOTES

UNITED STATES

Research on the Effect of High Pressures

According to the *Daily Telegraph*, Prof. P. W. Bridgeman, of the United States, has been able to obtain pressures up to 20,000 atmospheres and has investigated their effect on various substances. Under such enormous pressures, gases permeate metals; liquids become compressible, but with the exception of mercury, and contrary to the generally accepted opinion, do not permeate metals; and the physical properties of various substances become completely changed. It is stated that a solid steel wall is permeated by mercury (the exception mentioned above) under a pressure of 6000 atmospheres, and by hydrogen under a pressure of 10,000 atmospheres. Under a pressure of 12,000 atmospheres, water occupies 20 per cent. of its original volume and alcohol 27 per cent., paraffin and rubber become harder than soft steel, and phosphorus becomes black, non-combustible, and a good conductor of electricity. The new properties are stated to persist after removal of the pressure.

The Fixed Nitrogen Research Laboratory

Dr. F. G. Cottrell, the director of the U.S. Fixed Nitrogen Research Laboratory, states in his annual report that as yet fixed nitrogen cannot compete as a fertiliser with Chilean nitrate or coke-oven ammonia save under unusually favourable circumstances. Work has therefore been carried out on means of reducing the cost of working the cyanamide, synthetic ammonia, arc, and alkali cyanide processes. It appears, however, that any drastic reduction in the cost of operating the cyanamide process is improbable. Much work has been conducted on the transformation of nitrogenous compounds into technically useful materials, and a process has been developed on a semi-technical scale for producing urea from ammonia and carbon dioxide which promises to reduce the price of this material and so permit its use as a fertiliser. An extensive investigation is in progress on the chemistry of cyanamide and its derivatives, and methods have been developed for producing cyanamide (H_2CN_2) in quantity, for converting cyanamide into urea on a semi-technical scale, and for preparing guanidine salts. Cyanamide derivatives which appear to have value as ingredients in explosives have also been studied.—(*Chem. and Met. Eng.*, *Dec.* 20, 1922.)

CANADA

Bentonite

In Canada, the variety of clay known as bentonite has been found at Camrose, near the Red Deer River, in Alberta, and in the Nikola Valley, in British Columbia. Bentonite is especially valuable as a filler in the manufacture of paper and textiles, in which it has advantages over kaolin, and its use has also been suggested in soap-making (in which it can replace part of the soap substance), as a filler in rubber, leather, phonograph records, pressed and moulded insulating material, as a water softener and a base for toilet creams, as a carrier for printers' ink, and as a substitute for fuller's earth. The Canadian Department of Mines is investigating the deposits and seeking further uses for the material.—(*Ch. of Comm. J., Jan.* 5, 1923.)

Barium and Strontium Minerals

All the available information on barium and strontium minerals in Canada has been collected by Mr. H. S. Spence and published in the form of a report by the Canadian Department of Mines (Mines Branch No. 570, pp. 100). The chief source of barytes in Canada is Nova Scotia, the large deposits near Lake Ainslie, Cape Breton Island, having furnished practically the whole Canadian output. Scattered deposits in Ontario and Quebec have been worked, but the output has been small, and although large deposits have been discovered in Northern Ontario in the Langmuir, Elk Lake, and Matachewan areas, the Langmuir Mine has not reached the producing stage, and lack of transport facilities prevents development of the other deposits. Canadian barytes differs from that of the United States in occurring in veins, whereas the latter (Missouri ore) occurs in nodules and irregular masses, and is much softer. Analyses of a number of samples of Canadian barytes gave the following percentages:—$BaSO_4$ 86·60—98·67; $SrSO_4$ 0·70—6·20; $CaSO_4$ 0·30—4·50; $CaCO_3$ 1·60—8·21, the principal impuritie being small amounts of sulphides, calcite, fluorite, and sulphates of calcium and strontium. The output has fluctuated greatly; starting with 300 tons in 1885, it became 4312 t. in 1908, 3490 t. in 1917, and fell to 580 t. in 1918, and 468 t. in 1919, but rose to 751 t. in 1920. Several grinding mills have been established, but at the end of 1920, only one was in operation. The failure to establish the barytes industry in Canada is apparently caused by insufficient attention to trade requirements, the ground barytes being either too coarse, of a bad colour, or impure. The Canadian consumption of ground barytes, lithopone, and barium chemicals in 1920 is given in the appended table:—

	No. of firms	Ground barytes	Lithopone	Blanc fixe
			Lb.	
Paint	36	5,176,200	5,808,700	116,600
Rubber	13	1,328,000	1,065,600	30,000
Paper	5	—	—	280,000
Linoleum and oilcloth	1	—	1,600,000	—
Total	59	6,504,200	8,474,300	426,600

In addition 6000 lb. of barium carbonate. 550 lb. of barium chloride, and 77,500 lb. of barium peroxide were consumed in the rubber, paper, and drugs and pharmaceutical (4 firms) industries, respectively.

Only four occurrences of celestite of possible economic importance are known in Canada, and all of them are in Ontario; the largest deposit is at Bagot, Renfrew County, and is now being worked. There are three known occurrences of strontianite, but these are of mineralogical interest only. The report also contains general information on the sources and uses of barium and strontium chemicals.

GENERAL

The British Association

Sir Ernest Rutherford will preside over the meeting of the British Association for the Advancement of Science, which will be held in Liverpool from September 12—19, and the following have been elected sectional presidents:—

Section A (Mathematics and Physics): Prof. J. C. McLennan, F.R.S.; B (Chemistry): Prof. F. G. Donnan, F.R.S.; C (Geology): Dr. Gertrude

Elles; D (Zoology): Prof. J. H. Ashworth, F.R.S.; E (Geography): Dr. Vaughan Cornish; F (Economics): Sir W. H. Beveridge; G (Engineering): Sir Henry Fowler; H (Anthropology): Mr. P. E. Newberry; I (Physiology): Prof. G. H. F. Nuttall, F.R.S.; J (Psychology): Mr. C. Burt; K (Botany): Mr. A. G. Tansley, F.R.S.; L (Education): Prof. T. P. Nunn; M (Agriculture): Dr. C. Crowther. The local Secretaries are Mr. Edwin Thompson, Dr. A. Holt, and Mr. Walter Moon (Town Clerk).

Nickel

During the war nickel attained a sudden and phenomenal importance and the digest of statistical and technical information collected by the Imperial Mineral Resources Bureau (pp. 55. 1s. 6d.) on the production of nickel during the period 1913—1919 reflects this fact. The most important nickel ore is pentlandite, a sulphide of nickel and iron, and this is mined extensively in the Sudbury district of Canada. Other sources of nickel are New Caledonia, Norway, and Greece. Deposits, not yet worked commercially, are found in South Africa, Australia, France, Russia, Sweden, Cuba, and in the Dutch East Indies.

The world's production of nickel ore (in tons of metal) has been approximately as follows:—

	1916	1917	1918	1919	1920	1921
Canada	37,000	37.000	41.000	20,000	27,000	8,600
Germany ..	1,600	2,000	1,800	570	—	—
Greece	550	86	650	59	—	—
Norway	780	690	238	100	123	—
Sweden	35	49	24	4	—	—
New Caledonia ..	4,000	4,680	2,666	1.780	2.187	—
United States ..	820	360	394	456	326	99

Apparatus for Measuring the Specific Gravity of Gases in Small Quantities

In Technical Paper No. 5 of the Fuel Research Board (pp. 6, price 3d.), Mr. A. Blackie describes a manometric apparatus for determining the specific gravities of gases available in comparatively small quantities. Two determinations can be made with about 1·5 litres of gas, and for gases of specific gravities 0·4 to 0·6, relative to air, the results are correct to within ±0·5 per cent. The apparatus is similar to that devised by Sir Richard Threlfall (*cf.* J., 1907, 355), but shorter columns of gas and air are employed. In the present apparatus a column of gas and one of air, each contained in its respective vertical water-jacketed copper tube 24 feet long and ½ inch internal diameter are hydrostatically balanced against one another, and the differential pressure due to the columns measured by means of a Chattock tilting gauge. The mean temperature of the water jacket is determined by means of a constant-volume air thermometer. Some of the values obtained with the apparatus differed by as much as 3 per cent. from corresponding values determined by a Wright's effusion bell, and this is regarded as the maximum percentage error to which the latter method is liable when no correction for saturation of the gas with water vapour, viscosity, etc. are applied.

Chemical Society

The Anniversary Dinner will be held in the Hotel Cecil, Strand, on Thursday, March 22.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for January* 18)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm of agent	Materials	Reference number
Australia ..	Gold bronze powders; gold, silver and aluminium leaf; dry colours; aniline dyes	9751 E.D./ C.C.
Egypt ..	Photographic chemicals. plates, films, paper, etc. (tender for)	9726 F.E./ G.C.2
„ ..	Soap, paint, oil, alcohol, acids, grease, leather, steel, iron, copper, etc. (tender for)	9777 F.E./ G.P.
France ..	Raw coal tar	18106 F.W./ C.C.2
Latvia ..	Copper wire	6822 F.R./ E.P.
South Africa	Paper	71
Spain, Portugal, S. America	Steel bars, black and galvanised sheets, leather belting	7355 T.E.
United States	China, earthenware, stoneware ..	78
„ „	Tiles	79
„ „	Cement, rails (tender for)	17845 F.W./ G.C.2
Uruguay, Argentina	Glassware	80

TARIFF CUSTOMS EXCISE

Austria.—From February 29, all platinum goods produced in or imported into Austria must have a minimum fineness of 950/1000 and be stamped with the figure 950.

Brazil.—The proportion of duties payable in gold have been raised from 55 to 60 per cent., the proportion payable in paper money being reduced from 45 to 40 per cent.

Ceylon.—An ordinance has been issued prohibiting the export of rubber, save under licence, and limiting the exportable maximum per month to 60 per cent. of one-twelfth of the "standard annual production" of each estate. In addition an export duty is imposed of 2½ cents per lb., and a fee of ¼ cent per lb. is payable when not more than the exportable maximum has been exported in any one month.

Costa Rica.—Surtaxes have been applied to certain goods not affected by the "national tax."

Germany.—Solid artificial or coumarone resins may not be exported save under licence.

Mexico.—New import duties on glass bottles and jars vary from 6 to 20 centavos per kg. gross; the duty on carbonates of soda and potash is fixed at 1 centavo per kg. gross weight.

St. Lucia.—For importation, opium and other habit-forming drugs require a permit.

Straits Settlements.—Regulations controlling the sale of food and drugs may be consulted at the Department.

Tunis.—Particulars of the revised schedule of import duties may be obtained from the Department. The duties on picric acid, indigotin and other dyes are 20, 40, and 16 fr. per 100 kg. respectively.

REPORT

Report on the Economic and Financial Conditions in Brazil, dated September, 1922. *By* E. Hamblock, *H.M. Commercial Secretary, Rio de Janeiro. Department of Overseas Trade. Pp.* 66. *London: H.M. Stationery Office*, 1922. *Price* 1*s.* 9*d.*

Of the various States of Brazil Sao Paulo is by far the most flourishing, and its manufacturing industries, especially the production of chemicals, drugs, and pharmaceutical products, are expanding. Since 1915, local production of fertilisers has supplied the Union's requirements almost entirely, and only 13 tons was imported in 1921. Bauxite occurs in Minas Geraes and at Campinas, and chromite is found in Bahia and near Campo Affonso. Other Brazilian minerals include copper, lead, nickel, gold, clays, mica, lime, abrasives, graphite, ochres, saltpetre, pyrites, and mineral fertilisers; and various precious and semi-precious stones are also found. Minas Geraes possesses the largest deposits of iron ore. The Brazilian Government is disposed to protect the metallurgical industry and in 1921 gave power and concessions to the Anglo-Brazilian Iron and Steel Syndicate, Ltd. Negotiations for the acquisition of hydro-electric power for proposed iron and steel works to be erected by the Syndicate, will, it is anticipated, be soon completed and operations begun. Plans have been approved for the development of hydro-electric works at Pombos Island and the Mambucaba waterfall. By a decree in 1921, the Government of Minas Geraes granted favours to firms undertaking to manufacture iron and steel in any State of the Federal Union, and a reduction from 3 milreis to 200 reis per ton has been made in the State export tax on all ore destined for manufacturing purposes in Brazil. Deposits of manganese ores occur principally in Minas Geraes and Matto Grosso, but those in the latter State have never been exploited owing to the lack of transport facilities. No petroleum deposits of commercial importance have been discovered in the country. In Sao Jeronymo, 215,000 tons of coal was mined in 1921. Tests made in Britain, the United States and in Belgium with a view of employing Brazilian coal for the production of metallurgical coke are said to have given satisfactory results.

Total exports from Brazil during 1921 were valued at £58,587,000, compared with £65,451,000 in 1913 and £107,520,000 in 1920, the corresponding import figures for the same years being, respectively, £60,468,000, £67,166,000, and £125,005,000. During the war the United States supplied the greater part of Brazil's import trade. Official statistics for the first quarter of 1922 show that although Great Britain is again the most important source of Brazilian imports, the discrimination in favour of the United States and Belgium in the matter of certain imports from these countries still prevails. Early in 1922 an attempt was made to develop commercial intercourse between South Africa and Brazil; it is not anticipated that any great success will attend the project. British dyes would appear to be declining in price, whereas German dyes are apparently becoming dearer. Germany is interested in the acquisition of Brazilian dye-woods.

REVIEWS

(1) Inorganic Chemistry. *By* E. J. Holmyard. *Pp. xi*+560. *London: Edward Arnold and Co.*, 1922. *Price* 6*s.* 6*d. net.*

(2) An Inorganic Chemistry. *By* Prof. H. G. Denham. *Pp. viii*+683. *London: Edward Arnold and Co.*, 1922. *Price* 9*s. net.*

(3) Laboratory Exercises in Inorganic Chemistry. *By* J. F. Norris *and* K. L. Mark. *Pp. x*+548. *London: McGraw-Hill Publishing Co., Ltd.*, 1922. *Price* 10*s. net.*

(1) The reading and re-reading of this book has been sheer delight to the reviewer. It might appear that Mr. Holmyard undertook no very unusual task in writing what is correctly described by its sub-title as " A Text Book for Schools," and in the preface as " an attempt to present to students of the School and Higher Certificate Standards a logical course of chemistry which shall acquaint them with modern ideas and give them an insight into the problems, methods and achievements of the science." But the book he has produced is in fact remarkable, being, in the reviewer's opinion, quite literally and soberly the very model of all that such a book can and should be. It is not possible to write of it save in terms which appear exaggerated. The whole book is extraordinarily cleverly done ; it is the real substance of chemistry made living by the enthusiasm of a real chemist. Drastic selection, has, of course, been required to compress the whole subject of inorganic chemistry into some 540 small pages, but one is not conscious of it ; even after careful study one misses nothing whatever of basic importance. This book, in fact, differs from most text-books of chemistry big and little, in that it was obviously created not by whittling down the unwieldy mass of facts and theories which constitute chemical literature, but rather by the careful crystallisation of the author's own knowledge. From a goodly store of well-digested chemistry he has brought out the *essential* material, with nothing omitted, nothing redundant, and has written it down in logical order with perfect clarity, simplicity and conciseness of thought and language. One is indeed impressed by the skilful workmanship of the writing.

The general plan of the book is unusual and good : it falls into two main parts, one dealing with general theory, the other describing the elements in the order of the Groups of the Periodic Classification. The chapter headings in Part I. are :—Historical ; The Atomic Theory ; Equivalent Weights ; The Gas Laws ; Molecular Weight ; Atomic Weight ; Formulæ and Equations ; The Kinetic Theory ; Thermal Dissociation ; Electrolysis, Osmotic Pressure ; Chemical Equilibrium ; The Ionic Theory ; Catalysis, Colloids, Phase Rule ; The Periodic System ; Structure of the Atom. Each of these topics in turn is treated in a fashion which, whilst always "elementary," in the sense that it must command the interest and comprehension of any intelligent person, is most delightfully thorough, accurate and satisfying. At this stage in the progress of chemistry most teachers must feel how great are the difficulties in teaching the atomic theory; the author overcomes these difficulties in a characteristically direct and satisfactory manner by reverting to the actual historical development of the Daltonian theory and treating it as a hypothesis which, whilst excellent as a working guide in chemistry, is inexact in every particular. Mr. Holmyard has devoted much study to the history of chemistry and it is therefore not surprising that the historical treatment throughout is especially fresh, sound and attractive. Chapter XVI, on the Structure of the Atom, is very very good indeed; it has had the advantage of Professor Soddy's criticism, but it is apparent that the author must himself be given the credit for presenting, in the short space of 17 pages, a most closely argued, exact and yet entrancing (there is no other word which quite fits) account of recent developments.

After all this it may seem rather a shock to say that the book has many pleasant touches of humour, *e.g.*, as an exercise on the chapter on the atom, the request to "write an essay on the Clifton boy's dictum: *chemistry is a soul-destroying subject.*

But Mr. Holmyard believes that science "is the greatest of the 'humanities,'" and his book certainly does chemistry the very real service of presenting it in this light.

As constructive criticism attention may be drawn to a few misprints, *e.g.*, 22/4 litres for the G.M.V. five times in succession on page 64: the quantity is correctly stated as 22·4 litres on the next page; and *well* for *wall* on p. 102. Also, the boiling point of ozone is incorrectly given as—125 deg.

There seems no doubt that, as a school book, and for elementary students in university classes, this work *must* come into quite general use, simply through sheer excellence for that purpose: but it may be commended to a much wider public because no chemist, be his work in teaching, research or industry, can fail to derive from it much pleasure and profit.

(2) Professor Denham's book suffers in review by contrast with that just discussed. It is a general text-book of inorganic chemistry for university degree students constructed on the plan now usual, whereby, after a general introduction the non-metallic elements are discussed in the usual order with the interposition of chapters dealing with matters of general theory as they arise. But it is uninspired and, moreover, is marred by a number of rather serious errors and omissions. As examples the following may be cited, *inter alia:* The statement (p. 72) in heavy type that "the number of particles present in a colloidal solution is, under similar conditions of temperature and pressure, equal to the number of molecules of gas computed to be present in a corresponding volume of gas" seems to have no meaning; the definition of solutions (p. 113) as "mixtures which appear homogeneous in ordinary daylight, and which cannot be separated by ordinary mechanical means into their constituent parts," seems inadequate; after stating (p. 173) the contrast in solubility between the fluorides of calcium and silver and the other halides of these metals, the author says without further explanation, "Possibly this is connected with the tendency of hydrogen fluoride to associate in solution," which is at the best very obscure, whilst he does not anywhere point out that the abnormal boiling-point of hydrogen fluoride may be explained by its association in the liquid state. In the discussion of osmotic pressure the work states, again in heavy type, that "the osmotic pressure exerted by a dissolved substance is therefore identical with the gaseous pressure which that substance would exert, if the same weight of substance were in a state of vapour, under the same conditions of temperature and pressure." As examples of omissions it may be pointed out that the discussion of ozone (pp. 191–5) contains no reference to the Brodie ozonizer, or to Soret's work on the constitution of ozone, that the account of the allotropy of sulphur contains no reference to $S\lambda$ and $S\mu$ (p. 216).

In general it must be said that the book has no outstanding merit which might lead it to be preferred to other good textbooks now available.

(3) This laboratory manual is one more proof that conditions in American universities must be very different from those in our own. Many of the experiments described are of a very elementary nature, and some, such as the determination of density, specific heat and humidity, are purely physical.

Most university teachers here would take exception to the method of treatment: no intelligence or initiative is assumed or, apparently, desired of the student. The description of each experiment is preceded by a short "discussion" of the principle involved, and then by a list of "materials" to be obtained for the performance of the experiment; the description concludes with a list of numbered questions the answers to which constitute a report on the experiment and are supposed to be written on the blank page opposite.

Its utility is further limited by the fact that it is apparently written throughout with direct reference to a specific laboratory and its equipment and a specific course of instruction.

If its contents were reduced to one-third the book might possibly find a use in the teaching of school children just beginning experimental work in chemistry, but it is difficult to see how, in its present form, it can find useful application in English teaching.

H. V. A. Briscoe

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

No important changes in this market have been reported this week. Prices are as follows :—

Acetic Acid 40% tech.	£21.
Acid Hydrochloric	4s. to 5s. carboy d/d.
Acid Nitric 80° Tw.	£25 10s. per ton makers' works.

Acid Sulphuric, average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.

Acid Sulphuric, 94% arsenical, £6 10s. per ton makers' works.

Ammonia Alkali	£8 per ton.
Arsenic (White)	£65 to £75 per ton.
Bleaching Powder	£10 10s. to £11 10s.
Calcium Chloride	£6 per ton.
Copper Sulphate	£26 f.o.b.
Potash Caustic	£29 10s. to £30.
Salammoniac	£32 per ton d/d.
Potassium Bichromate	6¼d. per lb. d/d.
Salt Cake	£4 10s. to £5 10s.
Soda Caustic, 76%	£20 to £21.
Soda Crystals	£5 10s. carriage paid.
Sodium Bicarbonate	£10 10s. carriage paid.
Sodium Bisulphite Powder 60/62%	£19 to £20 10s. per ton, f.o.b. or f.o.r. London.
Sodium Chlorate	In slightly improved request. Foreign parcels offered at low prices.
Sodium Sulphide	£16.
Sodium Sulphite, Pea Crystals	£17 to £17 10s., 1 cwt. wooden kegs included.
Bisulphite of Lime	£7 per ton, packages extra and returnable.
Sodium Acetate 97/98%	£23 per ton.
Sodium Nitrite	£30 per ton 100% basis d/d.

WOOD DISTILLATION PRODUCTS

There are no changes to report in this section. Manufacturers' prices are as follows :—

Acetate of Lime brown	£8 per ton d/d.
,, ,, ,, grey 80%	£14 10s. per ton d/d.
,, ,, ,, Liquor	9d. per gall. 32° Tw. d/d.
Charcoal	£9 10s. to £10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefin'd.
Wood Naphtha, Miscible	7s. per gall. 60% O.P.
,, ,, Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£4 10s. per ton d/d.
Brown Sugar of Lead	£36 per ton.

TAR PRODUCTS

Acid Carbolic, Crude 60's	2s. 5d. to 2s. 6½d. per gall. Market firm with fair inquiry.
Acid Cresylic, 97/99	2s. 2d. to 2s. 3d. per gall. Fair inquiry.
Acid Cresylic, Pale 95%	2s. to 2s. 2d. per gall.
Acid Cresylic, Dark	1s. 10d. to 2s. per gall. Little demand ; offers have been made as low as 1s. 6½d. per gall.
Anthracene Paste, 40%	7d. per unit per cwt. Price nominal. Practically no business being done.
Anthracene Oil, Strained	7¾d. to 10d. per gall. Small demand.
Anthracene Oil, Unstrained	7⅝d. per gall.
Benzole, Crude 65's	1s. to 1s. 2d. per gall.
Benzole, Standard motor	1s. 7½d. to 1s. 11d. per gall.
Benzole, Pure	1s. 10d. to 2s. 2d. per gall. Demand very small.
Toluole, 90%	1s. 10d. to 2s. per gall. Small demand.
Toluole, Pure	2s. to 2s. 4d. per gall. Small demand.
Xylol	Prices range very widely from 2s. 1d. to 3s. 6d. per gall.
Creosote Cresylic 20/24%	10d. to 11d. Fair inquiry.
Creosote, Heavy	7½d. per gall. Demand strong.
Creosote, Standard specification	7¼d. to 8¼d. per gall. Strong and scarce.
Naphtha, Crude	9½d. to 1s. 2d. per gall.
Naphtha Solvent, 90/160	1s. 6d. to 1s. 10d. per gall. Market weak with little inquiry.
Naphtha, Solvent 90/190	1s. 7d. per gall.
Naphthalene, Crude, Drained Creosote Salts	£5 to £7 per ton. Exceptional prices as high as £9 10s. are heard of. There is a good inquiry for this product.
Naphthalene, Crude, Whizzed or Hot Pressed	£8 to £12 10s. per ton.
Naphthalene Crystals	£16 per ton.
Naphthalene, Flaked	£15 per ton.
Pitch, Medium Soft	130s. to 140s. per ton. Very firm.
Pyridine, 90/140	12s. 6d. per gall.
Pyridine, Heavy	8s. to 9s. per gall.

INTERMEDIATES AND DYES

Business has not been up to the average of the past few weeks, but the general tone remains confident. The chief intermediates are quoted below carriage paid and packages included unless otherwise stated :—

Acid H.	5s. 1d. lb., 100% basis.
Acid Naphthionic	2s. 7½d. ,, ,, ,,
Acid Neville and Winther	6s. ,, ,, ,,
Acid Sulphanilic	1s. 6d. ,, ,, ,,
Aniline Oil	11½d., drums extra, or 10d. naked at works.
Aniline Salts	11½d. or 10½d. naked at works.
Benzidine Base	6s. 6d. lb., 100% basis.
Dinitrobenzene	1s. 3d. lb., 11d. to 1s. naked at works.
Dinitrotoluene, 48/50	8d. to 9d., naked at works.
Dinitrotoluene, 66/68	1s. 2d. to 1s. 3d., naked at works.

Diphenylamine	4s. 1d. lb.
α-Naphthol	2s. 9d. lb.
β-Naphthol	1s. lb.
α-Naphthylamine	1s. 6½d. lb.
β-Naphthylamine	4s. 6d. lb.
p-Nitraniline	2s. 9d. lb.
Nitrobenzene	8d. lb., drums extra.
Nitronaphthalene	1s. lb.
Naphthionate Soda	2s. 8½d. lb., 100% basis.
Diethylaniline	4s. 6d. lb., packages extra.
Metanitraniline	5s. 6d. lb.
Para Toluidine	5s. lb.
Para Phenylene Diamine	12s. lb., 100% basis.
Meta Phenylene Diamine	5s. 6d. lb.
Meta Toluylene Diamine	5s. lb.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid Acetic, 80%	44s. cwt., ex wharf London. Slightly higher.
Acid Acetyl Salicylic	2s. 10d. to 3s. lb. Remains steady, fairly active business.
Acid Benzoic	2s. lb. represents spot value.
Acid Boric B.P.	£61 per ton crystals, £65 per ton powder, packages in 2 cwt. bags; carriage paid U.K.
Acid Citric	1s. 8d. to 1s. 8½d. lb., less 5% for ton lots. Dearer with further advance likely. A new feature is the arrival of small supplies from the British West Indies.
Acid Gallic	3s. lb.
Acid Pyrogallic crystal	5s. 6d. lb.
Acid Salicylic	1s. 5d. to 1s. 6d. lb. Very good demand, market firm and advancing.
Acid Tannic	3s. 3d. lb. unchanged.
Acid Tartaric	1s. 2½d. lb. for ton lots, less 5%. Market dearer—demand heavy; further advance anticipated.
Amidol	9s. lb.
Acetaniline	1s. 5d. lb. Small demand.
Amidopyrine	12s. 6d. to 13s. lb.
Ammonium Benzoate	2s. 6d. to 3s. lb., according to quantity.
Ammonium Sulphocyanide, recryst.	2s. 6d. lb. Cheaper qualities are available at 1s. 9d.
Barbitone	12s. 6d. lb. Dearer.
Benzaldehyde free from Chlorine	3s. lb. Cheaper.
Benzonaphthol	5s. lb.
Bromides	Potassium 7d., Sodium 8d., Ammonium 9d.
Calcium Lactate	2s. lb. for British made products.
Chloral Hydrate	4s. lb. for duty paid.
Formaldehyde, 40%	90s. to 100s. cwt. Supplies not plentiful.
Guaiacol Carbonate	8s. lb.
Hexamine	3s. 6d. lb. Price steadily advancing.
Homatropine Hydrobromide	30s. per oz.
Iron Ammonium Citrate	No change. Rather quiet with small demand.
,, ,, ,,	B.P. 2s. 5d. lb.
,, ,, ,,	Green 3s. 1d. lb.
Iron Perchloride	22s. to 25s. cwt. Steady market.
Menthol	38s. 6d. lb., less 2½% for original cases. Smaller quantities 39s. lb. nett.
Methyl Salicylate	2s. 2d. lb. for water white in glass containers. Drums and tins slightly less.
Methyl Sulphonal	13s. lb. Little inquiry.
Mercurials	Unchanged; rather dull market.
Paraformaldehyde	3s. lb.
Paraldehyde	1s. 5d. to 1s. 9d. lb., according to packing and holder.
Phenacetin	5s. lb. Firmer.
Phenazone	7s. lb.
Phenolphthalein	5s. 3d. lb.
Potassium Bitartrate 99/100% (Cream of Tartar)	98s. per cwt. for ton lots, less 2½%. Firm with upward tendency.
Potassium Metabisulphite	8d. lb.
Potassium Permanganate	8½d. lb. Quotations tending higher.
Quinine Sulphate	2s. 3d. to 2s. 4d. oz. Bulk packages. Fairly steady market.
Resorcin	5s. 6d. lb.
Salol	2s. lb.
Silver Nitrate	1s. 11d. oz. in 500 oz. lots.
Sodium Benzoate	2s. lb. spot.
Sodium Hyposulphite, Photographic	£15 to £17 per ton, according to quantity.
Sodium Potassium Tartrate (Rochelle Salt)	80s. to 85s. cwt. Fair demand.
Sodium Salicylate	1s. 9d. to 2s. lb. Market very firm and rising.
Sodium Sulphite, Anhydrous	£27 10s. to £28 10s., according to quantity, f.o.r. London drums included.
Sodium Sulphite Crystals	£17 to £17 10s. per ton, according to quantity. 1 cwt. kegs included.
Thymol	17s. to 19s. lb., according to quality.

PERFUMERY CHEMICALS

Amongst perfumery chemicals Rhodinol has fallen appreciably in price; otherwise there are no changes to report:—

Amyl Acetate	2s. 3d. per lb.
Amyl Butyrate	8s. ,,
Amyl Salicylate	3s. 3d. ,,
Anethol, melting point 21-22° C.	4s. 6d. ,,
Benzyl Acetate from Chlorine free Benzyl Alcohol	3s. ,,
Benzyl Alcohol free from Chlorine	3s. ,,
Benzaldehyde free from Chlorine	3s. ,,
Benzyl Benzoate, 19.5° C.	3s. ,,

Cinnamic Aldehyde, 98/100%	
Natural	14s. 9d. per lb.
Citronellol	22s. 6d. ,,
Citral, 100%	10s. 6d. ,,
Ethyl Phthalate	4s. 6d. ,,
Eugenol, 100%	10s. 6d. ,,
Geraniol (from Palmarosa)	32s. 6d. ,,
Geraniol	5s. 6d. to 12s. 6d. per lb.
Iso Eugenol	16s. per lb.
Linalol ex Bois de Rose ..	21s. ,,
Linalyl Acetate	22s. 6d. ,,
Methyl Benzoate	8s. 6d. ,,
Phenyl Ethyl Acetate ..	10s. ..
Phenyl Ethyl Alcohol ..	17s. 6d. ..
Rhodinol	45s. ,,
Terpineol	3s. ..

ESSENTIAL OILS

Anise Oil, Red Ship Brand	2s. 1½d.
Bourbon Geranium Oil ..	20s. for shipment.
Cananga Oil, Java ..	9s., firm.
Cinnamon Oil, leaf ..	4¼d. per oz.
Cassia Oil, 80/85% ..	8s. 7½d.
Citronella Oil, Java, 85-90%	3s. 6d.
Citronella Oil, Ceylon ..	2s. 8d.
Clove Oil	7s. 3d.
Eucalyptus Oil, 70/75% ..	1s. 10d.
Lavender Oil, Mont Blanc, 38/40%	14s.
Lemon Oil, spot	2s. 10d. New crop for shipment, 2s. 7d.
Orange Oil, Sweet, spot ..	9s. New crop for shipment, 7s. 9d.
Otto of Rose—	
Anatolian	24s.
Bulgarian	28s.
Palma Rosa Oil	17s.
Peppermint Oil—	
English, Mitcham ..	80s.
Wayne County	13s. 6d.
Japanese	7s. 6d.

TRADE NOTES

Wages in the Soap Trade

As a result of the intervention of the chairman of the Soap and Candle Trades Employers' Federation, the men at the soap and candle works of Messrs. J. and J. Fields, Lambeth, who have been out on strike nearly a fortnight, returned to work on January 19. A reduction of the standard rate of wages in the soap and candle trade was put into force on January 1, and the men at Messrs. Fields are working at the new rate. Certain other grievances will be inquired into when normal work has been resumed.

The Beet-Sugar Industry in Manchuria

About 9000 acres has been planted to sugar-beet in Manchuria this year and an excellent crop, about 50 per cent. greater than that of last season, is expected. The area under cultivation will probably be greatly extended next year. The South Manchuria Sugar Refining Co., of Mukden, which now proposes to obtain beet-seed locally, instead of from Germany and the United States, is erecting a second factory at Tiehling to commence operations at the end of this year. Beet-growers have been paid about 17s. 10d. per ton of roots, a price higher than that paid in Northern Japan, and as coal and labour are also cheaper, the outlook of the industry is promising.

Mineral Production in Formosa

The minerals produced in Formosa include gold, silver, copper, coal, petroleum, and iron ore. Little more than a third of the island has been surveyed geologically, but it is believed that the mountains in the interior are rich in minerals; and the completion of a hydro-electric plant at Jitsugetsutan (Lake Candidius) will make cheap power available in abundance for mining operations in any part of the island. The mineral output in 1920 and 1921 was as follows:—

		1920.	1921.
Gold	oz.	18,687 ..	28,455
Silver	,,	18,086 ..	26,525
Copper	lb.	1,584,000 ..	2,640,000
Coal	tons	1,140,000 ..	1,100,000
Sulphur	lb.	1,848.000 ..	1,861.200
Magnetic iron sand ..	,,	— ..	40,920

The commercial development of the more inaccessible regions of Formosa will probably begin within a few years.—(*U.S. Com. Rep., Dec.* 11, 1923.)

PUBLICATIONS RECEIVED

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Farben- und Lackkalendar. Taschenbuch für die Farben- und Lack-Industrie, sowie für den einschlägigen Handel. *By* Dr. H. Wolff *and* W. Schlick. *Pp.* 177. *Stuttgart: Wissenschaftliche Verlagsgesellschaft m.b.H.*, 1923.

A Text-book of Inorganic Chemistry. *By* G. S. Newth. *New and enlarged edition. Pp. xiii*+272. *London: Longmans, Green and Co.*, 1923. *Price* 8*s.*

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Mesothorium. *By* H. Schlundt. *Technical Paper* 265. *Price* 10 *cents.*

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JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

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EDITORIAL

ONE of our correspondents asks us to publish a pleasant and easy account of X-ray spectra written in simple language such as ordinary people use. He thinks that an article of this sort would help us all to understand the significance of the new element. We are in entire agreement with him and so soon as we can obtain from those who have been at work on the X-ray spectra of Hafnium and the rare earths, an accurate and authoritative account of the recent investigations we will take the necessary steps. To write in simple language the modern chemical discoveries is not so difficult as is commonly supposed, but it takes time. An expert who has devoted some years to the technical details of X-ray analysis or the ordinary spectroscope can very easily summarise some new piece of work, and he can do this with an accuracy and an insight which no one else can emulate. But he most naturally and quickly does it in the phraseology to which he is accustomed, and this is usually technical. If you call upon him, as he writes, to explain the meaning of Angstrom units, atomic numbers, Balmer series, Bohr's theory and $L\beta_3$ lines, you take up so much of his precious time that he does not readily respond to an invitation. And if one who is not an expert in this branch attempts to write on it, so many papers have to be referred to in back numbers of the *Philosophical Magazine* and the *Comptes Rendus* that much time is involved. In either case it is difficult to arrange, within a few days of the announcement of the new element, for an adequate account of the investigation suitable for a body of readers who differ widely in their tastes and information. We will bear our correspondent's suggestion in mind and if one of our physical chemists will favour us with such an article we, and our readers, will be greatly obliged.

* * *

The chorus of praise resounding the world over in celebration of the centenary of the birth of Pasteur, has not yet attained its height and Dr. Pasteur Vallery-Radot is to lecture on his grandfather's life and work in London on February 2. Now there comes another centenary, one that should be a source of especial pride to Englishmen. We refer to the centenary of the death of Edward Jenner, the discoverer of vaccination. To those of the younger generations the importance of this discovery may seem remote, and such is the confidence in the safety which its application has brought about that detractors of its value are not lacking. It is not our function to point out the folly of our national weakness for allowing sentiment to obscure the interpretation of fact; the recent outbreak of smallpox is sufficient evidence that the increasing avoidance of vaccination is not to be ignored. Jenner's work in founding the science of serotherapy is sufficient claim on the interest of chemists, for the consequences of his discovery range from the protection of vast armies in the field from epidemic disease to preventive inoculations against the winter "colds" that distress the populace. On the foundation thus laid in a Gloucestershire village has been built up the science of serotherapy, equipped with a formidable terminology, bristling with words like "antibodies," "complement fixers," "amboceptors," and the like. The bulk of the work has been done by medical and veterinary investigators, although the problems of serotherapy are fundamentally chemical problems, being concerned primarily with the investigation of reactions between protein matter. There could be no more suitable occasion than the centenary of the birth of Edward Jenner to put forward the plea for co-operation between the chemical and biological sciences, for real progress will be made only when it is realised that chemical research is not merely a means of increasing material prosperity, but touches the basis of life itself. As an instance of the necessity for co-operation between chemists and biologists—a co-operation that should have beneficial results in producing a clarification of the terminology—mention may be made of a recent discussion on fermentation, in which the "education" of bacteria was mentioned, whereas what was meant was merely the elimination from a mixed population of individuals not possessing the desired qualities.

The identification of micro-organisms is not work for the chemist ; nor should the biologist be occupied with the study of purely fermentative processes.

* * *

Our correspondent R.C., whose letter appears in this issue, thinks this journal should not include articles on pure chemistry and we think a little explanation may interest him and many other readers. The journal, including Transactions and Abstracts, goes to all members of the Society of Chemical Industry. Chemistry and Industry, without the Transactions and Abstracts, with the assistance of the Chemical Society, goes to several hundred Fellows of the Chemical Society ; it also is sent to a number of other subscribers and is on sale at a large number of railway bookstalls as appears in the advertisement in this issue. The Chemical Society, the Society of Chemical Industry, the Federal Council and several other Societies attach great importance to this co-operation, and it is perhaps a first step in a more far-reaching form of co-operation to be considered in the future. In a journal circulating among a considerable number of readers who are not all concerned in applied chemistry, a great variety of topics must be discussed. Some of these readers have a considerable knowledge of both pure and applied chemistry, some have a fund of information on one branch only, many have very little exact knowledge of chemistry, but are interested in the subject. We are therefore compelled not only to deal with pure chemistry as well as applied, but we shall have to publish articles which are very elementary indeed, bringing in facts which are well known to all those who have ever studied chemistry. If a reader finds sometimes an article which mentions no fact new to him, let him remember that there are others who are not so fortunate.

* * *

A detailed and critical examination is being made of the suggestions which we receive in connexion with this journal, and we are convinced that in a few months we shall find out what sections of the public it will appeal to, and how we can best satisfy them. If a reader finds that some sort of article is lacking, the best criticism is to send us an article of the type desired ; we shall take this as a hint and act upon it. To those, if any, who are dissatisfied with our progress, we must plead that if we are spared for a while we shall grow in substance and flavour. *Laissez-moi carpe devenir.* It takes more than a few weeks to build up an organisation. That part which deals merely with correspondence and proof-correcting is soon established ; it is a longer process to discover what the readers wish to read, and still longer to find which of our readers will write what is desired. Our readers are the only source of supply, and when the organisation is complete it will be found to be a co-operative society.

CHINA CLAY

Its Composition, Preparation and Uses

By H. F. COLLINS, A.R.S.M., M.I.M.M.

NEXT after coal (although a long way after) china clay or kaolin is the most important raw material that the United Kingdom is in a position to export. In view, therefore, of the trade balance against this country, and of the growing difficulty experienced in finding markets for our manufactured products in competition with those of other countries, the export of china clay, both from the point of view of output and of return freight, possesses an importance greater than would be suggested by a consideration merely of its intrinsic value per ton.

The china clay of commerce is not quite a raw material, but a purified and partially prepared one, since it is not found naturally in precisely the same form in which it is sold. Unlike the ball clays of Devonshire and Dorsetshire, which are of detrital origin, and are sold as dug. china clay is the product of the decomposition *in situ* of the felspathic constituent of granitic rocks, which in certain places have been converted into a soft crumbly material that upon soaking in water becomes pasty ; and in order to separate the clay from the other constituents of the rock (quartz and mica, with smaller quantities of tourmaline and other minerals), this must be disintegrated and the clay washed out by a stream of water, from which it is recovered by settling. The process is closely analogous to that by which nature herself produced detrital clays, only, being strictly under control as regards the material washed, the volume of water employed, and the impurities eliminated, the product is very much more uniform in respect of grain, colour, and composition, than any natural detrital clay can possibly be.

COMPOSITION

China clay is a white impalpable powder, which when kneaded with water forms a paste much whiter, although less plastic and tenacious, than common pipe- or ball-clay. Upon drying, the paste forms cakes or lumps of little coherence but of uniformly smooth and even texture, and powdery rather than greasy to the touch, although free from all grittiness.

In composition kaolin is a hydrated silicate of alumina, but although presumed to consist chiefly of the mineral kaolinite, it varies considerably in composition. The formula of kaolinite according to Dana is Al_2O_3, $2SiO_2$, $2H_2O$, which calls for 46·6 per cent. SiO_2, 39·5 per cent. Al_2O_3 and 13·9 per cent. H_2O. The composition of a large number of clays agrees fairly closely with this formula, as is shown by the following analyses, all of average samples of well-known brands of clay, dried at 100° C.

	1	2	3	4	5	6*
SiO_2 (and traces of TiO_2) ..	47·23	46·2	45·4	48·38	46·69	46·90
Al_2O_3	39·49	41·1	40·3	36·99	38·34	40·89
Fe_2O_3	0·23	0·1	0·2	0·62	0·45	0·14
CaO	0·31	tr.	tr.	0·15	0·33	0·13
MgO	0·24	0·2	tr.	tr.	0·10	0·08
Alkalis (calc. as K_2O) ..	0·21	0·4	0·6	0·29	1·42	0·58
Water	12·24	12·5	13·5	13·57	12·56	10·50
	99·95	100·50	100·00	100·00	99·89	99·22

* Average of four samples dried in vacuo over sulphuric acid.

It is, however, improbable that the composition of china clay is anything like so simple as would be indicated by the above formula. In the first place it seems likely that the alumina occurs combined in two different ways, for when clays are treated with hot H_2SO_4 about one-half of the alumina content dissolves out at once as sulphate, whilst the remainder only becomes soluble after long digestion with concentrated acid. In the second place nearly all clay contains a small amount of finely divided free silica (quartz), which resists alike boiling with H_2SO_4 and subsequent digestion of the residue with dilute Na_2CO_3. Further, as shown long ago by J. H. Collins*, when china clay is dried for long periods in vacuo over sulphuric acid, its combined water content is reduced uniformly to about 10·5 per cent. Column 6 in the foregoing table of analyses is the mean of samples of clay so treated and analysed by him. There are, moreover, certain exceptional clays that are much lower in silica and higher in alumina content than the typical varieties shown in the above analyses: these probably contain halloysite, allophane, or some similar mineral, in addition to the normal kaolin.

Distribution

China clay being a product of the decomposition *in situ* of the felspar of granitic rocks, it is at first sight curious that its distribution should be so extremely local. No workable deposit of china clay has been hitherto found in all the extensive granitic areas that cover so large an extent of country in Scotland and Ireland, and in the British Isles its occurrence is confined almost exclusively to the West of England, whilst even there, outside the granitic boss of the St. Austell district, it is only exceptionally found. The largest of the West of England granitic masses, that of Dartmoor, has thus far yielded china clay only towards its south-western extremity. Those of the Land's End—St. Ives area and of Wendron have shown china clay only at one or two points. In the St. Austell district alone do deposits of clay become relatively common, the number of those already known running up to nearly a hundred. These facts alone dispose of the hypothesis advanced by some that the decomposition of the granite has been effected by some surface agency, such as carbonic or humic acid, and render it certain that the alteration has been effected by solutions from below. The deposits themselves are rarely basin-shaped, nor do they cut out at shallow depths; on the contrary, they take the form of dykes or pipes, the depth being far greater than the breadth, and even when of great width, the depth is usually in proportion. No case is known in which a true dyke- or pipe-shaped deposit of china clay has "cut out" in depth, although many of those of small size have become unprofitable to work at depth, in consequence of the large amount of barren overburden, which has to be removed at the sides of the excavation as the depth of this increases. Close examination of every known deposit of china-clay ground shows that it is associated either with a single group of parallel fissure veins (the dyke-shaped deposits) or with two or more groups intersecting at an angle (pipe-shaped deposits). These veins vary in size from a fraction of an inch up to many feet; the principal filling is quartz, with which are associated schorl or black tourmaline, muscovite, gilbertite and other micas, and more rarely topaz, cassiterite, etc. It is noteworthy that the proportion of cassiterite has in several cases been sufficient to justify working the deposits for tin. Carclaze, for instance, the largest of the Cornish pits, was worked for tin considerably more than a century ago, long before the clay contents of the deposit were recognised as having any commercial value.

In nearly all cases it is noticeable :—

(1) That the greatest length of the deposit of "clayrock" corresponds with the direction of the principal group of fissures.

(2) That the decomposition of the granitic felspar is most complete in close proximity to the fissures, dying away gradually at a distance therefrom. In some cases, the decomposition appears to be confined to the section of ground lying between two parallel groups of fissures.

From these facts, it is impossible to avoid the conclusion that the fissures themselves have been channels through which the circulation of solutions (or vapours) from below has been effected. It is, however, by no means the case that the largest fissures have given rise to the greatest extent of decomposition; possibly, indeed, those veins which are the largest, and show the greatest development of quartz, may have been responsible for a comparatively small amount of decomposition in the surrounding rock, precisely on account of their rapid sealing up through the deposition of so large an amount of quartz.

As to the mineralising or decomposing agent, in view of the large amount of free silica introduced and deposited, it can hardly have been an alkaline solution. Neither is it likely to have been solutions or vapours carrying free carbonic or sulphuric acids, for carbonate and sulphate minerals are conspicuous by their absence. The comparative abundance of tourmaline and gilbertite (both of which contain fluorine in variable proportions), as an essential constituent of the altered rock indicates hydrofluoric acid as a possible agent, and experiments by the late J. H. Collins more than 30 years ago, demonstrated that it was possible to produce kaolin or china clay, undistinguishable in composition and properties from that found in the natural deposits, by exposing orthoclase felspar to vapours or dilute solutions of hydrofluoric acid for a long period at ordinary temperatures. At an elevated temperature the action would doubtless be much more rapid.

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* Mineralogical Magazine, Vol. VII., 1886, p. 209.

It may be assumed, therefore, without reasonable doubt, that hydrofluoric acid in solution or vapour was the agent that effected the decomposition of the West of England granites, and produced the china-clay. Not all of the felspar is equally affected. Large porphyritic crystals, when present, appear to resist decomposition after the whole of the smaller crystals forming the base have been altered ; since the latter includes the whole of the comparatively small amount of plagioclase present (chiefly albite or albite-oligoclase), it seems possible that plagioclase may be more readily affected than orthoclase.

Occasionally the veins carry some iron oxide, and in such cases the colour of the clay may be completely spoiled in their proximity. Usually, however, it is the very finest and whitest clay that is found between the veins and stringers. The proportion of clay in the ground worked depends of course upon the proportion of felspar in the original granite, and may vary from as low as 10 to 12 per cent. up to 30 and even 40 per cent. Usually it is the leanest ground which yields the best class of clay, *i,e.*, the whitest ; in " fat " ground, containing a high proportion of clay to sand and waste, the colour of the clay is often inferior, and the quality rarely better than common to medium. In the case of many pits that yield a comparatively low proportion of clay to the total ground worked, either on account of the inordinate proportion of quartz stringers (*e.g.*, Dorothy Pit), or to a low proportion of felspar in the original granite mixture (*e.g.*, Trethosa Pit), or finally, in consequence of the fact that only part of the felspar has been decomposed, much remaining still unaltered (*e.g.*, Lee Moor Pits), the comparatively poor yield is more than offset by the exceptionally high quality, namely, the pure white colour and extra fine grain.

The deposits of valuable clay are always overlain by a certain extent of " overburden " or worthless ground, that must be excavated and removed before the clay ground itself can be worked. This consists generally of surface soil or peat, and sand and gravel, with boulders of granite ; sometimes, too, of clay ground that is so discoloured as to be worthless. The total depth of worthless ground of these various kinds to be removed is rarely less than 6 or 8 feet, and may run up to 60 feet, although this is an extreme figure, a more usual one being 15 to 20 feet.

METHOD OF WORKING

The washing out of the clay from the " sand " and waste rock is always done *in situ* by a stream of water, which carries with it only the clay and the finest waste, the coarse sand and larger waste being raised from the bottom of the more or less funnel-shaped pit, usually by means of waggons running up an incline, and automatically tipped at surface on what are called " sky tips." If situated upon a hillside or upon high ground not too far from a deep valley, the cheapest way to open up a clay deposit is by means of an adit, below which are placed all the settling and drying arrangements so as to avoid the necessity for pumping the clay stream. If sufficient fall is available, the adit may be run upon a grade steep enough for the stream of water to carry with it not only the clay but the sand also, in which case hoisting of the sand is also obviated, as at Old Lee Moor. When the fall is insufficient for this, the adit carries away only the clay stream itself, and the sand is raised from the pit by means of self-tipping waggons running upon an incline, as at New Lee Moor and Carclaze.

Disintegration of the clay ground and washing out the clay from the other constituents is performed in two ways. In the more primitive but still largely used method, a stream of water running over the clay ground exposed in the pit cuts a shallow gully or " strake," the sides of which are continually broken down into the stream by mattocks and hoes. In the more modern method, the water is carried down the pit in pipes, and discharged at the bank of clay ground from a nozzle of $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in. diameter under a natural head (aided when necessary by pumps) of 60 to 100 lb. per square inch. Even in this case, a certain amount of hand labour is requisite to keep up the clay content of the stream to be pumped, particularly when the ground is " lean." The hydraulic method is especially suitable to " fat " and uniform ground ; the " strake " method of washing, however, affords facilities for picking out streaks and pockets of discoloured ground, which, if allowed to mix with the rest, would spoil the colour of the clay, and therefore lower its quality for market. Many producers of " best " and " high medium " clays therefore adhere to this method, in spite of slightly higher labour costs, on account of the facility for keeping up the grade of the best clay by picking out discoloured portions of ground for separate washing to yield " seconds."

The stream of mixed clay and sand resulting from the disintegration of the clay ground flows to the lowest point of the pit, whence, in some cases, clay and sand are raised together by means of gravel pumps, a square box grating round the suction of which serves to keep back all but very small stones. The delivery of the gravel pump is into large wooden boxes with hopper bottoms, in which the sand settles, the clay stream overflowing to the purifying plant.

The wear and tear upon gravel pumps is, however, considerable, whilst the pumping itself is neither so efficient, so capable of ready adjustment. nor so entirely reliable as that effected by ordinary plunger pumps. The more usual method of pumping, is therefore, by Cornish plunger pumps and pitwork, worked either by Cornish engines or by horizontal engines actuating balanced lifts. In this system, in order to reduce to a minimum the wear and tear, it is necessary to pump clay-water carrying only the finest sand and mica. The coarse sand is, therefore, first separated at the bottom of the pit in shallow "sand pits" with fronts of wooden slats, which are raised successively as the sand accumulates, to be subsequently shovelled out into tip-waggons running upon an incline and raised to the sky-tip at surface, whilst the clay water overflows and runs to the pumps.

On arriving at the surface, the clay water is split into several streams, and run through several series of shallow channels called "drags" and "micas," in which are deposited first the finest sand and secondly the flakes of mica and grains of coarse, imperfectly disintegrated clay. The purified clay is then settled in "pits" (usually circular) and stored in "tanks" (usually rectangular), in which it accumulates, acquiring the consistency of a thick "slurry" with from 45 to 55 per cent. of water and sometimes more.

This is trammed in wooden tip-waggons to the "dry," composed of a floor of fire brick slabs or "tiles," upon which the clay is spread in a layer from 12 to 5 in. thick, heated by means of the hot gases from coal fires which pass slowly underneath them.

In the case of many works situated close to a good road or a railway, the settled clay is transferred direct from the settling "pits" to the storage tanks behind the dry, situated at a lower level, by simply opening a "hatch" and pushing out the half liquid mass with the aid of a small stream of water. Often, however, particularly when the clay pits are situated high on the moors, and at some distance from the railway or from the shipping port, it is preferred to transfer the clay in earthenware pipes for a distance of from two to six miles from the settling pits to tanks and drys situated close to a railway or port.

For further details in connexion with the settling and drying of china-clay the reader is referred to a monograph on the subject published in the *Mining Magazine* for the months of November, 1919, to February, 1920, wherein reference is made particularly to the question of economy in drying.

(*To be continued*)

LEGISLATIVE AND DEPARTMENTAL INTERFERENCE WITH INDUSTRY AND THE COMMON WEAL.

By PROF. H. E. ARMSTRONG, F.R.S.

(*Continued*)

British employers were guilty of pure Quixotism. The Canadian representative was bitterly opposed to the action taken and the Australian delegates were all against it, though they agreed to fall into line with the others.

The terms of the Convention must be ratified by Governments to make them binding and it is clear that the time is past for such ratification in this country. As I have said, the agreement was made without consulting public interests. Lead paint is proved and known to be superior to all other paints as a protecting film. Not only have the dangers arising from its use been exaggerated and effects attributed to the lead which are due to volatile liquids used in thinning paint ; what is of far greater importance, the real source of danger, the dust produced in rubbing down, can now be entirely obviated. This had been established shortly before we left for Geneva by Mr. C. A. Klein, with whom I have had the privilege of working during the past dozen years. His constructive work has been of the greatest service to the industry. He first showed that ordinary sandpaper could be used wet. In the interval, a waterproof paper has been produced which seems even to improve with use. It is found not only to be feasible to rub down painted surfaces, before putting on a fresh coat, without producing dust ; such a method is admitted even to have advantages. So much is this the case, that recently regulations have been prepared by the Home Office, in collaboration with the Painters' and Decorators Industrial Joint Council of Great Britain, in one of which it is provided that "surfaces painted with lead paint shall not be rubbed down or scraped by a dry process."

Apart from sheer carelessness, the dangers to painters from lead, in future, will be nil. What they will most need to guard against will be the vapours given off from the volatile thinners, which are a necessary component of all paints : yet, of set purpose, at Geneva, the discussion of this danger was made taboo.

Such are the uses of adversity. It has compelled careful study of the problems and, fortunately, the element of imagination has been brought in and a constructive solution found.

ANTHRAX

Brief reference may be made here to the peculiar use our English Government sought to make of the International Labour Conference at Geneva, to secure the general disinfection of wool and hair infected with the anthrax organism, a well recognised and serious danger to those using wools of a certain class. As I took the place of the

Australian Employers' delegate on the Committee, I can speak with intimate knowledge of the proceedings, which were an extraordinary contrast to those of the White Lead Committee, which I also sat through.

In 1919, an Act was passed prohibiting the importation of anthrax-infected wools into this country. A Departmental (Home Office) Committee had studied the subject, not only with great care, but had taken the unusual step of dealing with the problem constructively. Mr. Duckering, one of the Departmental Inspectors, had devised and worked out, in all details, an entirely satisfactory, economic, disinfecting process. When it was found that the Act could not be enforced and that the incriminated wools were simply being diverted to other markets, to comply with the Act, a small factory was set up in Liverpool, to deal with the wools in bond. Our Government, instead of developing this enterprise into a commercial organisation in the hands of the trade, seeking as it were to unload their responsibility and the commercial burden upon the exporting countries, endeavoured to use the Geneva machinery to make disinfection generally compulsory. The committee of 24 was fortunate in having a most admirable chairman in Mr. Ribbing, a Swede. His most able report is printed in the Conference proceedings.

It was at once clear that the English proposal had no supporters. No attempt had been made, in advance, to consult with the representatives of India or the Dominions. Owing to the great length of the Indian frontier and for other reasons, it was impossible for India to contemplate compulsory disinfection. The problem was debated most thoroughly, without heat, though it involved much smoothing out of opinion; the labour delegates, in particular, were most reasonable. Ultimately the 23 members present were unanimous in agreeing with the Report; when brought before the Conference, this was accepted without a word of remark or discussion. The wise decision was taken to refer the matter to an International Committee for further discussion and report; this should have been our original proposal.

In my opinion, the proceedings of the Committee may well serve as a model for future Conferences, whilst those of the White Lead Committee and the subsequent proceedings in open Conference show what is to be avoided.

SAFEGUARDING OF INDUSTRIES ACT

This unhappy Act is, perhaps, the most striking and unfortunate exemplification of Departmental inability to face problems involving scientific issues. Everyone is acquainted with its farcical clause and the still more farcical lists which are based upon this. It is open to question, whether the terms of the Act justify any such lists. Certain it is, that the chief, if not the only gainers, by the Act are members of the legal fraternity. Be that as it may, what we chemists have to deplore and protest against, must protest against until remedy be found, is the shameful way in which the traditions of our craft are being mishandled. It is obvious that the Referee, as well as the Counsel engaged in the various hearings, are without feeling on the subjects argued about and mere dialecticians. What would the lawyers say if we were to presume to argue and determine knotty legal cases, involving profound knowledge of legal procedure and precedent? At least, they would demand that we should sit with legal assessors. The Referee appears but to count heads—to him a chemist is a chemist, his wholeness being no element in the case. Some of the evidence given has been most misleading. At least we should demand of the Board of Trade, nay insist, *that no further cases shall be heard* until scientific assessors are appointed to sit with the Referee.

The decision, in the opening case, in which it was ruled that calcium carbide was not a synthetic organic chemical, was against every canon of chemical belief. As early as 1854, our pioneer chemical systematist, Laurent, saw the importance of defining the term organic, in his great work on *Chemical Method*. In the chapter on "The functions fulfilled by simple bodies in organic substances," he writes:—

> We maintain for our part, that an organic substance is simply a substance containing carbon: thus marble, cyanogen, carbonic oxide, sulphide of carbon, chlorocarbonic acid, etc., are organic substances.

Since then every chemist able to envisage our science has followed this precedent.

THE DYESTUFF ACT

However unfortunate the action of the Board of Trade in mis-handling the Safeguarding of Industries Act, its attitude towards the Dyestuffs Industry has been far worse: it may well be said to have been its evil genius from the beginning. The position could not have been worse, had there been no Government subsidy. Up to the moment, we have not realised what are the conditions under which alone such an industry can be recreated, in this country: that its management *must* be in the hands of technically qualified persons, able to sympathise with and so hold intelligent communication with its staff; knowing, without explanation, the needs, the difficulties, the possibilities of the situation.

My attitude is not determined either by commercial considerations or by thought of future war—though I have both in mind. My object in advocating the firm establishment of the Fine Chemical and Dyestuffs Industries is of a different order: pride of race influences me most. We know we are as good players at Chemistry as those of our own class in Germany. The Germans, however, *say* the contrary, whatever they may think. As one of the team, I know that if I do not practice and, in fact, soon win, I shall be forced to give way to better players. I ask for the opportunity of practice during a fair time, My difficulty is the Board of Trade doesn't allow me and puts me under impossible conditions: it will not give me proper trainers and the example it thus sets acts against me everywhere; and so it is with all concerned.

Sir Alfred Mond, with characteristic clear-sightedness, saw the position and asked for proper inquiry into the working of the two Acts. As he said, the whole administration of the Key Industries Act requires overhauling; and this is equally true of the dyestuffs position.

Instead, the Board of Trade and the Department of Scientific and Industrial Research is to inquire. The one is the incriminated Department; the other is incompetent to do any such work. Sir Alfred Mond's is the only solution of the problem.

Original Inquiry and Research

The Departmental interferences to which I have referred, I am sure, have always been exercised with those good intentions with which a certain well known and much favoured resort is paved; they are due to an inherited, constitutional disability, usually reinforced by an Oxford training, to live up to the times—to recognise that a new method is in use, the world over, that which we call scientific; a method which is based upon observation, trial and experiment, not upon mere precedent and illogical discussion.

We are now threatened, in addition, with something far worse than an impassive wall which we cannot surmount. By a carefully calculated and premeditated attempt, our position of freedom as scientific workers and artists is being undermined and must be lost to us if we do not soon rise up in revolt. The Royal Society has been displaced and the position it should occupy taken over by a purely bureaucratic organisation, mainly influenced by literary men knowing nothing of our method. Its incompetence is shown by the way in which it has allowed its Fuel Research Board to spend large sums of money without submitting its scheme of action to competent criticism and to the interests concerned, in order to benefit by their approval, experience, and support. In various ways it is interfering with the free course of development of the art of scientific inquiry; we are being red-taped in every direction. To place painters, sculptors or poets in leading strings is known to be impossible: scientific inquirers we know belong to the same class as these, they are just as vagrant and sensitive: to curb and check their imagination is fatal. We must be masters in our own field. A false idea of the nature of scientific inquiry is growing up—mere students exercises are being dignified and paid for as Research, and soon the term will signify merely the act of repeating what some other fellow has already done—probably better. There must be a protest against such abuse.

The new Department should be included in Sir Alfred Mond's inquiries.

I began on a federal note. Let me end by striking one of higher range. My call to you is to take an active part in the battle of life, to show that you are not mere laboratory parasites but men of affairs; that you are alert watchers, ready at any moment to protect public interests. Difficult and hard times are before us and we must pull together to get through. If chemists unite in the Federal Council their example will influence those devoted to other subjects. Industry now recognises the importance of cultivating relations with science as well as with the public. Science is not yet so broad-minded—at least in its higher spheres. The respectable society I once frequented is now too dull to visit. The Royal Society is losing its public influence in every direction. In my young days, men like Faraday, Darwin, Playfair, Huxley, Tyndall, not forgetting the artist, naturalist, and geologist, Ruskin, addressed themselves to the public and were heard. To-day there is no one who has any public message to deliver. Sensational discoveries and inventions are talked of but there is no influence at work to maintain the ethical standards so prominently held up by the men I have mentioned. During years past, I have urged that the Royal Society should be organised as a scientific House of Peers, commanding the respect of the nation, critical of all things done in the name of science and willing to advise to the best of its power. If science is to live, some such step must be taken: otherwise it must be entirely commercialised. A vast incubus of inertia has to be overcome: we are too much wedded to one course of action. In Ruskin's words :—

> What strength of faith men have in each other; and how impossible it is for them to be independent in thought, however hard they try. Not that they ever ought to be; but they should know, better then they do, the incumbrance that the false notion of others is to them.

Our fault is a too entirely, if not selfish, devotion to our work: we mistake this for zeal.

It is written, "But a multitude of wise men is salvation to the world." Yes it is—provided always their wisdom be fluent. You know, Government tells you daily, that *your* wisdom is not asked for. You will, therefore, needs force it into use and will seek to do so, if you have any sense of your worth.

Here ends my hasted address. It is clear that "the bowsprit gets mixed with the rudder sometimes," even in ordinary life. Some printer's devil or sprite has put the slips in strange order and his ultimate section was the first; that on the Federal Council and a Palace of Chemistry came next, preceding that on milk.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

WHICH IS THE OUTSTANDING DISCOVERY ?

I asked last week and some of my readers have hastened to reply. There will not be space sufficient for me to comment on all the replies I have received, but some of them are most interesting reading. One of my correspondents, reviewing the past thirty years, gives pride of place to Madame Curie's discovery of radium on the ground that not only was it altogether novel and epoch-making in itself, but as a logical outcome of the investigation of its properties an entirely new conception of atomic structure has been evolved. To the ordered mind of the chemist the classification of the elements according to Mendeleef's periodic system came near to the ideal—the discovery of the radioactive elements has filled many gaps in the system. Radium—X-rays—α-particles—electrons, in the hands of such brilliant experimenters as Crookes, J. J. Thompson and Rutherford, are all stages in the inquiries which have led us very near to the limit of the knowable as regards the structure of the atom. As the ultimate aim of chemical science is the how and the why of everything, such basic discoveries cannot be surpassed in importance, and looking back it is little short of marvellous in what brief space of time they have been accomplished. The recognition of isotopes is again but a logical extension of the discovery of radium.

ANOTHER CORRESPONDENT TELLS ME

that my question would have been easier had I asked: "Which were the two outstanding discoveries of the past thirty years ?" He points out that two entirely separate lines of inquiry started within this period blended together to give us our present knowledge of the structure of chemical elements. In 1894 Rayleigh and Ramsay discovered argon, a gas which had probably been isolated, although not specifically defined, by the quantitative experiments of Henry Cavendish about a hundred years previously. The isolation of an entirely new form of matter, devoid of chemical properties, led Ramsay to look for argon or similar gases in various minerals. From the uranium mineral, Cleveite, he isolated another inert gas having a characteristic spectrum which showed a yellow line identical with the line noticed in the sun's chromosphere at eclipse and attributed by Norman Lockyer to the presence of a hypothetical element to which the name helium was given. In the gas extracted from Cleveite and other uranium minerals Ramsay had isolated terrestrial helium. In 1896 Henri Becquerel examined the radiations emitted by salts of uranium, which had the property of affecting photographic plates and discharging electroscopes. This investigation was continued systematically by M. and Mme. Curie, who found that pitch-blende possessed considerably more activity than isolated uranium salts, and subsequently they showed that the activity was due to a new element, radium. Further research showed that radium, itself a product of the disintegration of uranium, was also in a state of change. Among the products of the disintegration of radium was discovered helium, so that in this way the two independent lines of research became connected. All of which is very interesting, and I thank my correspondents for the letters they have sent me.

THE POSITION IN THE RUHR

goes from bad to worse, but becomes more defined as the weeks go on. It seems clear that France has a definite policy which she proposes to follow until either she herself is exhausted or Germany will yield to France's demands. At first, one was inclined to think that France had been misled into the belief that Reparations could be obtained by marching into the Ruhr; it now seems possible that she was not misled, but knew full well that she could obtain neither money nor goods, and therefore decided to take a strip of Germany which in time she could make remunerative. The protests from French sources rather confirm us in the opinion that the real object of the operations in the Ruhr is at last disclosed; and, immediately, one tries to estimate the effect on British chemical industry. The trouble has not yet extended so far to the south of the Ruhr as to affect directly many of the works of the Interessengemeinschaft, but already there is difficulty in obtaining supplies from Germany.

WHAT WILL HAPPEN ?

There are also more enquiries for fine chemicals and dyestuffs in this country, and the unfair competition by means of the rate of exchange is lessening. Our own works are likely to be busier, and there should be more opportunities for unemployed graduates in science. There are two pitfalls in the situation which we should do all we can to avoid. If there be an increase in the demands for British chemicals owing to the difficulties in which the Germans find themselves, it will probably be only of a temporary character. The collapse of Germany may, for the moment, lead to an increase in production in this country and a lessening of unemployment, but it will set back the recovery of Europe for many years and the final recovery of this country proportionately. The second pitfall is that our leaders, with the ever insistent demand of their shareholders for dividends in their ears, may be tempted after the lean years to force the rise in prices too high, and that will also retard recovery. Above all we want sane judgment and courageous leading at this juncture.

FORTHCOMING EVENTS

Feb. 5. Society of Chemical Industry, *London Section*, Engineers' Club, Coventry Street, W., at 8 p.m. "The Estimation of Fat in Casein," by G. T. Bray and F. Major. "Explosions in Liquid Air Rectification Plant," by Dr. E. Fyleman.

Feb. 5. A Course of ten lectures on "The Micro-Organic Population of the Soil" will be given by Sir John Russell and staff of the Rothamsted Experimental Station in the lecture theatre, Botanical Department, University College, Gower Street, W.C. 1, at 5 p.m. Also on February 7, 12, 14, 19, 21, 27, and March 1, 5, and 7.

Feb. 7. The Institution of Sanitary Engineers, Caxton Hall, Westminster, S.W. 1, at 8 p.m. "National Water Resources and their Allocation," by Percy Griffith, M.Inst.C.E., F.G.S.

Feb. 7. Royal Society of Arts, John Street, Adelphi, W.C. 2, at 8 p.m. "Electrical Resistance Furnaces and their Uses," by Charles R. Darling, F.Inst.P.

Feb. 8. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Photo-synthesis of Plant Products," by Prof. I. M. Heilbron.

Feb. 8. Institute of Metals, *London Local Section*, in the Institute of Marine Engineers, 85-88, The Minories, Tower Hill, E. 1, at 8 p.m. "The Investigation of the Constitution of Alloys," by Miss M. L. V. Gayler, M.Sc.

Feb. 8. Society of Chemical Industry, *Ottawa Section*, University Club, Elgin Street, Ottawa, at 8 p.m. "Biochemistry in Relation to the Rearing and Nutrition of the Silver Black Fox," by G. Ennis Smith.

Feb. 9. Society of Chemical Industry, *South Wales Section*, Technical College, Mount Pleasant, Swansea, at 7.15 p.m. "Stainless Steel and its Uses," by H. B. Hitch.

Feb. 9. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 9 p.m. "Rothamsted and Agricultural Science," by Sir John Russell.

Feb. 12. The Ceramic Society, Central School of Science and Technology, Stoke-on-Trent, at 7.30 p.m. "Notes on Application of Pyrometers to Ceramic Industries," by Mr. Chas. E. Foster.

Feb. 12. Royal Society of Arts, John Street, Adelphi, W.C. 2, at 8 p.m. "The Vulcanisation of Rubber" (Lecture 2), by Henry P. Stevens, M.A., Ph.D.

Feb. 13. Society of Chemical Industry, *Edinburgh and East of Scotland Section*, the Pharmaceutical Society, 36, York Place, Edinburgh, at 7.30 p.m. "Vitamins," by Dr. G. M. Findlay, M.A.

Feb. 13. Institute of Metals, *Scottish Local Section*, Institution of Engineers and Shipbuilders, 38, Elmbank Crescent, Glasgow, at 7.30 p.m. "Some Phases of Lead Manufacture," by John A. Sillars.

Feb. 14. Royal Society of Arts (Ordinary Meeting), 18, John Street, W.C. 2, at 8 p.m. "Progress in the Manufacture of Refractories," by W. J. Rees, Lecturer on Refractories in the University of Sheffield.

NEWS FROM THE SECTIONS

AMERICAN SECTION

Prof. R. H. McKee presided at the meeting of the American Section held on January 12, when the Perkin Medal was presented to Dr. Milton C. Whitaker for his work in applied chemistry. Mr. A. A. Bachaus gave an account of Dr. Whitaker's work at the Sullivan Saw-Mills, Aztec, New Mexico, and his subsequent career as head of the Chemical Engineering Department at Columbia University.

He was followed by Mr. A. D. Little, whose speech was full of personal humorous touches, and included a description of one of Dr. Whitaker's most important labours—the organisation of a plant for the manufacture of alcohol from molasses, and the production of vinegar and acetone. Dr. Whitaker was chairman of the New York Section of the Society of Chemical Industry in 1911 and President of the American Institute of Chemical Engineers in 1914. From 1915 to 1917 he was President of the Chemists' Club. Mr. Little praised highly the vigour of Dr. Whitaker, both in mind, body and vocabulary.

Dr. Charles F. Chandler presented the medal in the following words: "Dr. Milton C. Whitaker, my dear friend, it gives me the greatest pleasure as the representative of the Society of Chemical Industry and the affiliated Chemical and Electrochemical Societies of America, to place in your hands this beautiful Perkin Medal, as a token of the appreciation and affection of your fellow chemists." Dr. Whitaker, in accepting the medal, stated that he was very appreciative of the distinction which had been conferred upon him; that he had been an organiser rather than an individual worker and that the achievements which had resulted in the award of the Perkin Medal to him, were necessarily therefore achievements of the chemists with whom he had worked.

In dealing with organisation for chemical production, he stated that adequate organisation was a necessary condition to success, and while research chemists and physicists are laying the foundations for products, processes and plants, someone must develop and perfect concurrently a suitable organisation to carry research results through the various stages of development and finally to profitable production. Over-organisation was the most general fault, and in many cases during the war there was so much organisation that there was no one left to do the work. It was difficult to understand why men with a highly specialised technical talent who were surrounded by most fascinating problems, and with important achievements easily within their reach, should have a hankering to do executive work for which in many cases they were quite unsuited. Many research projects were doomed to failure from the very beginning because of the lack of interest or understanding on the part of those in authority. Research was entitled to the support of everyone in the organisation. The research men were often sensitive and temperamental and responded to encouragement and support, whereas discouragement frequently led to disaster. In his experience, so soon as the results of laboratory work were completed, plans were considered for an elaboration of these into a small laboratory apparatus. The co-operation of the engineers was ensured from the very beginning. Their engineers worked with and ranked with their research chemists, and experimental units which permitted of a continuous operation for a long period were soon established to produce a sufficient quantity of the product to enable it to be sold, and determine its market value. These were operated for several months, and enabled the staff to become familiar with the purchase of raw materials, costing, and selling.

He gave some account of the acetone process which supplied 60 per cent. of the war requirements for acetone, and the sudden change in affairs when the Armistice was signed.

Passing on to the production of ethyl acetate, he explained that he was called upon to work large volumes of dilute acetic acid varying in concentration up to 15 per cent., and his first problem was to make a thorough study of the reactions between alcohol and acetic acid, including equilibrium conditions, concentration of catalysts, and various ratios of acetic acid and alcohol. From this, it appeared that there is a very definite reaction between acetic acid and alcohol in dilute solutions. Very dilute sulphuric acid is an excellent and effective catalyst, the rate of re-action is comparatively high, and the old ideas about high concentration of the reacting materials and dehydration were mistaken.

Interesting statistics were given of the property of ethyl acetate to form constant boiling mixtures, and a table of mixtures of ethyl acetate, alcohol and water at various boiling points was given. The monthly production of anhydrous, chemically pure ethyl acetate by the continuous esterification of dilute acetic acid by this process is now over 150,000 gallons.

EDINBURGH AND EAST OF SCOTLAND SECTION

Prior to the informal meeting held on January 16, 1923, the members of the Section were entertained as guests by the Edinburgh University Chemical Society at a meeting held in the Medical Chemistry Department of the University. Professor G. Barger, M.A., F.R.S., presided, and a paper was read on "The Chemistry of the Genus Eucalyptus," by Prof. R. Robinson, D.Sc., F.R.S. A vote of thanks to Prof. Robinson was moved by Mr. R. E. Gibson, President of the Edinburgh University Chemical Society, and seconded by Dr. H. E. Watt, Society of Chemical Industry.

The Fourth Ordinary Meeting of the Section was held subsequently in the Tutorial Class Room, Medical Chemistry Department, Dr. H. E. Watt in the chair. The following papers were read :—(1) "Notes on an Apparatus for the Combustion of a Volatile Hygroscopic Liquid" : Mr. J. B. Shoesmith, M.Sc. (2) "Methods of Emptying Carboys of Strong Acid" : Mr. J. Adam Watson. A discussion followed in which Major Bruce, Messrs. Rutherford Hill and Baxter took part.

GLASGOW SECTION

A Joint Meeting of the Glasgow and Edinburgh Sections was held in the Institute of Engineers and Shipbuilders, Glasgow, on January 19, when Dr. E. F. Armstrong, F.R.S., read a paper on "Chemical Action, Particularly at Solid Surfaces."

In speaking of chemical action, Dr. Armstrong said we all know what it means in a general way, but none of us really know. We had allowed the physicists to hold the field with their explanations, and after hearing their dissertations and seeing their diagrams, we had just for a moment felt that all was clear and definite, only to find, after mature consideration, that we had not made any real advance, and that our conception of chemical action was still as nebulous as ever. What was wanted, the speaker said, was a return to chemical reasoning. Taking as an example the chemical activity of enzymes, Dr. Armstrong spoke of the idiosyncrasies of such bodies, their sensitiveness to outer influences, their high "ideals" as regards selective action, their "personality." These special properties they derived from structure and a very large reactive surface. The extreme difficulty of investigating such sensitive complexes as the enzymes was pointed out, and Dr. Armstrong showed that we had come to some understanding of their methods of reaction by careful study of the mechanism of the hydrogenation of fats in presence of finely-divided nickel. The central fact here was that the curve expressing the rate of reaction did not indicate mass action, but was a straight line, showing that the speed of reaction was sustained until 80 per cent. or even more of the fat had been hydrogenated. This measurement was of the speed of the slowest reaction taking place. The volume of criticism which has been directed against these results was mentioned, and emphasis was laid on the need for the most scrupulous exclusion of catalytic poisons ; for, by the intentional introduction of these, a curve of the logarithmic type could be obtained. The orientation, and loose anchorage of the fat molecule on the nickel surface, where the hydrogen reacted and the hydrogenated molecule became detached, was diagrammatically represented. In conclusion, Dr. Armstrong spoke of the importance of such types of chemical reaction to the animal organism and the process of metabolism.

The influence of the various societies which exist for the promotion of pure and applied chemistry has hitherto been dissipated by separate action. To ensure intimate co-operation and to focus public attention on chemistry, it has been decided, in place of separate social functions, to hold this year a joint dinner of the following chemical societies: Society of Chemical Industry, Institute of Chemistry, Society of Dyers and Colourists, Glasgow University Alchemists' Club, the Andersonian Chemical Society, and the Ardear Chemical Club. Arrangements have been made to hold the dinner in the Grosvenor Restaurant, Glasgow, on February 23. Applications for tickets (12s. 6d. each) should reach the Hon. Secretary, Dr. J. A. Cranston, not later then February 16. It is expected that the Lord Provost and other prominent citizens will be present, so it is hoped that chemists and their friends will rally in strong numbers.

BIRMINGHAM AND MIDLAND SECTION

The meeting held on January 23 marked the first of two evenings devoted to the discussion of various aspects of the fuel problem. Mr. E. V. Evans, O.B.E., F.I.C., who presided, said the gas industry was old and well-established, attributes which were liable to check progress, and without competition from electricity the industry would not have progressed as it has done during recent years. Contributions from the Birmingham Gas Department were of considerable importance in this connexion, and tribute should be paid to the work of Dr. Davidson, Dr. E. W. Smith and Mr. Rhead. To-day the problems of the gas industry were more numerous than ever before, and whilst efforts had to be made to reduce the price of gas, the efficiency of the consumers' appliances required equal attention. Maximum revenue had also to be obtained from by-products, the net revenue from tar and ammonia representing 15 to 20 per cent. of the cost of coal delivered into store. Many promising fields of development in the distillation of coal and preparation of coke remained practically untouched. It was probable that gas undertakings would eventually manufacture not only gas but a smokeless solid fuel containing little ash, which would in time supersede the use of raw coal in the domestic grate and in industry. In this way the scope of the industry would be greatly increased, and the time was coming when the gas industry would take its place as an outstanding example of that application of science to industry for the furtherance of which this Society was founded.

Dr. C. H. Lander, Deputy Director of Fuel Research, then read a paper on "Some Aspects of the Fuel Problem." For the satisfactory elucidation of the main problem of the full utilisation of the fuel resources of Great Britain it is imperative that this be regarded from the widest point of view, and that a sense of proportion should not be lost by concentration on any particular side of the question, whether that of chemistry, engineering or physics. Broadly speaking, the purposes for which fuel may be used can be divided into two categories:—(*a*) The development of mechanical power at some particular spot, and (*b*) the introduction of heat into some substance, also at a particular spot. Hence the value of any form of fuel depends on its ease of transport as well as on its ease of application.

The programme of the Fuel Research Board as laid down on its inception in 1917 followed two broad lines:—(1) The survey and classification of coal seams. (2) Investigation into all the practical problems involved in the replacement of raw fuel as at present burned by fuel obtainable from coal by carbonisation and gasification processes.

Under the first heading comes the survey of the national coal resources inaugurated by the Board, the practical work in connexion with which is being carried out by local Committees, the first of which, in the Lancashire district, is now at work correlating information concerning the most important seams in that district, and supplementing this by experimental work on sampling and analysis on a small scale. The personnel of these Committees includes colliery owners, managers, consumers and representatives of outside scientific interests, as well as representatives of the Fuel Research Board and the Geological Survey. In connexion with the Survey, experimental work on the full-working scale on typical coals is being carried out at H.M. Fuel Research Station. An important scientific committee has also been appointed by the Board to recommend standard methods for the sampling and analysis of coal which, it is hoped, will render analyses by different investigators more readily comparable than heretofore. In addition to the experimental work which is being carried on, careful records and maps are kept by the Board in connexion with the various seams and coals dealt with.

The second line of inquiry has included the question of gas standards, into which the Fuel Research Board made a thorough investigation, at the instance of the Board of Trade, and recommended the thermal system of charging for gas as the only method by which it was possible both to protect the consumer and to afford to the gas industry a freedom which would render it possible to select in each case those methods which would procure the most economical results. This question of gas standards led to experimental work by the Board on steaming in vertical gas retorts as a means of converting the potential heat units in coal into good and saleable gas, and a report was published in 1921 on their investigations into typical coals treated in this manner. Further experimental work on steaming is also being carried out at the direct request of certain important gas companies, and a report on some experiments with water gas plant will be published shortly.

The latest report so far published by the Fuel Research Board dealt with the question of low-temperature carbonisation, a subject in which widespread interest has been displayed as a possible source of home supplies of fuel oil and in connexion with the demand for a smokeless fuel. During the course of the Board's experiments, which have been carried out on the full working scale, and are still continuing, close touch has been maintained with outside investigators. The Board is not without hope that the economic and social difficulties involved in the solution of this problem may be overcome in the near future. Other aspects of the main problem dealt with by the Fuel Research Board may be summarised as follows :—

(1) Power alcohol and the possibilities of its production within the British Empire for motor transport and for use in internal-combustion engines. (2) The winning and utilisation of peat, regarding which a report is now in the Press upon the result of the investigations of the Fuel Research Board into Canadian and Continental practice, as well as upon the experimental work carried out by the Board in Ireland and at H.M. Fuel Research Station. (3) The suitability of mixtures of fuels for internal-combustion engines. (4) Investigation into the fundamentals underlying domestic heating. (5) Utilisation of special fuels in boiler furnaces. (6) Pulverised fuel.

In a paper on "The Thermal Efficiencies of Manufacture of Different Grades of Gas," Dr. A. Parker, of the Department of Fuel and Coal-Gas Industries, Leeds University, said that the industrial position attained by this nation was due in a large measure to the possession of a good supply of coal. The nation could not afford to continue to use this asset except in the most economical manner ; and at the same time determined efforts must be made to eliminate the smoke nuisance and the damage it caused to health and property. There was ample room for the more economical use of coal. The ordinary domestic fire, which was largely responsible for the smoke nuisance, radiated only 25 units of heat into the room for every 100 units in the coal used. The consumer of electricity received less than 10 per cent. of the energy of the coal used at the central generating stations ; and of every 100 units of heat expended at the gas works of the country, only about 45 were delivered to the consumer. For some years there had been definite co-operation in scientific research between the gas industry and the University of Leeds. Dr. Parker described the work already carried out, and the improvements resulting from this co-operation, and mentioned that much of the work had been made possible by the generosity of the Birmingham Gas Committee in allowing the use of installations at its works.

MEETINGS OF OTHER SOCIETIES

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The meeting held at Boston and Cambridge during the last few days of 1922 was full of interest to chemists as the topics discussed ranged from atoms and isotopes to photosynthesis.

Prof. T. W. Richards, of Harvard, told of his work on the change of bulk of atoms which he finds depends on compressibility and internal pressure. He showed diagrams of various atoms enlarged 200,000,000 diameters. Photographs of the tracks made by flying fragments of atoms were exhibited by Prof. W. D. Harkins, of Chicago. He took ten thousand photographs, many of which showed alpha particles colliding with atoms, similar to the pictures taken by Sir Ernest Rutherford in England. Professor Harkins hopes to prepare a kinematograph film showing the decomposition of the atoms by alpha particles.

By X-ray investigation Dr. G. L. Clark, of Harvard, has made an accurate map of the interior topography of various crystals. Thus cæsium tri-iodide forms a rectangular crystal which is somewhat similar in structure to the cubical crystal of the moniodide, but the two extra iodine atoms lie on the diagonals of the figure instead of at the corner or face positions.

By bombarding magnesium with high voltage electricity, Drs. C. Davisson and C. H. Kunsman have succeeded in finding out how the electrons are arranged in the magnesium atom.

Dr. R. S. Mullikan, of the University of Chicago, is attempting to separate the six isotopes of mercury by a novel form of distillation apparatus which carries off the atoms of mercury as rapidly as they evaporate from the surface of the boiling metal. The still is so efficient, that a ton of mercury may be evaporated in 24 hours in six glass flasks holding a pint each.

The changes undergone by certain carbohydrates were explained by Dr. C. O. Appleman, of the University of Maryland. He finds that the sugar in potatoes long stored in a cool cellar increases from about 0·3 to 5 per cent., but sweet corn (maize), which contains 5 per cent. of sugar, loses two-thirds of it shortly after it is pulled from the stalk.

The chemists of the Department of Agriculture have been engaged on the synthesis of thymol, a valuable antiseptic. Synthetic thymol, which is identical with the natural product, is manufactured from cymene, of which some 2,000,000 gallons are wasted annually in the United States and Canada.

An account was given of the new fumigating gas developed by the U.S. Public Health Service and the Chemical Warfare Service of the War Department. Cyanogen chloride or "tear" gas is mixed with hydrocyanic acid and used for fumigating ships, cars and houses to get rid of rats and other vermin. The new gas is easily detected in quantities too small to be dangerous to human beings and is harmless to foods, tobacco, fabrics, leather and metals.

Prof. Jacques Loeb, of the Rockefeller Institute for Medical Research, read a paper on the swelling of gelatin and other colloids. He considers that the electrical state of the aqueous solutions of these substances explains a large number of the anomalies which have been observed.

Dr. E. E. Slosson, of the Science Service, Washington, read a paper on the various sources of the world's power and how these are being gradually dissipated. Some day, he says, the world will have to stop drawing upon its carboniferous banks and live within its income. It will have to grow its fuel year by year as it grows its food.

Photosynthesis was discussed by Dr. Spoehr, of the Coastal Laboratory, Carmel, California, and Dr. S. E. Sheppard, of Rochester. Dr. Spoehr questions the commonly accepted theory that the formation of carbon compounds in plants proceeds by two simple steps, first the formation of formaldehyde from carbon dioxide and water, and second the combination of this to form sugar. British investigators claim that they have actually carried out these reactions in the laboratory, but Dr. Spoehr, in repeating their experiments, has failed to confirm their conclusions. Dr. Sheppard, in considering how the green leaf builds up sugars out of formaldehyde, admitted that no substance was as satisfactory as chlorophyll, but he pointed out the same reaction could be accomplished by the ultra-violet rays and cited experiments to show that when these rays act upon a solution of formaldehyde in water containing certain salts, such as sodium citrate and carbonate and copper sulphate, the formaldehyde is in part transformed into sugar. The work of Professors Baly and Heilbron was discussed.

INSTITUTE OF CHEMISTRY

The third general meeting of the Leeds Area Section was held in the Queen's Hotel, Leeds, on January 17. Mr. Mackey, who presided, read a paper on the "Professional Aspects of Sampling," in which he insisted that chemists should see their work through from start to finish. Sampling was often left to those who were not chemists and who were certainly not qualified to undertake the work, with the result that the analysis gave a misleading impression. If every chemist who was asked to evaluate a coal seam, or a deposit of iron ore, went to the mine and superintended the taking and preparing of the samples himself, it would add greatly to the value of his report. What might be termed "Departmentation" was to be deprecated and men working in the laboratory should be versatile and take an intelligent interest in what was going on around them.

Mr. Grinling, in his paper on "Work's Practice in Sampling," drew attention to the differences between samples taken for public analysts and consulting chemists, and those taken for work's control. The former, as a rule, represent the average of the whole consignment, whereas with the latter other factors have to be taken into consideration. If, for example, the whole consignment is not uniform in general condition and appearance, it will probably be necessary to take samples representing the different portions, each sample being separately analysed and reported upon. Sampling in a works presents several possibilities, all of which have their disadvantages. If, as sometimes happens, the sampling is done by individuals who know little about sampling and its importance, the results are nearly always unsatisfactory It is better for the chemist to take the samples himself, as it enables him to get first-hand information which may be invaluable to him when making his report, but taking into consideration the value of the chemist's time, this method is not economic. Probably the most satisfactory method is for the chemist to have a staff of trained samplers under his control. An efficient sampler must be a man of many parts; he must be a good clerk, very tactful, observant, clean in his methods and not afraid of hard work. Every works chemist should be able to take samples, but a sample, however carefully taken, is of little value unless it is properly labelled, and its full history attached to it. The keynote of successful sampling is common sense and a clear idea of what is wanted.

SOCIETY OF GLASS TECHNOLOGY

Prof. W. E. S. Turner presided at the meeting held in Sheffield on January 17. A very cordial welcome to the meeting was given to Mr. H. L. Dixon, of Pittsburgh, U.S.A., who was, said Prof. Turner, well known not only in America but also in England and on the Continent, and had built nearly all the glass furnaces in America. During the forenoon members had the privilege of visiting the works of Messrs. Thos. Firth and Sons, Ltd., Sheffield, where they saw various processes in the manufacture of stainless steel.

The first paper, presented by Dr. W. H. Hatfield, was entitled "'Stainless' Steel, with some Consideration of its Application to the Glass Industry." At the outset, Dr. Hatfield stated that he could not do more than suggest some directions in which "stainless" steel might be useful in the glass industry. The most important property of stainless steel was its resistance to corrosion and to oxidisation.

Resistance to ordinary corrosion was not of much interest to glass technologists, but resistance to oxidisation at high temperatures was of considerable importance, especially because the steel scaled at much higher temperatures than ordinary steels. Stainless steel had such different properties from ordinary steel that it must be studied as an entirely different material from many points of view. After demonstrating how nitric acid rapidly attacked ordinary steel but left stainless steel unaffected, Dr. Hatfield said that stainless steel could now be cast directly, and very malleable sheet steel could also be made. It could be drawn into tubes of such fineness that hypodermic needles were now largely made from the material. Turbine blades had been successfully turned, and in this case the steel was brought into contact with steam at high temperatures. He showed pieces of turbine blades that had been in use eighteen months and still retained their special properties, whereas under the same conditions ordinary nickel-steel blades had ceased to function properly. Practically all the turbine manufacturers had adopted stainless steel for the manufacture of blades.

Stainless steel was an alloy of iron with from 12 to 14 per cent. of chromium. The carbon content varied a little with the different types of stainless steel, but for general purposes might be considered to be about 0·30 per cent., which was very similar to that of ordinary structural steels. A stainless steel could now be made which was impervious to sodium sulphate, though some types of stainless steel were liable to be affected by continued contact with it. Micrographs were shown illustrating the structure of various special steels such as nichrome and tantiron. The former resisted oxidising influences and maintained its strength at high temperatures, and the latter was not ductile but relatively hard and brittle like cast iron. Stainless steels could be considered as alternatives for those now used in the glass industry from two standpoints, viz., resistance to scaling and strength at high temperatures. Stainless steel had a high tensile strength, equal to the best alloy steels, had a high fatigue range and might be hardened and tempered. There were many directions in which the material might be useful, the most notable being for parison and blow moulds. Many parts of feeder devices might be usefully produced in such material, as might also blowing irons, rolls, belt conveyers, lehr chain pins and other things, including knives for cutting viscous glass. The ends of blowpipes might very well be made of stainless steel. Brushes which had to be made of wire could well be made of stainless steel. Explaining recent developments in the use of this steel, Dr. Hatfield said that where a highly polished surface was needed, stainless steel was admirable for the purpose. Indeed, several firms were producing scientific mirrors from this material.

A discussion followed, in which there took part Prof. W. E. S. Turner, Major V. F. Gloag, and Messrs. J. H. Davidson, W. C. Snowdon, R. Hemingway, and Guy Simpson. Replying to the discussion, Dr. Hatfield said that the question of a good surface was answered by the manufacture of the mirrors he had referred to. Stainless steel would do very well in muffle lehrs, and it could be easily welded to stainless or ordinary steel, but a good deal depended on the skill of the smith employed. He thought that the moulds used in glass-making were too heavy. Stainless steel could withstand crushing and ordinary wear and tear as well as most materials. He could not give information as to comparative costs, but the cost of stainless steel approximated to that of cheap high-speed steel; it was a special steel, and not a cheap steel, but the cost was not prohibitive. The expense was always justified when used in those industries where its special properties gave it an advantage over other materials.

The second paper was entitled "Some Measurements of the Viscosity of Glasses near their Annealing Points and a critical Review of some recent Literature on the Annealing of Glass," by S. English, M.Sc. Mr. English showed that, contrary to the general opinion, strain in glass could not always be detected by examining the glass in polarised light, and that the most sensitive position was that in which the direction of the strain in the glass was at 45° to the plane of polarisation of the light. In discussing strain viewers, the lecturer dealt with the defects in design of a strain-viewer recently put on the market and showed that with a strain-viewer of this type it was very easy to obtain misleading indications of the presence of strain. Reviewing the statements made concerning the advantages accruing from the use of a selenite or quartz plate in connexion with the analysing nicol prism, it was shown that the claim made by one author that the selenite plate was more sensitive than plain crossed nicols was only true when a very poor source of light was used, and that a further claim made by another author to be able to distinguish between tension and compression stresses by the use of such a plate was entirely untrue. Details of the measurements of the mobility of various types of glasses from the annealing temperatures through a range of 150° C. were given, and it was shown that the rate of change of mobility of the glasses at their annealing points was approximately constant, most of them requiring a rise in temperature of 9° C. to cause a doubling of the mobility. In some cases this temperature interval rose to as much as 11° C. At temperatures of 100° or 150° C. above the annealing points the temperature interval required to double the mobility was generally rather wider than that required at the annealing points. Curves were shown indicating that the mobility of glasses is not a true logarithmic function of the temperature, and that a point of inflexion in the curves will probably be found at temperatures rather higher than those included in the present range. It was also suggested that the well-known working properties of lead glasses and other soft glasses were determined more by the rate of radiation of heat than by rate of change of viscosity with temperature.

BIRMINGHAM UNIVERSITY CHEMICAL SOCIETY

Professor G. T. Morgan delivered his presidential address to the Birmingham University Chemical Society on January 22. There was a very large attendance of students and industrial chemists numbering over 200.

After referring to the Empire's resources in the precious metals, gold and silver, and also in the light metals aluminium, magnesium and beryllium, which are of special interest in the production of light alloys, Prof. Morgan said that ultra-light alloys are now being produced by the Magnesium Co., Ltd., of Wolverhampton. The metals of the less common earths are utilised chiefly in the form of their compounds. Barium and strontium preparations are mainly derived from British sources, and the world's requirements for thoria and ceria employed in the incandescent mantle industry are largely supplied from the extensive Travancore deposits which will meet the demand for many years.

The favourable situation of the Empire in regard to the supply of tungsten minerals should place us in a premier position for manufacturing tungsten steel—one of the great triumphs of modern metallurgy—but before the war, Germany controlled two-thirds of this production, the importation of German tungsten into this country having an annual value of £300,000. This unfavourable position, which existed up to July, 1915, contributed to the shortage of shell which jeopardised the military operations in the late war. In the development of our mineral resources it is essential to take the long view. Systematic research is needed even on chemical elements which have not hitherto received industrial application. Zirconium provides an instance of a metal which has so far been examined chiefly by German and American chemists, the English contribution to this branch of mineral chemistry being very small. Quite recently two Danish chemists have announced the discovery of a new element from zirconium mineral. Cobalt is another example of a metal which merits increased attention, the annual production being only of the order of 400 tons. The chief deposits are in Ontario, and Canadian chemists are becoming prominent as investigators of this element. There is a world shortage of the valuable metals of the platinum group owing to the partial failure of the Russian supply. These metals have been detected in many parts of the British Empire. Tasmania has furnished osmium and iridium and the nickel-copper ores of Sudbury, Ontario, have yielded notable quantities of platinum and palladium. Cobalt has a promising future as an alloy metal, as it confers hardness and durability on aluminium ; until recently cobalt was only used in combination as a pigment colouring material. The possession of this varied assortment of mineral wealth carries with it the obligation to utilise this heritage to the best advantage to humanity. If the present possessors fail in this respect sooner or later the task will be undertaken by others.

The chief reason why the synthetic-colour industry has become a so-called "Key" industry is an educational one. A highly developed industry in coal-tar products leads with unfailing certainty to proficiency in other chemical arts. The main thesis which should be pressed on the attention of all our public men and leaders of industry is that of safeguarding our natural resources in *materia chemica.* There is only one strategic chemical front, and we can not fall behind in any particular branch of chemical trade without grave risks of losing ground in all the correlated industries.

In conclusion, Prof. Morgan said he thought he had said sufficient to show that there was sufficient work to be done by all the chemical students from the Birmingham and other English Universities. In spite of trade depression and the enormous output last summer of more or less trained chemical students under the Government scheme, the numbers of chemists unemployed or seeking positions are very small. Although our industry is under a cloud for various reasons, the outlook is not bad for the adequately trained chemist.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

A lecture on the nitrogen-fixation plant at Muscle Shoals, Alabama, U.S.A., was delivered at the meeting which took place on January 17, by Mr. John Frazer, Professor of Chemistry, and Dean of the Towne Scientific School of the University of Pennsylvania, who is now in France for the purpose of lecturing before various French Universities. The lecturer observed that the site was admirably chosen, and the enormous plant itself was erected with extreme rapidity, but at very heavy expense. At present the factory is lying idle, owing to the lack of interest shown by American farmers in the use of ammonium sulphate, a product which the plant was built to produce by the cyanamide process.

THE INSTITUTION OF CHEMICAL ENGINEERS

The first meeting of the Provisional Council was held on January 10, 1923, at 166, Piccadilly, London, W. 1. The solicitor reported that he had received from the Board of Trade the Certificate of Incorporation and the order of the Board of Trade giving authority for the Institution to commence work.

Sir Arthur Duckham, K.C.B., M.I.C.E., was elected the first President of the Institution, and Mr. K. B. Quinan and Dr. C. C. Carpenter were elected the first Vice-Presidents of the Institution. Prof. J. W. Hinchley, Wh. Sc., A.R.S.M., was elected Honorary Secretary, and Mr. F. H. Rogers, M.I.M.E., as Honorary Treasurer. The President announced that he would have great pleasure in presenting to the Institution its Seal.

It was decided to hold the first Annual Meeting of the Institution on March 14, 1923, in London.

A list of names was approved for election, and the Selection Committee was then elected as follows :—Messrs. J. Arthur Reavell, M.I.M.E. (Chairman), Prof. J. W. Hinchley, F. H. Rogers, M.I.M.E., E. W. Smith, D.Sc., Wm. Macnab. Mr. C. S. Garland, M.P., Mr. S. G. M. Ure and the Hon. Secretary were elected to discuss the question of taking part in the British Empire Exhibition in 1924 with Mr. Woolcock. Mr. W. J. U. Woolcock was unanimously elected an honorary member of the Institution. The next meeting of the Provisional Council will be held on February 21, 1923, at the offices of the Institution.

CORRESPONDENCE

PROFESSOR ARMSTRONG AND THE SMOKE ABATEMENT COMMITTEE

SIR,—I have read with some interest and a little amusement the strictures which Prof. Armstrong has been pleased to pass on the Committee appointed by the Ministry of Health to inquire into the abatement of smoke and noxious vapours. His assertions that " nearly all the evidence was directed to proof of nuisance and in some cases to the difficulty, if not impossibility of avoiding it," " that very little constructive evidence was taken and this related to the use of gas or central-heating appliances," that " smokeless, easily-combustible solid fuel was considered only on two occasions " and that "no scientific evidence was given on the subject," are simply misstatements of fact.

In the first place it should be pointed out that the Committee visited a number of industrial centres in order to inquire on the spot into the cause of the smoke or other nuisance from noxious fumes. At these places very many persons, desiring to lay complaints before the Committee, were given an opportunity of being heard and they, of course, swelled the number of persons whose evidence appears in the report. Prof. Armstrong omits to mention this and does not trouble to discriminate among the 130 witnesses between those who were invited to give evidence and those who were not. Out of curiosity I have been through the list of witnesses, leaving out the uninvited who merely wished to lodge complaints, and have divided them into what might be termed constructive witnesses and those who gave evidence in regard to damage by noxious fumes and smoke. I think that even Prof. Armstrong must admit that something more definite than a mere opinion in regard to the extent of damage to health and property is demanded before any serious legislation could be justified.

The constructive witnesses, who numbered upwards of fifty, included seven architects, five heating engineers and experts, five gas experts, two electrical engineers, seven smoke and sanitary inspectors, six manufacturers of iron, steel, copper, spelter and tinplate, two producers of low-temperature coke as well as Sir George Beilby, who supplied scientific evidence on the subject, three manufacturers of pottery by coal-fired and producer-gas furnaces, a chemical expert in pottery manufacture, an iron and steel works chemist, the late and present chief alkali inspectors, a professor of metallurgy, a few manufacturing chemists and one or two witnesses called to clear up the legal aspects of the question. None of this evidence was given as a proof of nuisance and as regards low-temperature coke we collected all the information that was available at the time, whilst some of us took the opportunity of seeing the plant and of testing Mr. MacLauren's and the Barnsley products. On the side of evidence of nuisance or damage we heard seven medical men, two agriculturists, Sir Frank Baines of H.M. Office of Works, Miss Fitzgerald, of Manchester, who gave information in regard to the cost of washing and a number of witnesses, as previously stated, who wished to lodge complaints of smoke and noxious fumes. Prof. Armstrong states that the Committee included one chemist who had been engaged in measuring fog and its effects. There were, as a matter of fact, two chemists, Mr. Curphey, the late chief alkali inspector, and myself. It is, however, impossible to discover which of us has the distinction of being the chemist designated by Prof. Armstrong as neither of us, so far as I know, has been engaged in the manner he described.

Prof. Armstrong is a distinguished man of science and no one would for a moment doubt his sincerity in denouncing an abuse where it exists, but as a man of science he should realise the value of facts. He has taken no pains to do this and has, consequently, passed an entirely false judgment on the work of the Committee. He repeats the word " constructive" five times in one column; but I have failed to discover in his remarks one constructive idea unless it is the use of "dust-fuel" to which he refers in passing. Is he using it or doing anything to promote its use? He seems to attach great importance, as we all do, to the production and use of low-temperature coke. At the time when the report was compiled the Barnsley works was supplying it at 60s. a ton at the works when coal was costing about 50s. delivered. It has now come down to 35s. at the works; but is still as dear as or dearer than coal. One cannot force people to buy low-temperature coke unless they find some advantage in price, and, if so, what constructive action does Prof. Armstrong propose to take?

I would say, in conclusion, that had Prof. Armstrong, instead of girding at a Committee for its supposed shortcomings, used the columns of your journal for introducing really practical suggestions or what he would call "constructive" ideas, how much more valuable would his contribution to the subject have been! Fault-finding is so very easy.

J. B. Cohen

CATALYSIS

(With apologies to the late Sir W. S. Gilbert)

Scene.—The surface of a piece of charcoal

[Enter a Chlorine molecule. She sits down dispiritedly on two adjacent carbon atoms and sings:—]

Here am I a Chlorine molecule so free,
Hey but I'm doleful, willow willow waly,
Nothing that I care for will combine with me,
Hey willow waly O.
Nothing that I care for will combine, and therefore
Hey willow waly O!

[Enter a molecule of CO—very smart, morning coat, silk hat, etc.—sits down on two adjacent carbon atoms beside her.]

CO:
Prithee, nascent Chlorine, will you marry me?
Hey but I'm hopeful, willow willow waly.
I may say at once I have lots of energy,
Hey willow waly O.
Energy, I use it, other compounds lose it,
Hey willow waly O.
Chlorine:
Radiant Sir, altho' I'm wishful to combine,
Hey, but I'm joyful, willow willow waly,
Never dared I hope for cavalier so fine,
Hey willow waly O.
I will follow ever, decomposing never,
Both:
Hey willow waly O.
[They go off arm in arm.]
[Curtain]

R. T. M. H.

THE "ORGANIC" CHEMIST

Sir,—Excuse me laughing, but I can't help it. If Charles Dickens were alive he would make nearly as much fun of chemists as of lawyers, touching their quibbles and verbose pleadings. I am not a chemist—at least, I have given up thinking that I am. Fifty years ago I got the idea into my head that I was a chemist, but in recent years phase rules, ions, electrons, emanations, isotopes, higher mathematics and such like terrors have knocked the conceit out of me and forced me to escape the muddling throng and take refuge in the strangers' gallery to watch the show in comfort. It is at times entertaining. Nearly a hundred years ago Wöhler knocked to bits the barrier that separated "organic" chemistry from ordinary chemistry. Ever since chemists have been trying to readjust the barrier, sometimes a bit nearer and sometimes a bit further with more or less "no man's land," but only to find that it is a phantom anyone can walk through if he wants. But if the term "organic chemistry" is silly, the height of absurdity is reached in the word "organic chemist." Names such as Metallic Chemist, Watery, Beery, Gassy, Oily, Soapy Chemist or Irony, Steely and Brazen Chemist would be just as sensible.

"Wheerfur—Theer! I la'af!"

—I am, Sir, etc., Joseph Barnes

THE HUMAN ELEMENT IN THE CHEMICAL INDUSTRY

Sir,—Those of us whose main concern is the human side of the Chemical Industry are able to appreciate at its full worth Viscount Leverhulme's recent letter to you. One fears that in the Chemical Industry, as in most others, the human problem was more or less ignored in pre-war days. Seldom was the task of dealing with the employees entrusted to one individual as his especial responsibility. Boards of directors, generally speaking, were not accustomed to concern themselves with questions affecting their workmen unless and until serious trouble threatened. In point of fact, the war was responsible for awakening employers to a realisation of the existence of a "Labour Problem." Previously, one never heard that expression. During the war, however, the atmosphere of comradeship induced by the existence of a common peril, caused employers to realise at long last that those who before the war had been merely "hands" were in reality human entities with legitimate needs and aspirations which demanded fulfilment.

With this discovery came the belated recognition of the fact that the management of workmen is a science, and consequently a function that can only be efficiently performed by persons with the requisite qualifications. It was a great step forward when firms began to appoint "labour managers" who were presumed to be men with inborn tact and a thorough understanding of human psychology. The concentration into the hands of a capable labour manager of all questions relating to labour was found by countless firms throughout the country to result in infinitely smoother relationships with the men and a consequent higher efficiency of production.

(In passing, I would like to draw attention to one direction in which I found American employers more far-sighted than British employers. American employers have recognised that even with a generous-minded directorate and a considerate management, the wheels of industrial relationships frequently become clogged owing to the foremen not being educated in the science of "man-management." As a result, many American firms give their foremen a course of training which helps them very considerably in meeting the thousand-and-one little difficulties with which they are continually faced. British employers would do well to emulate their American cousins in this respect, and to judge a foreman more by his capacity for dealing wisely with his men than by his mechanical efficiency or driving capacity.)

In addition, however, to teaching us the value of specialised labour management in the factories, the war taught us the value of a corporate sense in an industry. There was no corporate sense in the Chemical Industry so far as its treatment of labour questions was concerned. Each chemical firm, whether it employed scores or thousands of men, was a separate unit depending solely on its own judgment for guidance in dealing with its workmen. The largely-increased number of labour questions caused by war conditions led to a number of chemical manufacturers meeting together informally to exchange notes and to seek or give advice one to the other on some knotty labour point. The success of this venture prompted the formation of the Chemical Employers' Federation in June, 1917. The first two points laid down were:

1. (1) That the Federation would deal with nothing but labour questions, and
2. (2) That its members were in honour bound to send to its deliberations the men (directors if possible) who were responsible for the labour matters of their respective firms.

The result of adopting these two basic lines of policy has been that those chemical firms who are members of the Federation have the advantage of the collective assistance and advice of the men who personally handle their own labour problems daily, and who, by interchange of opinions, etc., round the Federation table, are continually becoming more expert in the science.

It should be noted that from its inception the Chemical Employers' Federation has consistently endeavoured to satisfy as far as possible those legitimate needs and aspirations of the workmen, to which reference has already been made. It has failed to satisfy them completely, and must necessarily fail, of course, because in a progressive civilisation needs and aspirations grow faster than does the power to satisfy them. The main thing for enlightened employers is to ensure a continuing effort to satisfy; stifled aspirations are the most fertile soil for the seed of unrest.

Many employers fall into the error of thinking that workmen are actuated first and last by financial considerations; chemical manufacturers have not done so. They have recognised through the activities of the Chemical Employers' Federation that "man does not live by bread alone," and that the most essential thing for a working man is to be assured of the dignity of his labour, and to feel that he is a factor, however humble, in the industry in which he is employed. The Chemical Employers' Federation has tried to give the men this assurance by creating wherever possible joint bodies representative both of employers and workpeople, in order that the common interests of both may be fully and freely discussed in a spirit of sincerity that shall convince the workman that he is regarded as a helper and not a chattel.

Joint bodies of this kind will never satisfy the workmen, however, if they degenerate into occasions for the mere interchange of pleasant compliments. They must be constructive, and in the chemical industry they have been so. One result has been the abolition of the old 12-hour shift system of working; another, the supersession of the plan whereby shiftmen worked every day, weekday, Sunday and Bank Holiday, without any additional remuneration, by the payment of overtime for Sunday and holiday work. A third result has been a very marked improvement in time-keeping, induced by the grant of a week's holiday annually with full pay to those who observe a certain standard of time-keeping. The first year that promise was made 45 per cent. only of the men earned the holiday; the second year the percentage jumped to 70, and is still improving. One firm employing over 5,000 men affords a wonderful example of the advantages of the annual holiday. Those men who do not lose more than two days in the year without reasonable excuse ("lates" being counted) are given a week's holiday and two weeks' pay. Last year 99 per cent. earned their holiday, and this remarkable figure is but decimal points higher than those of the preceding years.

I think we are right in claiming that the Chemical Employers' Federation was the first body of its kind to see the advantages both to workmen and employers of the annual holiday, and to put the scheme into force for an entire industry.

A criticism has been made that the Federation was apparently an organisation "for giving money away," the implication being, of course, that improper and costly concessions were made to the workmen. It is true that chemical workers' wages reached, and even now are at, a higher percentage above pre-war than those of almost any other corresponding class of labour, but the Chemical Employers' Federation has consistently considered the welfare of the industry in making its wage proposals. In fact, the Chemical Employers' Federation was the first body to recognise that wage advances must stop and that the then level of wages must be reduced. For some months we were as "a voice crying in the wilderness," but ultimately other industries admitted the correctness of our attitude and followed suit. Our policy has been to pay as high wages as are consistent with the national interests and with the future prosperity of our industry. In pursuance of that policy, our rates have been unchanged since April 1, 1922, and are now stabilised until April 1, 1923.

I have endeavoured to show that Viscount Leverhulme's formula for dealing with human nature is in active operation in the heavy-chemical industry at least, and it is our great regret that the organisations which exist in other sections of the chemical trade cannot see their way to join forces with us, so that our industry as a whole might present to the world the example in "labour management" that it does in scientific attainment and efficiency.—

I am, Sir, etc., R. Lloyd Roberts,
Secretary, Chemical Employers' Federation.

Winnington, Northwich.
January 18, 1923.

THE JOURNAL

Sir,—I read with interest the letter containing suggestions from three technical chemists, and agree with them, with the exception of one point, namely, the necessity of a journal embracing pure and applied chemistry.

I would suggest that the *Journal* of the Society of Chemical Industry remain a journal of applied chemistry.

The duplication of papers and abstracts is bound to take place when every scientific society is working independently, trying to cover every branch of chemistry.

What is required is a system of exchange whereby our members can obtain papers and abstracts from societies dealing with the various branches of chemistry. As it is now, if a chemist is a member of three or four societies, he receives similar abstracts from each society, and as a consequence retains his interest in one and loses it in the others.

The cost of subscriptions to many societies is very heavy and must be considered.—I am, Sri, etc., R. C.

Erratum.—The name of the author of the obituary of Dr. Lunge, published in the issue of January 26, should read T. W. Stuart, not T. W. Stewart.

PERSONALIA

Dr. H. S. Allen has taken up his duties as Professor of Natural Philosophy in the University of St. Andrews.

Mr. A. Hutchinson has been appointed to the University Lectureship in Crystallography established at Cambridge in connexion with the special Board of Physics.

The Royal Scottish Society of Arts has awarded a Keith Prize to Dr. D. Turner and Mr. D. M. R. Crombie for their paper on "An Investigation of the Ionised Atmosphere around Flames by means of an Electrified Pith Ball."

Messrs. Clayton, Son and Co., Ltd., of Leeds, have given 500 guineas and the Tottenham District Light, Heat, and Power Co. 250 guineas towards the cost of the experimental coal-gas plant, for the investigation of problems in the carbonisation and gasification of coal, which is being erected by Mr. Henry Woodall at Leeds University in memory of Sir Corbett Woodall.

* * *

The death is announced of Prof. J. B. Haycraft, well-known for his investigations into physiological problems such as the chemistry of the blood, the senses of taste and smell, and animal mechanics.

With regret we announce the death of Mr. F. E. Weston, B.Sc., Head of the Chemistry Department of the Polytechnic, Regent Street, and a member of this Society. In addition to his work as a teacher, Mr. Weston was the author of several treatises, of which "The Detection of Carbon Compounds" is perhaps the best known, and of late he had devoted much attention to the use of clay in soap-making.

NEWS AND NOTES

BRITISH INDIA

Forecast of the Indigo Crop, 1922–23

The final general memorandum on the indigo crop of 1922–23 estimates the total area at 296,800 acres, or 7 per cent. less than the final estimate last year. The total yield of dye is estimated at 2730 tons, which represents a decrease of 11 per cent. on the final revised estimate of last year.—(*Ind. Tr. J.*, *Jan.* 4, 1923.)

Forecast of the Sesamum Crop

The final forecast of the sesamum crop is as follows:—Final forecast for 1922–23 (including Burma): area, 4,847,000 acres; yield, 428,000 tons. Final forecast for 1921–22 (excluding Burma): area, 4,450,000 acres; yield, 450,000 tons.—(*Ind. Tr. J.*, *Jan.* 4, 1923.)

UNITED STATES

Mesothorium

Dr. R. B. Moore, chief chemist of the U.S. Bureau of Mines, in a short preface to a pamphlet on mesothorium, published by the U.S. Bureau of Mines, states that mesothorium is now used as a substitute for radium, not only for luminous paint, but also for medical purposes, and that it is now being recovered—as a by-product in the extraction of thorium—by two companies in the United States.

Dr. Schlundt gives an account of the radio-active changes of the elements of the thorium series and a table of the radioactive constants. Accounts are also given of the determination of the ratio of mesothorium to thorium, of the γ-ray activity of thorium D, of the extraction of mesothorium from monazite sand and its concentration by fractional crystallisation of mesothorium bromide, and of the decay of radiothorium and mesothorium preparations. A bibliography is appended to the pamphlet.

GENERAL

The Existence of a Hitherto Unrecognised Factor Essential for Reproduction

In a recent number of *Science* (*December* 8, 1922), two American investigators, H. M. Evans and K. S. Bishop, working at the University of California, have given a preliminary account of their researches on the reproduction of animals fed on diets composed of mixtures of "purified" foodstuffs. They have observed that rats fed on a diet apparently adequate as regards protein, fat, carbohydrate, salts, and at least two of the vitamins, A and B, are usually sterile in the first generation, but certainly fail to reproduce in the second. The sterility observed in such cases appears to be of a highly characteristic type. Natural foodstuffs contain a substance, X, which prevents the onset of sterility or cures it when it has been induced by the defective diet. As far as the authors can ascertain, the newly recognised dietary factor can be differentiated from any of the accepted vitamins, A, B, or C.

The results announced by these American workers are of great interest, but it may be wise to await fuller details of their experiments before accepting their main conclusion. It must be remembered that there are many difficulties in attempting an interpretation of observations such as Evans and Bishop have made. Thus, for example, the conclusion that the vitamin A is not the factor concerned is based on the results of experiments in which the effects of butter and cod-liver oil were compared, without, perhaps, sufficient attention being paid to the very wide variations in the amount of vitamin A present in these two oils. Doubtless the authors have considered such possibilities, and when their full results are published more detailed evidence in support of their views will be presented. Anyone who has carried out controlled experiments on the feeding of animals will probably agree that the first function of the body to be suppressed or damaged when the diet is deficient, either quantitatively or qualitatively, is that of reproduction, and the writer of this note has had many experiences, both with small animals such as rats and mice and also with farm animals such as pigs, which demonstrate that sterility may be induced by several types of dietary deficiency. Whether or not the main conclusions of the investigators at the University of California are correct, their experiments certainly provide additional evidence of the great importance of fresh foodstuffs, and constitute another warning against the modern tendency in food production whether for human use or for the rearing of farm stock.

The Hardness of Vitreous Silica

In a letter to *Nature* of January 6, Mr. Cosmo Johns and Prof. C. H. Desch describe experiments on the hardness of vitreous silica. The commercial silica glass has been described as softer than quartz, and this has been a difficulty in the way of Beilby's theory of hardening, according to which the vitreous modification should be harder than the same substance in the crystalline condition. The sample of silica used was melted on the top of the slag in an open-hearth steel furnace when the temperature was exceptionally high. It was completely isotropic, and the hardness, as found by scratching tests by the sclerometer and by the scleroscope, was distinctly greater than that of crystals of quartz.

Petroleum Production in Russia.

The following figures have been published concerning the production of petroleum in Russia during the first half of 1922 and the corresponding period of 1921 :—

District	Long tons raised to July 1, 1922	Long tons raised to July 1, 1921
Baku	1,492	1,281
Grosny	726	658
Emba	64	12
Total	2,282	1,951

These figures indicate an increase of 331 tons, or 17 per cent. over last year's production. On the average the intended programme was exceeded. The number of bore-holes has increased. During July 26,215 storage tanks were filled, or 3,950 more than during June.

The Use of Fertilisers on Forest Land

The old idea that the yield of wood could not be increased by applying fertilisers to forest land is, as the result of recent research, shown to be erroneous, treatment of the land with fertilisers containing nitrogen, potash, phosphoric acid and lime having resulted in many cases in a considerable increase in the growth of the trees. A test extending over 14 years has been carried out at Owing, Sigmaringen, on the slopes of the Jura Mountains, where a stretch of land that contained only a few pine trees and juniper bushes, and had been used for some time for pasturage, was divided into two parts, one of which was treated with nitrogenous fertiliser and sown with Swedish clover. Both parts were then planted with firs and divided into sections some of which were completely, and others partly, fertilised, whilst others were left untreated. Between 1906 and 1920 the average increase in height of the trees in the sections treated with Thomas meal and kainite was 523 cm., in those treated with Thomas meal alone 513 cm., and in the untreated sections only 408 cm. Ground burnt lime by itself effected very little improvement in the growth. Trees in the sections planted with clover showed a very considerable increase in growth, especially in the first year, but the tests on the whole showed that equally good results may be obtained by the use of mixed fertilisers without a previous crop of leguminous plants.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for January* 25)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Tiles	110
Canada	Tinplate, black sheets	82
”	Plumbago, dextrin crucibles	83
”	Steel, brass and nickel-silver wire	*
Chile	Rubber goods, leather, lubricating and lighting oils, grease (tender for)	7357/F.L./G.C.2
Egypt	Hides, pigskins (tender for)	†
Italy	Paper	91
Kenya	Red paint	10377/E.D./E.C.2
Morocco	Soap, candles	9661/F.E./C.C.
Netherlands	Formaldehyde, caustic soda, Epsom salts, sodium sulphate, ferrous sulphate, soda crystals, tartaric acid, sodium bisulphate and bicarbonate, sodium sulphite, copper sulphate, ammonium chloride, glacial acetic acid (98-100%), earthenware	96
”	Caustic soda	97
”	Tiles	98
Portugal	Copper sulphate, fertilisers	7226/F.L./E.C.2
South Africa	Brass and copper sheet	10387/E.D./E.C.

* Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C.2.

† Ref. Muh 1923/5/1. Inspecting Engineer, Egyptian and Sudan Governments, Queen Anne's Chambers, London, S.W.1.

TARIFF CUSTOMS EXCISE

Argentina.—Importation of opium, heroin, cocaine and preparations thereof is subject to licence and permitted solely through Buenos Aires.

Australia.—A "dumping" duty has been applied to portland cement of United Kingdom origin, the duty representing the difference between the fair market value of the goods at the time of shipment and the export price.

British India.—The complete text of the revised tariff valuations is given in the issue for January 25. Among the classes of goods affected are fuel, gums, resins, lacs, ores, oils, wax, fertilisers, chemicals, drugs, medicines, dyes, colours, tanning materials, glassware, earthenware, hides and skins, iron, steel and various metals, paper pulp, paper, cement, china clay, pitch, and soap.

Denmark.—The regulations restricting the importation of footwear in the manufacture of which artificial leather or pasteboard has been used have been continued until the end of 1924.

Italy.—The statistical tax on imports has been increased from 20 to 25 centesimi per unit.

Poland.—The conditions under which import permits are granted are set out in the issue for January 25.

Spain.—A temporary commercial agreement has been made with Germany.

Uruguay.—Modifications have been made in the tariff valuation on perfumery and toilet articles.

REPORTS

REPORT ON THE ECONOMIC AND FINANCIAL SITUATION OF AUSTRALIA, REVISED TO OCTOBER 1922. *By* S. W. B. MCGREGOR, *H.M. Senior Trade Commissioner in Australia. Pp.* 94. *Department of Overseas Trade. London: H.M. Stationery Office*, 1922. *Price* 2*s.* 6*d.*

The state of depression in Australian commerce and industry recorded in the last Report (*see* J., 1921, 437 R) still obtains, largely owing to the difficulty of wages adjustment, which, however, must come before conditions return to normal. Although at present Australia is the United Kingdom's second best customer, British traders will have to employ every means in their power to retain their present share in the Australian market, in face of competition from the United States, and possibly from other countries. It is pointed out that the Bureau of Commerce and Industry numbers among its aims the encouragement of British manufacturers to establish branch factories in Australia. The Institute of Science and Industry has made further progress, and a new scheme provides for the formation of Bureaux of Agriculture, Industries, and of Information.

The total production of industries during the year 1920-21 was valued at £402,208,000, made up as follows:—Agriculture, 28%; pastoral, 23%; dairy, poultry, etc., 13%; forestry and fisheries, 3%; mining, 6%; manufacturing, 27%. The production of metals and minerals during 1921 has previously been analysed in these columns (*cf.* J., 1922, 131 R). The closing down of the Newcastle works of the Broken Hill Proprietary Co., Ltd., was an important incident in Australian iron and steel manufacture; this was attributed to the high cost of coal and wages, and the shortness of working hours. In 1921 the output of pig iron amounted to 352,365 tons, an increase of 8365 tons over 1920. Paints, varnishes and cement are now made locally in sufficient quantity to supply the home market, as are also bottles, though other glass-ware is imported. The Government offer of a premium of £50,000 has given impetus to oil-prospecting, but so far no oil has been found in the Commonwealth.

External trade for the year ending June 30, 1921, showed an adverse balance, imports amounting to £163,801,826, and exports to £132,159,912. The competitive imports amounted to £126,044,552, of which the United Kingdom supplied 61 per cent., U.S.A. 20 per cent., and Japan 4 per cent. The imports of manufactured metal goods were valued at £29,170,930 (the U.K. supplying 62 per cent. of this); of machinery, £9,873,285 (U.K. 48 per cent.); earthenware, cement, china, and glass, £3,158,152 (U.K. 39 per cent.); ammunition and explosives, £1,164,208 (U.K. 64 per cent.); chemicals, £4,637,410 (U.K. 52 per cent); paints and varnishes, £626,920 (U.K. 63 per cent.); oils, fats, and waxes, £493,396 (U.K. 41 peh cent.). The chief chemicals imported were:—Tartaric acid, £294,577; cream of tartar, 1356 tons; synthetic dyes, £412,841; proprietary medicines, £260,506; drugs, etc., £338,856; perfumery, £56,909. Of the exports the United Kingdom took £67,519,740, or 51 per cent. of the total; other British countries £25,916,368 (20%); the United States £9,965,575 (8%); Japan £3,117,572 (2%). In 1921-22 imports amounted to £101,063,661, and exports to £127,949,445.

Report on the Commercial, Industrial, and Economic Situation of China in July, 1922. *By* H. H. Fox, *Commercial Counsellor, and* A. H. George, *late Acting Commercial Secretary, H.M. Legation, Peking. Pp.* 64. *Department of Overseas Trade. London: H.M. Stationery Office*, 1922. *Price* 1*s*. 9*d*.

Although the commercial and industrial development of China has again been retarded by civil war, and in a lesser degree by floods and famine, yet industrial enterprise is progressing gradually (*cf.* J., 1921, 454 R), especially in the ports, and it is felt that the set-back to home industries which were established when foreign supplies were difficult to obtain, is merely incidental. The problem is to initiate, not to revive, an industrial system, and the Chinese frequently fail to appreciate the value of co-operation between foreign and Chinese capital and interests. The sugar industry has been declining for some time; the present production is estimated at 450,000 tons, and imports at 350,000 t. Sugar-beet planting has not been successful, but experimental cultivation is being continued. The vegetable-oil industry is important but badly equipped, though it caters for a large home consumption as well as export. Estimates of the annual output of coal varies between 10 and 18 million tons; the output of the Kailan Mining Administration, an Anglo-Chinese concern, is over 4 million tons per annum, and could be increased. The present production of iron ore is 1,500,000 t., of which about two-thirds is smelted in the country. Various other ores are produced, but the small demand has caused many mines, even some of old standing, to close down. Exports of lead and zinc ores increased, however, in 1921. With ample supplies of limestone and other materials available, cement manufacture is becoming one of the leading industries of the country, and one factory alone hopes to bring its annual output to 200,000 t.

Foreign trade in 1921 amounted to £297,959,671 (taking the Haekwan tael at its average value of 3s. 11$\frac{7}{16}$d.), of which imports made up £179,110,978 and exports £118,848,693. The general fall in world prices during the period must be considered when comparing the figures for the two years.

Of the total imports the United Kingdom supplied 16 per cent., Hong Kong 25 per cent., other British countries 6 per cent., Japan and Korea 23 per cent., and the United States 19 per cent. Among the chief items were:—Iron and steel, 155,644 t.; copper ingots and slabs, 28,415 t.; tin, block, 4493 t.; tinplate, 23,943 t.; cement, 150,829 t.; coal, 1,361,781 t.; sugar, 473,876 t. Of the following items the value only is stated:—Metals and minerals other than above, £2,220,695; dyes, colours, and paints, £5,788,073; matches and materials, £728,628; leather, etc., £1,684,700; glass, £728,354; soap and materials, £414,618; medicines, £139,476. Germany has restored her pre-war organisation for selling dyestuffs in China, helped by the depreciated mark. (For some details of the indigo market in China *see* J., 1922, 459 R.)

Of the exports, Hong Kong took 25 per cent., the United Kingdom 5 per cent., other British countries 5 per cent., the United States 15 per cent., Japan and Korea 31 per cent. Among the chief items were:—Pig iron, 157,625 t.; ores, iron and others, 55,495 t.; tin, in slabs, 6133 t.; antimony regulus, 12,466 t.; coal, 1,886,398 t.; oils, vegetable and essential, 126,883 t.; tallow, 8477 t.

REVIEWS

Synthetic Colouring Matters. Colours Derived from Pyridine, Quinoline, Acridine and Xanthene. *By* Prof. J. T. Hewitt, F.R.S. *Pp. xi*+405. *London: Longmans Green and Co.*, 1922. *Price* 14*s*. 6*d*. *net*.

This work is trebly welcome, first because it is the initial volume of the half-dozen monographs on colouring matters to be issued in Sir Edward Thorpe's series of "Monographs on Industrial Chemistry," secondly because it deals with a number of small groups of dyes which are, for the most part, inadequately treated in existing text-books, and lastly, and perhaps most important of all, because the book emanates from one who is recognised as an expert in the subject and whose researches have done much to settle the problems connected with these classes of dyes.

Originally, as Prof. Hewitt tells us, it was his intention to write a single work on dyes of the Acridine, Xanthene, Azine and Oxazine groups, but later the large amount of material available made it desirable to write two books dealing with the Azines and Oxazines on the one hand and with the Acridine and Xanthene dyes on the other. In view, however, of the importance which has been attached of late years to the sensitising dyes of the Quinoline series, dyes derived from Pyridine and Quinoline have been included in the present volume. Accordingly we have a separate chapter dealing with the constitution and preparation of the Cyanines and Isocyanines and related compounds which summarises in an admirable way the important researches carried out during the war which enabled Prof. Pope and Dr. Mills and their co-workers to prepare at Cambridge the dyes used in sensitising the photographic plates used by the Allied air forces in the struggle, thus contributing in no small measure to the final victory. It is a pity that the book was published just too soon to include a reference to the work of Mills and Braunholz upon the Cyanines derived from oxythionaphthene which possess certain valuable properties, but this group of colouring matters is now being so intensively investigated that no book can hope to keep level with it, and we are grateful to Prof. Hewitt for bringing the subject right up to 1922. (In passing it may be noted that the missing reference to Williams on p. 55 should be to British Patent 1090 of 1859.)

The only adverse criticisms that might be made are—apart from the few inevitable misprints—that in the desire to document the book fully the author has, perhaps, made needlessly long extracts from German patent specifications which, as he himself says, do not always contain the whole truth and nothing but the truth. It would probably have been better in most cases where several examples are quoted for the same type of reaction to have given the results in tabular form, omitting all references to actual quantities and times, for which in any case the original patents would have to be consulted; for these reasons certain parts of the book are of unnecessary length and could quite well be abbreviated.

Lastly, as a certain amount of information has been forthcoming of late years on actual manufacturing processes one would have appreciated, where possible, a little fuller treatment of the actual works, processes and diagrams of plant used.

But it is always easier to criticise than to do a thing oneself, and those who have had experience of dealing with the publication of works on this branch of chemistry will recognise the vast amount of care and labour which Prof. Hewitt must have expended on the production of the present excellent volume and their gratitude and thanks are due to the distinguished author for contributing a really valuable addition to chemical literature.

FREDERICK A. MASON

BLEACHING POWDER AND ITS ACTION IN BLEACHING. *By* R. L. TAYLOR. *Pp.* 78. *Manchester and London: John Heywood, Ltd.*, 1922. *Price* 4*s.* 6*d. net.*

This book is a collection of papers which the author published in the *Journal* of the Chemical Society and in the *Journal* of the Society of Dyers and Colourists during the period 1910–1922. One is disappointed to find that the author's earlier papers on hypoiodous acid are not included, for this work was referred to by an Austrian chemist as "Die schoenste Arbeit von R. L. Taylor," and there is no doubt that it will be the means of preserving Taylor's name in the memory of chemists.

It is difficult to justify the re-issue of papers in book form, although it is sometimes done for the purpose of reviewing a period of development in some branches of chemistry; but it is probably better to give a summary of the papers, pointing out how criticisms have been met and emphasising the final conclusions drawn from the series of papers. The latest opinions are the only ones which matter, and little is to be gained by reiterating views since abandoned.

The work on the action of air and of carbon dioxide on bleaching-powder solution has been carefully carried out and is a record of well-conceived experiments, but in giving an opinion on the work on bleaching, the reviewer is in an awkward position, because he has engaged in a controversy with Taylor on the subject. Moreover, a large portion of the book deals with this controversy or one side of it. It is, however, interesting to quote the opinions of a third party, namely, S. R. Trotman (*cf.* J., 1922, 222 T), on points in the controversy: "I am of the opinion that for weak solutions of bleaching-powder, such as would be used in bleaching, Higgins's view is correct"; and before the Nottingham section of this Society on November 22, 1922: "Bleaching . . . . is probably due to the gradual formation of hypochlorous acid." As previously mentioned, Taylor's book would be improved were it made a fuller record of all his researches, which were carried out during a very busy and effective life devoted to the teaching of science in Manchester.

S. H. HIGGINS

TABLES ANNUELLES DE CONSTANTES ET DONNÉES NUMERIQUES DE CHIMIE, DE PHYSIQUE, ET DE TECHNOLOGIE. *Published under the auspices of the International Union of Pure and Applied Chemistry. Vol. IV.*, 1913–1916. *Part I., pp.* 626; *Part II., pp.* 627–1377. *Paris: Gauthier-Villars et Cie.; London: Cambridge University Press; Chicago: University of Chicago Press.* 1921, 1922. *Price* 140*s.*

The publication of the Annual Tables of Chemical, Physical and Technological Constants, which was discontinued during the war, has now been resumed with the issue of Volume IV, which includes all the scientific and technical data published in the years 1913, 1914, 1915, 1916. The Editorial Committee has had to overcome great difficulties and some still remain to threaten the continuation of its work, which is considered essential by scientists and engineers.

To provide support for the Committee, the International Union of Pure and Applied Chemistry decided to form an International Fund, and subscriptions from France and the United States have already furnished half the sum required. It is hoped that other countries will subscribe without delay, as the Committee would then be able to publish Volume V, for which the data, covering the years 1917 to 1922, have already been collected. The importance of such a collection of data becomes increasingly evident, especially as much of the information could otherwise be obtained only by detailed study of every scientific and technical periodical. Besides the names of practically every scientific establishment in the world, the list of subscribers includes those of firms representing the most varied branches of industry. The task of collecting and publishing such a large mass of information is particularly heavy, and only when the list of subscribers includes all those who *should* subscribe in their own interests, will the future of the Tables be assured. The two parts which constitute Volume IV are well printed in a reasonably clear type and are well bound. To Dr. Charles Marie, who has edited the Tables, the greatest credit is due for the publication of such a vast collection of accurate numerical data in orderly sequence and arrangement.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The general position shows a tendency for prices to firm up somewhat. This is undoubtedly due to an anticipated shortage of supplies from Germany as a result of the French occupation of the Ruhr and the probable shortage of fuel for industrial purposes. Should it become necessary for the Germans to import coal, cost of production will rise enormously, and even the tremendous depreciation in the value of the mark will render their competition in the British market practically unavailable.

Acid Acetic, 40% tech.	£21 per ton.
Acid Hydrochloric	4s. to 5s. carboy d/d.
Acid Nitric, 80° Tw.	£23 per ton. In rather small demand.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali	£8 per ton. Home trade demand, which has recently been somewhat down, is showing slight improvement. Export in good demand.
Arsenic (White)	About £70. Demand still good and supplies very short.
Bisulphite of Lime	£7 per ton, packages extra and returnable.
Bleaching Powder	£10 10s.-£11 10s. per ton. Very slight improvement to report. Continental offers not quite so frequent and at rather higher figures.
Calcium Chloride	£6 per ton, carriage paid. No appreciable change—foreign offers still at low figures.
Copper Sulphate	£26 per ton f.o.b.
Potash Caustic	£29-£30 per ton. Not very much doing, but position shows signs of hardening.
Potassium Bichromate	6¼d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.-£5 10s. per ton. Inquiry still good, with rather small inclination on the part of sellers.
Soda Caustic, 76%	£20-£21 per ton. Position somewhat improved at unchanged prices.
Soda Crystals	£5 10s. per ton carriage paid. Unchanged.
Sodium Bicarbonate	£10 10s. per ton carriage paid. In better demand both for home and export trades.
Sodium Bisulphite, 60/62%	£19-£20 10s. per ton f.o.b. or f.o.r. London.
Sodium Chlorate	Market dull, with offers of Continental make at low prices.
Sodium Sulphide	£16 per ton. Position unsatisfactory and demand very poor.
Sodium Sulphite, Pea Crystals	£17 - £17 10s., 1 - cwt. wooden kegs included.
Sodium Acetate, 97/98%	£23 per ton.
Sodium Nitrite	£30 per ton, 100% basis, d/d.

WOOD DISTILLATION PRODUCTS

There is a brisk inquiry for all products, and in most cases the demand is greatly in excess of production, consequently prices for some products show a sharp upward tendency.

Supplies of Wood Naphtha (to pass customs and excise regulations for methylating) are very scarce, and home prices have followed the American quotations, which are about 1s. per gallon less for prompt shipment than prices asked for stocks held in this country, or respectively 6s. 10d. and 7s. 10d. per gallon. Grey Acetate of Lime (80%) is also greatly in demand by both home and Continental users, the shortage being due to restricted imports from America and also to some extent to reduced output in this country. Some importers are asking as high as £19 10s. c.i.f., but most of the home makers have sold at considerably lower prices, as indicated in the "prices column," although prices of both the Brown and Grey qualities are tending upward, the former still showing a pro rata advantage to the user on the Acetic Acid content.

Considerable quantities of French Forest Burnt Charcoal are being offered and imported in competition with the more superior home-produced Retort Charcoal at varying prices, but recent shipments to Manchester worked out at £8 7s. 6d. per ton delivered buyers' works. Where high grade Charcoal is required, however, British producers have little trouble in selling at much higher figures.

Acetate of Lime, Brown	£9 per ton d/d.
Acetate of Lime, Grey	£15 10s. per ton d/d.
Acetate of Lime, Liquor	9d. per gall. 32° Tw. d/d.
Charcoal	£9 10s. to £10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15°Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefined
Wood Naphtha, Miscible	7s. ,, ,, 60% O.P.
,, ,, Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead	£36 per ton d/d.

TAR PRODUCTS

Acid Carbolic, Crude 60's	2s. 5d.-2s. 6½d. per gall. Market firm with fair inquiry.
Acid Cresylic, 97/99	2s. 2½d. per gall. Good business doing.
Acid Cresylic, Pale, 95%	2s. to 2s. 2d. per gall.
Acid Cresylic, Dark	1s. 6½d.-1s. 11d. per gall. Very little demand.
Anthracene Paste, 40%	7d. per unit per cwt. Price nominal; no business.
Anthracene Oil, Strained	8d. to 10d. per gall. Small inquiry.
Anthracene Oil, Unstrained	8d. per gall.
Benzole, Crude 65's	1s. 1d.-1s. 2d. per gall.
Benzole, Standard Motor	1s. 8d. to 2s. per gall.

Benzole, Pure	2s. to 2s. 2d. per gall. Small inquiry.
Toluole, 90%	1s. 10d. to 2s. per gall. Small inquiry.
Toluole, Pure	2s. to 2s. 4d. per gall. Small inquiry.
Xylol	2s. 6d. to 3s. 6d. per gall.
Creosote, Cresylic, 20/24%	10d. to 10½d. per gall. Fair business doing.
Creosote, Middle Oil	8¼d. per gall. Good business doing. Market strong.
Creosote, Heavy	8d. ,, ,,
Creosote, Standard Specification	7¾d. ,, ,,
Naphtha, Crude	9½d. per gall.
Naphtha, Solvent, 90/160	1s. 6d.-1s. 10d. per gall. Weak. Very little inquiry.
Naphtha, Solvent, 90/190	1s. 7d. per gall. Weak. Very little inquiry.
Naphthalene, Crude, Drained Creosote Salts	£6 to £7 per ton.
Naphthalene, Crude, Whizzed or Hot Pressed	£9 to £10 per ton. Good inquiry.
Pitch, Medium Soft	135s. to 140s. per ton. Market very firm and demand good.
Pyridine, 90/140	11s. 6d. to 12s. 6d. per gall.
Pyridine, Heavy	8s. to 9s. per gall. No business.

INTERMEDIATES AND DYES

Acid H.	5s. 1d. lb., 100% basis.
Acid Naphthionic	2s. 7½d. ,, ,, ,,
Acid Neville and Winther	6s. ,, ,, ,,
Acid Sulphanilic	1s. 6d. ,, ,, ,,
Aniline Oil and Salts	10d. lb., naked at works.
Benzidine Base	6s. 6d. lb., 100% basis.
Dinitrobenzene	11d. to 1s. lb., naked at works.
Dinitrotoluene, 48/50	8d. to 9d., naked at works
,, 66/68	1s. 2d. to 1s. 3d., naked at works.
Diphenylamine	4s. 1d. lb.
α-Naphthol	2s. 9d. lb.
β-Naphthol	1s. lb.
α-Naphthylamine	1s. 6½d. lb.
β-Naphthylamine	4s. 6d. lb.
p-Nitraniline	2s. 9d. lb.
Nitrobenzene	8d. lb., drums extra.
Nitronaphthalene	1s. lb.
Naphthionate Soda	2s. 8½d. lb., 100% basis.
Diethylaniline	4s. 6d. lb., packages extra.
Metanitraniline	5s. 6d. lb.
Para Toluidine	5s. lb.
Para Phenylene Diamine	12s. lb., 100% basis.
Meta ,, ,,	5s. 6d. lb.
Meta Toluylene ,,	5s. lb.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The prices of Pharmaceutical Chemicals are all distinctly firmer in the expectation that German competition may soon be eliminated for some space of time. It is possible that shortage of spot supplies of some chemicals may result in the prices going higher for a brief period.

Acid Acetic, 80%	£44 per ton.
Acid Acetyl Salicylic	2s. 10d. to 3s. lb. Price unchanged but distinctly firmer with good demand.
Acid Benzoic	2s. lb. still accepted for spot parcels, but it is difficult to book at this figure for forward delivery.
Acid Boric, B.P.	£61 per ton crystals, £65 per ton powder, packages in 2-cwt. bags; carriage paid U.K.
Acid Citric	1s. 6d.-1s. 8d lb. Market very firm. Considerable buying going on.
Acid Salicylic	1s. 5d. to 1s. 6d. lb. With a firmer tendency.
Acid Tartaric	1s. 2½d.-1s. 2¾d. lb., less 5% for minimum 1-ton lots. A further advance has taken place. The market is daily becoming firmer on increased demand and on progressive increase of cost of raw materials.
Acetanilide	1s. 6d. lb. Slightly less for quantity.
Amidopyrin	14s. lb. Firmer in view of smaller supplies being available.
Ammonium Benzoate	3s. lb. for best makes.
Ammonium Sulphocyanide	2s. 6d. for recryst.
Atropine Sulphate	12s. 6d. oz. Higher prices are expected to prevail before long.
Barbitone	12s. 6d. lb. In better demand.
Benzonaphthol	5s. lb.
Bismuth Salts	Prices per lb. for cwt. lots are as follows:—Carbonate 13s., Citrate 11s. 7d., Nitrate Cryst. 6s. 11d., Oxide 14s. 5d., Salicylate 10s. 3d., Subchlor, 12s. 8d., Subgallate, 9s. 6d., Subnitrate, 11s.
Bromides	Prices stiffening up owing to uncertain conditions on the Continent.
Calcium Lactate	2s. 6d. to 3s. 6d., according to quality and quantity.
Chloral Hydrate	4s. lb. for duty paid.
Guaiacol Carbonate	8s. 6d. lb. There is very little demand at the moment.
Hexamine	3s. 6d.-3s. 9d. lb. Very much firmer, with higher rates being quoted for forward delivery.
Homatropine Hydrobromide	30s. per oz.
Iron Ammonium Citrate	No change; rather quiet with small demand.
,, ,, ,, B.P.	2s. 5d. lb.
,, ,, ,, Green	3s. 1d. lb.
Iron Perchloride	22s. to 25s. cwt. Steady market.
Menthol	37s. 6d. lb., less 2½% for original cases. Smaller quantities 38s. lb. nett.
Methyl Salicylate	2s. 2d. unchanged, for good quality.

Mercurials	Unchanged. Market for quicksilver weaker.
Paraldehyde	1s. 6d. to 1s. 9d. lb. Spot supplies are short and higher prices must soon obtain.
Phenacetin	5s. lb. Still firm.
Phenazene	7s. lb. Price hardening upwards.
Phenolphthalein	5s. 6d. lb., with little offering.
Pilocarpine Nitrate ..	22s. 6d. oz.
Potassium Bitartrate 99/100% (Cream of Tartar)	98s. per cwt. for ton lots, less 2½%. Firm with upward tendency.
Potassium Ferricyanide ..	4s. to 4s. 3d., according to quantity.
Potassium Iodide	15s. 8d. lb. for cwt. lots. Cases free. Demand still good.
Potassium Metabisulphite	8d. per lb.
Potassium Permanganate ..	8½d. lb. for good quality.
Quinine Sulphate	2s. 3d. to 2s. 4d. oz. Bulk packages. Fairly steady market.
Salol	2s. lb., with higher prices probable in face of any demand.
Silver Proteinate	12s. lb.
Sodium Benzoate	2s. lb. Very firm in common with Acid Benzoic.
Sodium Citrate, B.P.C. ..	2s. per lb. for cwt. lots.
Sodium Potassium Tartrate (Rochelle Salt)	80s. to 85s. per cwt. Fair demand.
Sodium Salicylate ..	2s. powder, 2s. 1d. crystal. Prices are as yet unchanged, but very firm.
Sodium Sulphite, Anhydrous	£25 10s. to £28 10s., according to quantity; f.o.r. London, drums included.
Sodium Sulphite, crystals ..	£17-£17 10s. per ton, according to quantity.
Thymol	17s. to 19s. lb. Much firmer on withdrawal of some of the competition abroad for the synthetic article.
Ammonium Carbonate, B.P.	£37 6s. 8d. nett per ton.
Magnesium Carbonate, Light Commercial ..	£40 per ton.
Magnesium Oxide—	
Light Commercial ..	£85 per ton.
Heavy Commercial ..	£29 per ton.

PERFUMERY CHEMICALS

Amyl Acetate	2s. 3d.
Amyl Butyrate	8s.
Amyl Salicylate	3s. 3d.
Anethol (melting point 21/22° C.)	4s. 6d.
Benzyl Acetate from chlorine-free Benzyl Alcohol ..	3s.
Benzyl Alcohol free from chlorine	3s.
Benzaldehyde free from chlorine	3s.
Benzyl Benzoate, 19.5° C.	3s.
Cinnamic Aldehyde 98/100%, Natural ..	14s. 9d.
Citronellol	22s. 6d.
Citral, 100%	10s. 6d.
Ethyl Phthalate	4s. 3d.
Eugenol, 100%	11s.
Geraniol (from Palmarosa)	30s.
Geraniol	5s. 6d. to 12s. 6d.
Iso Eugenol	17s.
Linalol, ex Bois de Rose ..	21s.
Linalyl Acetate	22s. 6d.
Methyl Benzoate	8s. 6d.
Phenyl Ethyl Acetate ..	10s.
Phenyl Ethyl Alcohol ..	17s. 6d.
Rhodinol	45s.
Terpineol	3s.

ESSENTIAL OILS

Anise Oil, Red Ship Brand	2s. 1½d.
Bourbon Geranium Oil ..	20s. for shipment.
Cananga Oil, Java ..	9s. Firm.
Cinnamon Oil, leaf ..	4½d. per oz.
Cassia Oil, 80/85% ..	8s. 7½d.
Clove Oil	7s. 3d.
Citronella Oil, Ceylon ..	3s.
Citronella Oil, Java 85/90%	3s. 6d.
Eucalyptus Oil, 70/75% ..	1s. 10d.
Lavender Oil, Mont Blanc 38/40%	14s.
Lemon Oil, spot	2s. 10d. New crop for shipment 2s. 7d.
Orange Oil, sweet, spot ..	9s. 6d. New crop for shipment 8s. 3d.
Otto of Rose Oil—	
Anatolian	24s.
Bulgarian	28s.
Palma Rosa Oil	17s.
Peppermint Oil, English, Mitcham	80s.
Peppermint Oil, Mayne County	14s.
Peppermint Oil, Japanese ..	7s. 6d.

TRADE NOTES

London Joint City and Midland Bank, Ltd.

The Ordinary General Meeting was held on January 2[illegible] 1923. The Right Hon. R. McKenna (Chairman) said that our commerce is distinguished from that of any other country by its large proportion of foreign trade, which, it is safe to say, before the war absorbed one-third of the labour of our people, whether in production, transport, or clerical work. It appears that though our Imperial trade has suffered less than our foreign trade, it has still been greatly impaired, and so far from reducing our loss has itself contributed to it. The relations between capital and labour are on a far better footing than they were two or three years ago. Post-war illusions have been dispelled and there is a general disposition to face realities. The public has a wider recognition of the necessity for national economy, of the crushing effect of excessive taxation on industry, and of the need for greater production. If we look for a revival of trade, for more abundant revenue and for a reduction in taxation, we must leave prices to take their own course under the normal pressure of supply and demand and must seek a general increase of wealth through a more abundant output.

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EDITORIAL

WE are not ashamed to confess that we have only a very indistinct idea of what an Editorial should be and why such notes are published in weekly journals. The leading articles in a daily newspaper, which are perhaps the ancestral type of this sort of writing, are usually better written, better printed and much shorter, than the news which deals in detail with the particular topic. They therefore often save the busy man the trouble of reading a couple of columns of small print. In the case of our *Journal*, they can hardly be anything more than brief comments on subjects which happen to come before the editor in the two or three days which precede the printing and publication of the issue. They must be the most ephemeral part of the reading matter, merely a polite and conventional invitation to the reader to begin, so soon as he feels inclined, to read the *Journal* itself. They are perhaps comparable to the speech of the chairman who introduces a lecturer in a few preliminary observations. If our experience is a guide, the audience is very tolerant, even kindly disposed, to a chairman whose speech is brief. How we have all suffered from the chairman who has spoken for a quarter of an hour and then racks his brains for an elegant phrase with which to end his peroration, trying first one and finding it not to his satisfaction, then trying another, wearying with these efforts the listeners who would be only too thankful if he stopped in the middle of a sentence or, better still, in the beginning of it! The writer of such introductory paragraphs should not let trifles stand in the way of his duty, this being to make the reader speedily welcome some piece of news or well-written article. Undue attention to trifles often hinders the real work. " He that observeth the wind shall not sow, and he that regardeth the clouds shall not reap."

* * *

It was a wise man who stated : " There are two kinds of things it is no use complaining about : the things that can be helped and the things that can't be helped." We fancy that Dr. Scott must be some such philosopher. He received some years ago from a friend a sample of sand from New Zealand, analysed it and found what he thought was an oxide of a new metal ; waiting for that leisure, which is so elusive, he kept the sample and its solutions, hoping to turn his attention to it at an early date. Before he could find a convenient opportunity, other workers, engaged on accurate X-ray analysis, announced the occurrence of lines which could only belong to some such metal. Without a word of regret at this prior announcement, with no complaint of hard luck, Dr. Scott speedily completed his analysis, prepared a double fluoride of the new element and potassium, determined approximately the atomic weight of the new element, as announced before the Chemical Society and reported in our present issue, offered a sample of the new oxide to the other workers, Professors Coster and Hevesy, which offer has been gratefully accepted, and is now engaged with the small residue of his material in making a more complete investigation of the new element and its compounds. The new element has some of the properties of the titanium group : for instance, its capacity for forming double fluorides, and it is interesting to note that this double fluoride is hygroscopic ; it might have been expected it would have more affinity for water than the corresponding compounds of titanium and zirconium. Titanium was named from the Titans, one of whom was Oceanus, and Dr. Scott proposes for the new element the name Oceanium, as being of the same class as Titanium and not so purely local as Hafnium, or Celtium, the alternatives proposed by some of the other applicants for the vacant space in the list of atomic numbers. It is a pity that the name of Moseley, the pioneer in X-ray work, does not lend itself to this sort of nomenclature, whilst Scotium is more suggestive of Celtium than is reasonable in the circumstances. To those of us who were born south of the Tweed it is a little disconcerting that the elements recently discovered by British chemists should so many of them be claimed by Ramsay and Scott; this belongs to the category of things that can't be helped, and we must be as philosophic as Dr. Scott. There are only very few elements left to discover, and we beg Dr. Aston, Professors Perkin, Wynne and others to claim some of these for England before it is too late.

* * *

The paper by Dr. Fyleman read before the London Section of the Society of Chemical Industry on the 5th inst., had already been published in full in our Transactions of January 26. This experiment in premature publication, combined with the interesting character of the topic, led to a capital discussion, and those who are responsible for organising such meetings might well consider whether an early distribution of prints of an important paper might not be very helpful. In this particular case the Author dealt with a number of explosions which had occurred in the distillation of liquid air and various explanations were suggested as to the possible origin of these through the accumulation of solid acetylene, perhaps assisted by an electric spark. The American Chemical Society has quite recently published some curious cases of gas and other explosions which show how unexpected may be the influences which bring about such disasters. A Naval Surgeon walked to his garage in rubber boots and a fur coat, the friction of which generated enough electricity to cause an explosion of petrol and air which destroyed his motor car. When petrol is pumped through a hose or through a skin or chamois strainer a high voltage is generated. But perhaps the most unlikely cause of an explosion is that described by the New York Society for the Prevention of Cruelty to Animals, who have been in the habit of asphyxiating stray cats in large numbers. There have been half-a-dozen minor explosions and one serious one caused by dropping a basket full of cats into ordinary illuminating gas. Electricity was generated in sufficient quantity to explode the gas in contact with air. We refer our readers to a communication from Mr. A. H. Gill of The Massachussets Institute of Technology in the February number of *Industrial and Engineering Chemistry.*

CHINA CLAY

Its Composition, Preparation and Uses

By H. F. COLLINS, A.R.S.M., M.I.M.M.

(*Continued*)

At first sight, the method of drying may appear primitive, but when it is considered that the objective is the complete elimination of water from a sludge or slurry containing 50 per cent. of that substance, without running any risk of damaging the colour of the product by overheating, contamination with iron, or with the products of combustion, the finding of an alternative to the present system is seen to be not a simple matter. Filter-pressing the sludge reduces its water content from 50 per cent. to 25 per cent., but the elimination of the remainder requires more than half the fuel necessary for the original content of 50 per cent., and even the saving in fuel that is realised is largely offset by increased cost for labour, power, and wear and tear. Strict regulation of the combustion in the furnaces of the "drys," eliminating on the one hand imperfect combustion with production of smoke and of carbonic oxide, and on the other, circulation of surplus air through the fire boxes, which was formerly the greatest source of excessive consumption, has in the best practice reduced the consumption of fuel to not much more than one-half its former proportions, and in actual practice, with coal of good quality and under good control, clay is being dried with a consumption of only 8 to 9 per cent. of fuel. For this it is necessary to employ furnaces with closed ashpits, the whole of the air supply being preheated by passage through the brickwork, and regulated in quantity; to use an auxiliary air supply over the bridge after firing up; and to have automatic carbon-dioxide recorders in the flue at the base of the stack.

Much has been heard from time to time of the purification of clay by centrifugal separation from sand and mica, and by electrolytic separation of impurities such as iron and titanic oxides. Prevention is, however, better than cure, and whilst many foreign clays are much improved in colour and quality by electrolytic separation, the greater part of our own West of England clay is already so free from these particular impurities that such refinement is unnecessary because unwarranted by the market demand, whilst as regards our "common" clays (the bulk of which are inferior to the "medium" quality or "seconds" clays only in possessing a cream or yellowish tinge) the amount of improvement that can be effected by such methods does not seem likely to compensate for the additional cost. The yellow colour of common clays is generally, though by no means invariably, due to the presence of iron oxide. Sometimes, however, it is due to some form of organic matter, which disappears upon "firing," leaving the clay dead white.

Uses of China Clay

The two principal uses of china clay are for paper-making and pottery. During the pre-war period. less than one-third of the total output was employed for the latter purpose, by far the largest individual use of the material being for paper-making. Other uses are :—

(1) As a stiffener, mixed with size, for loading cotton cloth and other textile fabrics. Clays for this purpose, like those used for paper-making, are known as "bleaching" clays.

(2) For the manufacture of sulphate of alumina, and of alum ; the more aluminous varieties are naturally preferred for this purpose.

(3) For the manufacture of ultramarine. In Germany alone from 12,000 to 15,000 tons are said to have been used for this purpose before the war, but the trade seems to have shrunk to minute dimensions since.

(4) As an absorbent and loading material in the manufacture of linoleum, papier maché, and white celluloid goods, also of tyres and other rubber goods, and of modelling materials.

(5) In the manufacture of special wall plasters and distempers (particularly in the U.S.A.) ; also for tooth and toilet powders, cleansing soaps, coloured chalks and crayons, etc.

(6) For the adulteration of whiting, and of various zinc and lead mixed white pigments and of plaster-of-paris, and as a filler to give body and weight to asbestos and other packings, also as a simple adulterant to chemical manures and to certain articles of food that are sold in powdered form.

In paper-making, china clay, mixed with size, performs the function of filling the pores or voids between the shreds of pulped vegetable fibre that form the grain or skeleton of the paper, giving it body as well as a solid even surface. For best quality paper, the whitest and best grades of china clay are always preferred, colour being added to suit when making cream or azure papers, not only because the colour is in that way under better control, but because the whitest clays are also the finest, and therefore keep in suspension better. For newspapers and other paper of lower class, a common grade of clay can of course be used.

Sometimes, in paper-making, two qualities of clay are employed, a low medium clay, provided its grain be fine enough, being used for the body of the paper (called "loading" clay), whilst the half-finished paper is passed through a bath of high quality fine and white clay (called the "coating" clay) mixed with size, and then between hot rollers in order to give it a smooth and glossy white surface. Such coated paper is employed for making paper for process blocks, etc., and for other purposes.

The distinction between "potting" and "bleaching" clays (*i.e.*, those used for paper-making and for loading textile fabrics) is by no means definite, or based upon any characters that lend themselves to specification. In general, bleaching clays must be fine-grained, so that they show but little tendency to settle out from the emulsion-like baths into which they are made up ; also they must be of best to medium colour, according to the exact use to which they are put.

The colour of common and medium quality clays, for so-called "bleaching" purposes, is often improved by judicious "blueing."Aniline blue, mixed in a barrel with water, is allowed by means of a syphon to drip in any desired proportion into the stream of purified clay water on its way to the settling-pits. The capacity of china clay for absorbing pigments is so great that the perfectly soluble dye is all taken up by the deposited clay, leaving the overflow water as free from colour as if no dye had been used. The best clays, of course, are of a dead white colour without any such extraneous assistance, but occasional stained sections of a pit that ordinarily yields best clay can be brought up to standard by this means, whilst the distinctly yellowish tinge of "low medium" clays is often counteracted in this way sufficiently to improve their selling price considerably.

As to the "potting" clays, their colour in a raw state does not so much matter so long as they "fire" white. As a general rule clays are preferred for potting that settle fairly rapidly ; speaking generally therefore, their particles may be coarser than those of the clays best suited to paper-making. Potting clays often contain somewhat larger quantities of alkalis and alkaline earths than do the bleaching clays ; such impurities, which increase the tendency to frit at a very high temperature, improve their quality for pottery purposes. China clay of any possible composition will give good results in potting provided the other ingredients are varied to suit. Pottery formulæ, however, are purely empirical, foremen and workmen are dominated by custom and by infinite unconscious prejudice, and so it happens that one particular brand of china clay is preferred to another quite as good or possibly better, simply because there is no one willing to risk making the slight change in the formula required to compensate for a slight difference of composition, or unprejudiced enough to survey the results of a change without bias.

Speaking generally any clay which is sufficiently white and fine-grained will fetch a better price for paper-making than for potting, but many clays which are not white enough for high-class paper nor sufficiently fine-grained, provided they "fire" white, are in good demand as potting clays.

Electrolytic Purification

Upon the Continent of Europe clay intended for the manufacture of high-tension insulators is freed from iron and titanium oxides (the principal harmful impurities) by passing a continuous current of electricity at from 60 to 100 volts through the slowly moving stream of clay slip flowing through a trough of semicircular section, the anode being a metallic drum revolving slowly within the trough, while the cathode is a half-cylinder of wire netting suspended concentrically and only half an inch below. The iron and titanium oxides, being electropositive, collect below the wire netting, whence they are removed by a worm discharge, whilst the purified clay, being electronegative, attaches itself to the surface of the drum, whence a fixed knife removes it in the form of a slab about half-an-inch thick.

It has been suggested that the yellowish colour of inferior Cornish clays could be so much improved by such treatment as to enable them to be graded as of much higher quality. It does not appear, however, that the probable improvement likely to result in the colour of the clay will be sufficient to compensate for the additional cost of the process.

Foreign Competition

An impression seems to prevail in many quarters supposedly well informed that china clay is a product peculiar to Cornwall and Devon, and not found anywhere else. It is true that most of the so-called "kaolin" produced in the United States is of detrital origin, like the "ball clays" of Devonshire and Dorsetshire, and cannot be compared with English china clay either for colour or for uniformity of fineness. Even in the United States and Canada, however, and to a greater extent in France, Bohemia, Denmark and Spain, deposits are to be found of granite, gneiss or felsitic rock, the felspathic constituent of which has been, like those of the West of England, kaolinised *in situ*. As regards quality, whilst foreign methods of mechanical preparation are rarely carried out so thoroughly as with us, neither do the same facilities exist for cheap working, some of the French, Bohemian and Saxon deposits yield upon washing a product quite equal in colour and fineness to our own. The pre-eminence of the West of England output of china clay is due to the following factors :—

1. Large size of the deposits, and their extension over comparatively wide areas close to surface with but little "cover."
2. Methods of mechanical purification that are at once simple, inexpensive, and thorough, securing uniformity of product.
3. High average quality and colour as compared with the average product from any other district.
4. Proximity to shipping ports and the convenient situation of these for outward bound ships in search of a convenient "ballast" cargo.

Best "bleaching" clays from Cornwall and Devonshire are sent all over the world for paper-making, even to countries like France, Germany and the United States, which have fairly good domestic sources of supply. This is partly because of their great natural uniformity of character, partly because, being water-borne, they can compete within very wide limits of space with the domestic clays that have to be sent long distances by rail, as for example from the Southern States to Chicago or other Western centres. In spite, therefore, of the improvements that are gradually being effected in the mechanical preparation of foreign clays, it seems probable that British china clay will continue to assert and maintain its pre-eminence, and that the export trade will gradually return to its former dimensions, except possibly that to the United States. This recovery, however, must of necessity be a slow process, dependent upon the general recovery of trade, and it will be a long time before sales can overtake productive capacity.

Output and Profits

During the 20 years before the war, the output of china clay had shown a fairly steady increase from 425,000 tons in 1895 to 860,000 tons in 1912 and 1913, whilst during the first half of 1914 the sales amounted to 500,000 tons, or at the rate of one million tons per annum. Of this total between 75 and 80 per cent. was exported to foreign countries, the chief individual consumer being the United States, with a consumption which had risen steadily from 65,000 tons in 1895 to 335,000 tons in 1914. The war, with its scarcity of tonnage and high freight rates, cut down the export trade to very small dimensions, foreign countries being thus forced to develop to the utmost their native sources of supply, which are in many cases abundant, though generally of inferior quality. In view of this development of native supplies it seems doubtful whether exports to the United States will ever again reach the high-water mark of the years just before the war.

After the war there was a rapid increase in exports, mainly with a view to replenishing vanished stocks abroad, but this was followed by a slump, from the effects of which the industry is only now recovering. Really accurate figures in regard to output, sales and export are not obtainable ; the Government statistics in regard to export in particular being most misleading, since ball clay and lump and ground china stone are all included with china clay in one general total without distinction, a fact which renders these statistics absolutely useless to those interested in the industry.

As regards actual deliveries during the past three years, information furnished confidentially to the writer leads him to put forward the following figures, which he believes will be found to be close approximations to the truth, viz. :—

	Tons
1920	770,000
1921	370,000
1922	670,000

Seeing that the actual output for the first half of 1914 was at the rate of one million tons per annum, the above figures show that, in spite of the recovery in 1922 from the depression of 1921, which certainly represents a real improvement, the output of to-day is still far short of that of the pre-war period. This, however, does not tell the whole story. During 1914 many extensions of drying plants were in course of erection, and a good many new ones have been completed since, so that the total productive capacity of the industry, as measured by drying capacity (the accepted standard), must be at the present time very nearly 1¼ million tons per annum. Owing, therefore, to the limited demand, the actual output of china clay is still only about 55 per cent. of the total productive capacity of the existing plants. In view of the many misleading statements recently published in regard to the great improvement in the trade, and its prosperous condition, it seems desirable to draw attention to the undoubted fact that the plant and equipment at present employed in the industry is far from being fully utilised.

As to prices and profits, the principal controlling interests seem to have realised that the only hope of regaining the markets lost during the war period is to reduce the selling prices to the lowest point possible. The present selling prices, however, are still so far in excess of the pre-war prices (at which good profits were made) that some have jumped to the conclusion that producers must still be making large profits. This is by no means the case at present, for the costs of production have increased at a greater ratio than have the selling prices.

In the first place, comparing the year 1921 for instance, with 1914, the standing charges at a clay works remain at about the same level whatever the output. Salaries of officials, and the cost of maintaining the shafts, levels, pumps and other plant suffer little or no reduction even if the works stand idle all the year. The surface and coming spring water has to be pumped in any case, and considerable expense is often caused in an idle pit through slipping in of material from the sides. All these costs are on a much higher basis than in 1914, perhaps on the aggregate nearly double, and upon one-half or less of the full capacity the aggregate cost of these standing charges per ton of clay produced and sold is nearly four times as great. Minimum rents are in some cases so high that they only merge in the royalty when the pit is being worked at more than half the full capacity. Local rates, too, have gone up enormously.

As regards operating costs proper, all are much higher absolutely, apart from any question of working at below full capacity. Coal for pumping and for drying, which forms a considerable proportion of the total operating cost, although coming down in price, is still much dearer than in the pre-war period: its average price during the years 1921–1922 may be taken at about double that of the pre-war period 1913–1914. Even a greater discrepancy is to be noted in regard to the wages part of production cost, although not all of this is apparent. Not only does the current rate of wages paid in the industry rule higher than in the pre-war period, but there is some falling off in efficiency. Up to 1916 the district had been characterised by its free labour. About that time (entirely through the agitation of organisers from outside, who were paid agents of a trades union anxious to increase its membership and its political influence) branch unions were started in the district, and soon the whole of the workers became members of the union in question. The usual consequence followed, (although as usual stoutly denied by the union officials and sympathisers), namely, that efficiency, or the work done per man, showed a serious falling off. The union has ceased to have any influence in the district as an active factor in the labour problem, but the falling off caused by its former influence has not yet been completely made good.

Upon the whole, therefore, as a consequence of all the various reasons enumerated, the rise in working costs has kept far ahead of that in selling prices, as compared with the pre-war period; and the margin for profits in the industry will remain somewhat small until the condition of the world, and particularly of Central Europe, approaches more closely to normality, and until output begins to catch up productive capacity.

THE CALCIUM CARBIDE INQUIRY

By SIR WILLIAM J. POPE

Part II

THE conception of an organic compound which prevailed until well into the nineteenth century was well expressed by Buffon: "A living organic matter exists, universally distributed throughout all animal and vegetable substances, which is essential equally to their nutrition, their development and their propagation" (Histoire des animaux, 1836, vol. 4, page 52). The abandonment of such a fundamental distinction between inorganic and organic chemistry as is involved in this statement left a need for an empirical subdivision and, as has been already shown (this Journ., p. 5), a majority of the foremost contributors to the development of organic chemistry agreed to include as organic compounds "the compounds of carbon generally; a small minority of such chemists exclude from their definitions, carbonic oxide, carbonic anhydride and the salts of carbonic acid with inorganic bases. No other compounds of carbon are excluded from the definition by any organic chemist of repute."

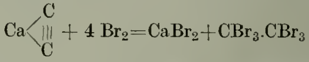
The desire of the few to exclude carbonic oxide, carbonic anhydride and the metallic carbonates from the list of organic compounds arose largely from the wide distribution of these substances and their importance to others than purely organic chemists; it led Schorlemmer to "define organic chemistry as the chemistry of the hydrocarbons and their derivatives" (Definition 14, page 6). This definition does not really make for logical unity because carbonic anhydride, which it designs to exclude, is as intimate a derivative of methane as oxalic acid is of ethane, and both the latter are admitted to be organic compounds. It will now be shown, however, that Schorlemmer's definition, which was advocated by several of the expert witnesses called during the calcium carbide hearing, leaves the latter substance without doubt in the category of organic compounds; further, that an even more narrowly limited definition which was quoted, to the effect that an organic compound is one which contains a hydrocarbon radicle, still includes calcium carbide as an organic compound.

The term "derivative" as used in organic chemistry has had a curious history. It was first liberally applied by Berthelot, in accordance with a well-known philological rule in the Latin tongues, to any substance derived or prepared from the subjective substance; thus, he spoke of ethylene dichloride as a derivative of ethylene and of monochloroethylene as a derivative of ethylene dichloride (Chimie organique, 1860, vol. 1, page 219) and of "derivatives formed by addition, elimination and substitution" (Méthodes générales de synthèse, 1864, page 506). In later days he restricted the term "derivative," in general, to substitution products (La synthèse chimique, 1883). Frankland very rarely used the word, and when he did was careful to indicate clearly by a formula the closeness of relation to which he referred (compare Phil. Trans., 1856, **147**, 59); the contents pages of the "Ansichten über die organische Chemie," of 1881, show that van't Hoff's lavish use of the term was always accompanied by a precise indication of the degree of relationship concerned. In German the word derivative is only occasionally met with, and then almost always with a prefix indicative of the kind of substitution concerned; in Graebe (Geschichte der organischen Chemie, 1920) the word only occurs a few times, and in each case, with a suitable prefix, as synonymous with substitution product.

Without discussing further the subtle variations in usage of the qualitative term "derivative," which requires to be quantified before it acquires an intrinsic meaning, it is submitted that if calcium carbide can be shown (1) to be acetylene in which the two hydrogen atoms are replaced by the equivalent bivalent atom of calcium, and (2) to contain the hydrocarbon residue, —C ⋮ C—, which is the characteristic bivalent acetylene radicle, it will be included by all the definitions of any weight. The experimental evidence bearing on these points is very complete, although little of it was revealed during the inquiry.

Direct Evidence of the Constitution of Calcium Carbide

When calcium carbide is kept for several months in contact with excess of bromine, calcium bromide and perbromoethane are obtained in almost the yields indicated by the equation :—



$$\mathrm{Ca}\Big\langle\overset{C}{\underset{C}{|||}} + 4\,\mathrm{Br_2} = \mathrm{CaBr_2} + \mathrm{CBr_3.CBr_3}$$

(Barnes, *Chem. News*, 1919, **119**, 260). This reaction, proceeding slowly and practically quantitatively in the absence of water, is convincing proof that the calcium carbide molecule contains two atoms of carbon joined by the triple acetylene bond; if this is not agreed, and it was contested at the hearing, it must be admitted that organic chemistry possesses no methods for determining molecular constitution.

Another argument, a little more involved but quite as definite, which was not produced during the enquiry, may be now stated.

The Constitutions of the Metallic Carbides

The metallic carbides are numerous and may be classified in a manner which reveals the existence of simple relationships between their types of molecular composition, and therefore constitution, and their chemical behaviour. For purposes of illustration a few types may be distinguished and the type reactions described.

Type 1—This is represented by silicon carbide, SiC, which is chemically a very inert substance.

Type 2—This is represented by manganese carbide, Mn_3C, and ferrous carbide, Fe_3C. In the most simple molecular compositions ascribable to these substances, one atom of the quadrivalent element carbon is associated with three atoms of the bivalent metal. Brame and Lewes showed (J. 1902, **21**, 755) that the following hydrolysis occurs :—

$$Mn_3C + 6\,H_2O = 3\,Mn(OH)_2 + CH_4 + H_2.$$

The hydrolysis of ferrous carbide does not proceed so simply, but it is clear that carbides of this type are not simply related to acetylene.

Type 3—This is represented by aluminium carbide, Al_4C_3, and beryllium carbide, Be_4C_3, in which four atoms of a tervalent metal are associated with three atoms of the quadrivalent element carbon. Both carbides yield methane with water, and Matignon has shown (Comptes rendus, 1907, **145**, 676) that the following reaction occurs :—

$$Al_4C_3 + 12\,H_2O = 3\,CH_4 + 4\,Al(OH)_3.$$

It is evident that carbides of this type are closely related to methane; they are certainly not simple derivatives of acetylene.

Type 4—This is represented by all those substances the composition of which corresponds to that of acetylene, C_2H_2, in which one or both univalent hydrogen atoms are replaced by an equivalent number of atoms of a univalent or a bivalent metal. Such a limitation of molecular composition permits only the following four varieties of constitution; in these M' represents an atom of a univalent metal and M'' an atom of a bivalent metal. In each case actual compounds are quoted as examples:—

A $M'HC_2$. Represented by sodium diacetylide, $NaHC_2$, rubidium diacetylide, $RbHC_2$, and lithium diacetylide, $LiHC_2$.

B $M''(HC_2)_2$. Represented by calcium diacetylide, $Ca(HC_2)_2$.

C M'_2C_2. Represented by sodium, lithium, silver and cuprous monoacetylides, namely, Na_2C_2, Li_2C_2, Ag_2C_2, and Cu_2C_2.

D $M''C_2$. Represented by calcium monoacetylide, CaC_2, and strontium monoacetylide, SrC_2.

It will now be shown that only those compounds included in the four groups, *A*, *B*, *C* and *D*, which constitute the general type 4, are metallic derivatives of acetylene; they thus differ in constitution from compounds of the general types 1, 2 and 3, which may now be dropped out of the discussion. The argument is as follows:—

The metallic diacetylides and monoacetylides are produced as the result of, and are subject to, a number of general reactions. These reactions are numerous, and some of the individual acetylides are not known to obey all of them. But since each acetylide is involved in several of the class reactions, no doubt can persist that all are of identical chemical type of constitution; it will be seen ultimately that the acetylides are thus necessarily formulated as metallic derivatives of acetylene.

REACTIONS OF FORMATION OF CERTAIN METALLIC ACETYLIDES

a $2\,M'+2\,CH\vdots CH=2\,M'.C\vdots CH+H_2$.
b $M'H+CH\vdots CH=M'.C\vdots CH+H_2$.
$M''H_2+2\,CH\vdots CH=M''(C\vdots CH)_2+H_2$.
c $2\,M'+2\,C=M'.C\vdots C.M'$.
$M''+2\,C=M''C_2$.
d $2\,M'NH_3+2\,CH\vdots CH=2\,M''.C\vdots CH+2\,NH_3$ $+H_2M''(NH_3)_2+2\,CH\vdots CH=M''(C\vdots CH)_2+$ $2\,NH_3+H_2$.
e $2\,M'.C\vdots CH=M'.C\vdots C.M'+CH\vdots CH$.
$M''(C\vdots CH)_2=M''C_2+CH\vdots CH$.

The above reactions apply in the following cases:—

a When M' sodium or potassium.
b ,, M' is Na, K, Rb, Cs.
,, M'' is Ca.
c ,, M' is Li.
,, M'' is Ca, Sr or Ba.
d ,, M' is Li, Na, K, Rb or Cs.
,, M'' is Ca.
e ,, M' is Na, K, Rb or Cs.
,, M'' is Ca.

It is thus seen that all the substances classified under type 4, in which the type composition is that of acetylene in which one-half or all the hydrogen is replaced by an equivalent number of atoms of a univalent or a bivalent metal, are connected by a series of reactions. Each reaction is not yet known to occur in connexion with the acetylides of all the alkali and alkaline earth metals, but each occurs with a number of them. The reactions are thus type reactions of a set of compounds containing one element of constitution in common; if it can be proved that one of the compounds contains the acetylenic radicle, $—C\vdots C—$, it will follow that all contain the same constitutional element and are therefore metallic derivatives of acetylene containing this hydrocarbon radicle. A ready proof is available, as will be seen below, that sodium diacetylide corresponds to the latter description and has the constitution $NaC\vdots CH$.

All the compounds classified under type 4 yield acetylene on hydrolysis, those containing an alkali metal or an alkaline earth metal on treatment with water, those containing silver or copper when treated with acid. During the hearing it was suggested that the evolution of acetylene when water is added to calcium carbide is an "accidental circumstance" which had led to the erroneous conclusion that calcium carbide is a derivative of acetylene; the fact that all substances of type 4 undergo hydrolysis in the same way effectually disposes of this ingenious notion. Whilst it was apparently agreed that silver and cuprous acetylides are true metallic derivatives of acetylene, it was suggested that their stability towards water indicates that they differ in constitution from calcium carbide; but much greater divergences in behaviour are commonly to be observed between compounds which are admittedly metallic derivatives of the same hydrocarbon. Thus, zinc methyl, $Zn(CH_3)_2$ is spontaneously inflammable in the air and reacts violently with water giving methane and zinc hydroxide, whilst mercury dimethyl, $Hg(CH_3)_2$, is stable in the air and towards water, and only gives methane when boiled with acids.

PROOF THAT SODIUM DIACETYLIDE HAS THE CONSTITUTION, $NaC\vdots CH$

When sodium diacetylide, $NaC\vdots CH$, is treated with carbon dioxide under pressure, it becomes converted into the sodium salt of propiolic acid, $HC\vdots C.CO.OH$ (Skosarewski, Chem. Centr., 1904, ii, 1024). This reaction by which a hydrogen atom in an organic compound is replaced by a carboxyl group, .CO.OH, is frequently observed in organic chemistry; its occurrence with sodium diacetylide is proof that the acetylenic element of molecular structure is present in the substance and that this compound is therefore a derivative of acetylene.

Lebeau and Picon (Comptes rendus, 1913, **156**, 1077) have shown that sodium diacetylide dissolved in liquid ammonia obeys the following reactions with methyl iodide and with butyl iodide in the cold :—

$$NaC{\vdots}CH+CH_3I=NaI+CH_3.C{\vdots}CH, \text{ and}$$
$$NaC{\vdots}CH+CH_3.CH_2.CH_2.CH_2I=$$
$$NaI+CH_3.CH_2.CH_2.CH_2.C{\vdots}CH.$$

Picon further showed that the butene, $CH_3.CH_2.C{\vdots}CH$, is formed by the action of ethyl iodide or bromide on sodium diacetylide (Comptes rendus, 1914, **158**, 1184), and that the pentene, $CH_3.CH_2.CH_2.C{\vdots}CH$, is produced in a similar manner from propyl iodide (Comptes rendus, 1914, **158**, 1346). He described later analogous reactions in which ethylenic hydrocarbons are produced (Comptes rendus, 1919, **168**, 825).

The proof is, therefore, complete that sodium diacetylide, $NaHC_2$, is a sodium derivative of acetylene, and that its constitution must be represented as $NaC{\vdots}CH$. It is thus again demonstrated that calcium carbide is the calcium derivative of acetylene and that it contains the acetylenic hydrocarbon radicle, $—C{\vdots}C—$.

In his decision, the Referee commented on the fact that several definitions of an organic compound had been proffered; he quoted "compounds of carbon" without and with certain exceptions, the latter qualification referring to the erroneous translation of a German definition to which he attached considerable weight, "hydrocarbons and their derivatives" and "compounds of carbon which contain an organic radicle." It is now clear that calcium carbide conforms to all the important definitions of an organic compound.

Several curious objections were raised against the inclusion of calcium carbide as an organic compound. It was suggested that if its molecular weight corresponded to the formula CaC_2, it should be a low boiling liquid; the futility of this objection is obvious from the fact that cuprous acetylide, admittedly a derivative of acetylene, is not a low boiling liquid, and gold, the molecular weight of which is that of the atom, boils at a very high temperature.

The tribunal, having failed to elicit the fact that organic chemists are all but unanimous in their definition of an organic compound, exercised itself in the search for other criteria of this well-characterised entity. Surprise was expressed at the contention that calcium carbide is an organic compound in view of its stability towards heat, and the expert witnesses were asked to name examples of similar stability; curiously enough, the obvious instance, which was under discussion the whole time, was never quoted. The equilibrium mixture of gases obtained by heating carbon in hydrogen at 1700° contains a trace of acetylene, and the proportion rises to about 3 per cent. at 2800° (Pring and Hutton, Chem. Soc. Trans., 1906, **89**, 1591); at the temperature of the electric arc, namely, 3500° to 3750°, the equilibrium mixture, starting with hydrogen, methane or acetylene, contains roughly 86 per cent. of hydrogen, 3 per cent. of methane, and 9 per cent. of acetylene (Bone and Jerdan, Chem. Soc. Trans., 1897, **71**, 41). The stability of acetylene towards heat thus increases steadily up to towards 4000° and thermodynamic reasons exist for believing that the optimum point has not even then been attained. Calcium carbide,on the other hand, decomposes into carbon and calcium in a well-heated electric furnace (Moissan, Comptes rendus, 1898, **126**, 306) and, since metallic calcium readily volatilises in an electric furnace under reduced pressure (Pohl and Pringsheim, Ber. physik. Ges., 1912, **14**, 506) it would seem that the decomposition temperature of calcium carbide should be near the boiling point of calcium.

The experimental evidence thus indicates that acetylene itself is the most stable organic compound known towards heat, and that it is more resistant against heat than is calcium carbide; in fact, very few inorganic compounds withstand heat so well as acetylene.

In parts I. and II. of this series of articles it is claimed that calcium carbide has been proved to be an organic compound, the calcium derivative of acetylene, and to contain the acetylenic hydrocarbon radicle; in part III. it will be shown that calcium carbide is a synthetic compound.

NOTES FROM HEATHFIELD

By the Rector, Rev. B. V. WHITE, M.A.

Dear Mr. Editor,—The Parish of Heathfield lies in the County of York, about a dozen miles to the north of Harrogate. Being very large and extensive, it abuts on many other parishes, as Pateley Bridge, Blubberhouses, Appletreewick, and Ramsgill. The soils and rocks of this district are almost as various and diversified as the views and aspects. The high part to the west consists of a vast hill of limestone, rising to a height of some fourteen hundred feet above sea-level; this is capped in some places by a thin stratum of shale, and in some others by a layer of millstone grit which forms bold crags, standing out sharply on the sky-line. The lower slopes of this hill are well wooded with ask, oak, and sycamore. The bottom of the valley is only some four hundred feet above sea-level, and the little river has wandered about in days gone by and made a wide strath of fertile meadows and pastures. From all the slopes of the hill, and particularly from Red Brae, there is a very engaging view, an assemblage of hill, wood and moorland, with the river winding its silvery course among the farms and byres in the dale. From the top of the hill there is a vast prospect of all the mountains of Craven and the West of Yorkshire. You may see in fair weather the lovely valley of the Wharfe with Simon Seat, Great Whernside and Hawkswick Clouder, and from the crags on the adjoining moor, which rises yet higher, you may gaze on Penyghent and Pendle Hill and Little Ingleborough, as the old rhyme names them. My rectory stands in a pleasant situation near a purling beck or stream; it is well shaded by sycamore trees, and has an agreeable garth where many herbs and vegetables flourish. A plantation of spruce and larch shelters me from the north and north-western gales.

The population are a hardy folk engaged in farming; in the lower parts cattle are reared, but on the short sweet grass of the limestone pastures the half-bred moorland sheep flourish exceedingly, and these roam also on the rough heather of the millstone grit, sharing the solitude with the golden plover, the peewit, the curlew, and the grouse. You might imagine that in so pastoral and primitive a place, so far removed from the busy hum of men, I should have few opportunities of pursuing the studyof chemistry, which has long been a favourite diversion of mine, but I find abundant opportunities of seeing how, even here, chemistry plays its part in our lives, and with your permission I will set down in writing some of my reflections on this science.

It has been my misfortune never to have had any neighbours whose studies have led them towards the pursuit of chemistry; so that for want of a companion to quicken my industry, and sharpen my attention, I have made but slender progress in a kind of information to which I have been attached from my childhood. And until your weekly *Journal* appeared, there seemed to be no journal of chemistry whose cost was within my means, and which I could read with profit.

The limestone here is a very pure white or light grey limestone of the carboniferous series; the upper beds are full of corals and other fossils; in some of the lower beds there are bands of chert or flinty rock of extreme hardness. It is a marvel to me how so great a thickness of rock—for the limestone here is upwards of three thousand feet thick—could have been formed in the space of time which my teachers allow for the growth of the world since its creation. From an examination of the rock it appears in its origin to be entirely organic, made up of corals, seaweeds, shells of all kinds, with many smaller organisms. These, while they lived in the slimy ooze, or on the stones at the bottom of some ocean, were able to absorb the carbonate of lime which had been dissolved in the sea water, and they built up from this the delicate shells, stalks, or skeletons which remained after the creatures had ceased to exist.

These broken relics formed in course of ages the stupendous rock I have described, though in the lapse of time there have been many changes. In many places the rock has lost all trace of its original animal origin, and has become like marble, crystalline, with fine crystals of calcite, which glitter after a shower of rain like precious gems.

I see from your pages that there has been some dispute as to what is an organic compound. I do not know whether any dispute will take place as to limestone, but if it does, I beg you to invite the learned referee to spend a night at "The Sportsman's Arms" at Wath, or "The Race Horses" at Kettlewell, and if he will let me know I will gladly escort him to Elbolton or Cracoe Swindon or Coldstones, and will show him such sights that without any further evidence he will agree that the limestone of Craven is organic. But I must admit that my parish is not really in Craven, but only abuts on it; yet I like to consider myself as belonging to Craven, a country above all others where one may get to love the silence that is in the starry sky, the sleep that is among the lonely hills.

On the right hand side of the road that leads to the railway station—for we are quite civilized here though primitive—is a lime-kiln, the use of which goes back to a time whereof the memory of man runneth not to the contrary. Here the limestone is roasted—formerly by a peat fire—but now, since the railway came, by coal; the carbonic acid is driven out from it, leaving only the calcium oxide or lime. Although limestone is so abundant here, the land is constantly in need of lime; the rains wash out the lime from our light soil fairly quickly, and my neighbours are always glad to lime their land; it sweetens the pastures and it kills the grubs and slugs and other vermin, and the farmers tell me that it helps the crops to obtain more benefit from the soil and manure, though I confess I have notenough chemistry to explain how this should be.

The freshly-roasted lime or quicklime is not suitable for the land; it is too hot, and must be slaked by adding one part of water to about three parts of lime. The lime and water unite to make a hydroxide of lime, and the combination gives rise to great heat. Some of the boys in the village last November sprinkled gunpowder on the lime as it was slaking and were much pleased to find it took fire with a considerable blaze.

Lime has a great variety of uses, and one of these is for mortar and cements. In making mortar, the lime is mixed with fine sand and water, and it quickly begins to harden on exposure to air. All air contains a small proportion of carbonic acid, usually about ·04 per cent., and this combines with the hydroxide of calcium to form calcium carbonate and water. The water gradually evaporates, and the calcium carbonate forms a binding round the sand; the sand itself seems to take no part in the chemical change in the setting of mortar.

An ingenious man of my acquaintance formed a company some years ago for the manufacture of artificial stones. He made wooden frames of suitable sizes, packed them with roasted limestone, and then introduced both carbonic acid, which he had recovered from the roasting, and water, and so made an excellent limestone of the exact shape and size he desired; this stone was marbled or grained as he desired and took a good polish. Unfortunately the expense of the roasting and other operations much exceeded the value of the finished stone and the company ended in disaster. This has been impressed on my memory by the fact that my aunt Rachel asked me one day in quite a casual manner if the process was scientifically sound. I told her it undoubtedly was, upon which the foolish woman, without any further advice or consideration, invested twenty pounds of her money in it, and she has often blamed me for the loss of it, which is most unjust. The judicious investment of money is, I imagine, a difficult study. Some time ago a project was started for the recovery of gold from sea-water which indeed does contain a small proportion of this metal in the form, I suppose, of gold chloride. I was attracted by the novelty of the proposal and sent fifty pounds to the promoters and a day or two afterwards I paid a visit to one of my parishioners, Col. B., a manufacturer of ammonia and many other chemicals. He was one of the original members of your Society, was for some years a member of Parliament, and is possessed of great means. Five hundred pounds would be nothing to him as an investment, and I thought he would be easily persuaded to write a cheque for such an amount, but he distinctly objected and on my telling him what I had done he made some remark of which I forget the first part, but I know it ended "are soon parted."

Lead mining has been practised in this parish for several centuries; if tradition is to be believed, the Romans not only mined lead, but smelted it in some parts of Yorkshire. The top of our hill is covered with the debris of old workings, heaps of limestone, mounds of barytes and fluorspar left by the old man, as the primitive worker is known locally. The lead ore occurs as galena or lead sulphide, which is found in a multitude of small veins running through the limestone. The galena is usually accompanied by fluorspar, barytes and calcite and as these are white or colourless crystals and the lead ore is silvery blue or almost black, the appearance of a large block of the vein matter is often very beautiful. A few men are still engaged in exploring the old workings, selling lead ore when the price is favourable, selling barytes at other times, and in the summer months exporting fluorspar to America. Formerly some of the lead ore was smelted here in the smelt mill, but this is no longer in use and the lead ore is now sold to smelters in Newcastle, Chester and Brough. Not that Brough, which the famous George Steadman came from, which is in Westmorland, but another less famous one in Derbyshire. But the water wheel which operated our own smelt mill is still turned round at regular intervals, so that all will be ready for the bold man who wishes to resume smelting here. And winding its way up the hillside for nearly a mile is the stone tunnel or flue to catch the lead fumes and products of combustion from the furnaces in the smelt mill. This flue now provides a home for scores of rabbits and a playground for their young ones; in Nature nothing is wasted. The miners in this parish have handed down their traditions through many generations and they have kept well abreast of modern notions. Some seventy years ago a party of Welshmen settled here with up-to-date ideas of mining and money-making, and a little later some other "foreigners" came into the district, this time from Arkengarthdale, about fifty miles north of this parish, a great place for lead mining. So you see we do not stagnate. The galena, PbS, is roasted and forms sulphate of lead $PbSO_4$; this being heated with more galena the following action takes place:—

$$PbSO_4 + PbS = 2Pb + 2SO_2.$$

Both these actions take place in the same hearth or furnace, and the sulphur dioxide carrying away with it some discoloured lead sulphite, galena and soot, with occasionally a little lead sulphate, finds its way along the flue gradually depositing the solid particles in a fine dust along the sides and bottom of it.

The number of industries in which the lead finds a place is very large. Lead sheets, and lead pipes are much used in building houses and chemical factories; very thin lead sheet or lead foil is used for lining tea-chests and other packages; red lead is used in painting and plumbing; white lead is used in painting; silicate of lead is used very largely in the pottery industry as a glaze. Litharge or lead monoxide, PbO, has many uses; varnish makers use it in making varnishes and driers; the makers of india-rubber use it in making the rubber suitable for motor tyres, and the makers of electric accumulators use it as the chief means of storing electric energy.

Most lead when first smelted contains a little silver and sometimes it contains a minute trace of gold. The lead from our parish is particularly pure, a source of great pride to us, although the lack of the usual few ounces of silver to the ton of lead deprives the miners of a certain amount of profit. Great refinement in metals, as in men, does not invariably tend to the accumulation of wealth.

I intend in a subsequent letter to describe to you the chemistry of our electric accumulators when I deal with the very ingenious way in which we make use of the power of the Stony Grooves beck to furnish electric lighting for our houses.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments of his contributor, but does not necessarily agree with them.

Representatives of Chemical Societies

met last week to prepare their plans for the scientific exhibit which is to be an adjunct to the chemical section of the British Empire Exhibition. I hear that the scheme is to include a propaganda section which will present to the visitor a survey of the outstanding work in chemistry during recent years. A very necessary piece of work, if the scientific visitors are to take away with them some permanent record of what the whole section is intended to show. There is also to be on view selected examples of the research work carried out at our Universities and Colleges, in order that our visitors may be able to see that behind the industry itself there is a stream of invention which flows not less sluggishly in our country than in any other competing countries. So far, so good; but I hear nothing of any provision for meeting my fellow-journalists from abroad or, indeed, of a place where scientific men generally can meet their fellows. Here is a chance for the Chemical Industry Club to show what its members can do!

The Therm Committee

has finished taking evidence, and the last sitting of the Committee was noteworthy for the appearance of Dr. Carpenter in the witness-box. It was a pleasure to hear evidence given by a master in the art. Clear, with the simplicity which comes only with the use of right language; concise, with never an over-statement; his cross-examination merely elucidated further information on additional points which the Committee had in mind. It seemed clear to me from the manner in which the Chairman of the Committee dealt with other witnesses on that day that the Committee had all the information they wanted. Indeed, a less courteous Chairman would not have allowed them to open their lips in the box, for there was much vain repetition. I suppose we shall have to wait some weeks before we get the Committee's Report, but if I were a wagering person I should make a small investment that the system of charging by the therm will remain.

A Warning

The editor has printed some verses which seems to have been suggested by the airy "Meditations of a Sodium Atom" to some youthful reader. I presume he is youthful, though I have no evidence, because one outgrows these and other ailments:—

> "me quoque
> In dulci juventa fervor in celeres iambos
> Misit furentem."

But I think I am performing a friendly action in warning him against allowing this to become a habit. An occasional lapse into verse is excusable, even in scientific people, but it is dangerous; like drug-taking, the taste once acquired, so I am told, may become a malady against which the wretched victim struggles in vain. I should be truly grieved if it were said of our innocent correspondent:—

> "Him too the mania, not the muse has seized;
> Not inspiration but a mind diseased."

On the other hand, if he has already reached years of discretion, I shall feel some anxiety about his future; it seems a small thing to parody a few verses in order to put forward some chemical proposition; but did not a philosopher say: "If once a man indulges himself in murder, very soon he comes to think little of robbing; and from robbing he comes next to drinking and Sabbath-breaking, and from that to incivility and procrastination. Once begin upon this downward path, you never know where you are to stop. Many a man has dated his ruin from some murder or other that perhaps he thought little of at the time." I invite R.T.M.H. to reflect on these observations before he again seeks the assistance of the Muse. It is his moral state which troubles me, not my own reputation, which is above suspicion.

Sir William Alexander's Letter

to the consumers of dyestuffs, containing as it does an assurance that they can rely on British dyestuffs if the difficulties abroad increase, and the crisis is prolonged, should serve to allay any anxiety. It is interesting to see how the consumers turn to the British maker as soon as there is difficulty in obtaining dyestuffs from the Continent. Yet, such is the habit, they still continue to decry British dyes. I heard an interesting example of this only a few days ago in connexion with the forthcoming British Empire Exhibition. It appears that while the agitation for the use of none but Empire products was in full blast the British dyemakers put in a claim that none but British dyes should be used in the Exhibition. The authorities were solemnly told by certain users in the North of England that the British makers could only supply a small percentage of the dyes required! This canard was instantly killed by the production to the authorities of the sample colour books of some of the firms. It is a pity these books are so expensive to produce; they should have a much wider circulation. I very much doubt whether people like Professor Armstrong have ever seen them, judging from his article in last week's issue. They prove conclusively that the range of colours now being made in this country is very much wider than most people suspect. It is not, however, absolutely complete, so the upshot of this matter is that, as far as possible, none but British dyes will be used in the Exhibition.

FORTHCOMING EVENTS

Feb. 9. Society of Chemical Industry, *South Wales Section*, Technical College, Mount Pleasant, Swansea, at 7.15 p.m. "Stainless Steel and its Uses," by H. B. Hitch.

Feb. 9. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 9 p.m. "Rothamsted and Agricultural Science," by Sir John Russell.

Feb. 9. Physical Society of London, Imperial College of Science and Technology, South Kensington, S.W., at 5 p.m. Annual General Meeting will be held, after which (1) a paper will be read on "The Eötvös Torsion Balance," by Capt. H. Shaw and E. Lancaster-Jones, and (2) a demonstration of the 'Flame Phone' will be given by H. W. Heath.

Feb. 9. Chemical Engineering Group, The Chemical Industry Club, 2, Whitehall Court, S.W. 1, at 8 p.m. "Some Control Formulæ in connexion with Leaching and Evaporating," by Prof. F. G. Donnan.

Feb. 12. The Biochemical Society, The National Institute for Medical Research, Mount Vernon, Hampstead, at 5.30 p.m. "A Comparison of the Hydrogen-ion Concentration Determined Electrically with the Hydrogen-ion Concentration Calculated from the Carbon Dioxide of Blood in Pathological Conditions," by T. R. Parsons and E. P. Poulton. "The Blood in Polycythæmia," by J. M. H. Campbell, G. H. Hunt, and E. P. Poulton. "The Mode of Action of Vitamins," by W. Cramer.

Feb. 12. The Ceramic Society, Central School of Science and Technology, Stoke-on-Trent, at 7.30 p.m. "Notes on Application of Pyrometers to Ceramic Industries," by Chas. E. Foster.

Feb. 12. Royal Society of Arts, John Street, Adelphi, W.C. 2, at 8 p.m. "The Vulcanisation of Rubber" (Lecture 2), by Henry P. Stevens, M.A., Ph.D.

Feb. 12. The Institute of Brewing, *London Section*, the Institute of Chemistry, 30, Russell Square, W.C. 1, at 8 p.m. "Cellulose Fermentation," by H. Langwell and H. Lloyd Hind.

Feb. 13. Society of Chemical Industry, *Edinburgh and East of Scotland Section*, the Pharmaceutical Society, 36, York Place, Edinburgh, at 7.30 p.m. "Vitamins," by Dr. G. M. Findlay, M.A.

Feb. 13. Institute of Metals. *Scottish Local Section*, Institution of Engineers and Shipbuilders, 38, Elmbank Crescent, Glasgow, at 7.30 p.m. "Some Phases of Lead Manufacture," by John A. Sillars.

Feb. 13. University of London, University College, Gower Street, W.C. 1, at 5.30 p.m. "Electric Fields in Atomic Physics," by Prof. E. T. Whittaker, F.R.S. Also on March 13, 15, 20, and 22.

Feb. 13. Institute of Industrial Administration, London School of Economics, Clare Market, W.C. 2, at 8 p.m. "Practical Hints on Buying and Selling," by F. Mott.

Feb. 14. Royal Society of Arts (Ordinary Meeting), 18, John Street, W.C. 2, at 8 p.m. "Progress in the Manufacture of Refractories," by W. J. Rees, Lecturer on Refractories in the University of Sheffield.

NEWS FROM THE SECTIONS

NOTTINGHAM SECTION

The Meeting held jointly with the Society of Public Analysts on January 17 was devoted to a discussion on "The Detection of Small Quantities of Arsenic." Mr. Burford welcomed the meeting as evidence of the co-operation of chemists from different societies. and stated that an official report of the meeting would be published later. Mr. Chaston Chapman, in opening the discussion, recalled a previous one organised by the Nottingham Section of the Society of Chemical Industry in 1901, and a report of the Joint Committee of that Society and the Society of Public Analysts in February, 1902. He referred to the contamination of beer by arsenic in 1900 and the value of the Reinsch test as a ready method for rough differentiation of contaminated from uncontaminated materials. When it was found that malt itself might occasionally be contaminated, some more delicate method of detection became necessary, and the Joint Committee already mentioned, recommended a modification of the Marsh-Berzelius test, which was very sensitive. Later, attention was turned to the Gutzeit method, which is the standard method of the British Pharmacopœia, and is very useful, especially for "sorting" purposes.

The Marsh test was due to James Marsh, at one time an assistant of Faraday, and afterwards engaged in the Royal Arsenal at Woolwich. It was first published in 1836, and Mr. Marsh was awarded the Gold Medal of the Society of Arts for his communication on it. There is some doubt as to whether Liebig was not the first to recommend the passage of the gas through a heated glass tube so as to obtain the arsenic in the form of a mirror, and Berzelius suggested passing the gas over heated metallic copper so as to convert the arsenic into the silvery copper arsenide. In discussing the details of the Marsh-Berzelius and Gutzeit methods, Mr. Chapman said there was no difficulty in obtaining pure hydrochloric, sulphuric and nitric acids, or cadmium sulphate and cadmium chloride. The calcium chloride used for these tests should be specially purchased and should be in the form of small granules and neutral in reaction. The zinc should not only be pure but must be sensitive.

For the reduction of pentavalent to trivalent arsenic, ferrous or stannous chloride could be used when necessary. Years ago, Dr. Dyer called attention to the insensitiveness of zinc, and experiments by Mr. H. D. Law and himself had shown that this was largely due to the presence of impurities in the metal. By coating insensitive zinc by cadmium it could in many cases be made sensitive, and this method is now widely used. The electrolytic method with a platinum cathode has the disadvantage that the activity of the platinum varies with use.

Mr. J. M. Wilkie alluded to some recently published American papers recommending rod zinc instead of granulated zinc. He alluded to the use of lead instead of platinum as electrodes as suggested by Sand and Hackford. His own method was a combination of Sand and Hackford's apparatus with that of Sir Edward Thorpe, but using a more opaque porous pot, and it included the Gutzeit modification worked out by Hibbert. The use of stannous chloride with ferric chloride seemed to be growing, especially in America. Small quantities of potassium iodide were excellent as reducers. Glycerol reduced arsenic rapidly in solution, but using this with iodide it was necessary to find an absorber of the iodine in acid solution. Terpin hydrate was first tried, but it was subsequently found that glycerol which had been oxidised with permanganate acted similarly to terpin hydrate and had the advantage of being soluble in water. One c.c. of 80 per cent. glycerol is mixed with a tenth of its volume of 50 per cent. sulphuric acid and to the mixture 2 c.c. of 5 per cent. potassium permanganate is added; when colourless the reagent is ready for use. With this reagent the hydrogen iodide is maintained at its original concentration.

Dr. Monier-Williams advocated the electrolytic method. In his own apparatus, the porous pot was very thin and the anode was a strip of lead foil. The cathode was a small disk of lead foil. He had experimented on cooling the tube immediately after the heated part by wrapping round the tube a piece of filter paper with an end hanging down and dipping into water. He found that this procedure gave a sharp ring, and was of advantage in very delicate tests.

Major Trotman, speaking from 30 years' experience as a Public Analyst, said he had had more trouble from the arsenic test than anything else.

Dr. Thorne had found arsenic in malt in quite appreciable quantities. This often gave rise to beer having a percentage above the legal limit. He had tried the electrolytic method, the Gutzeit method and others, but finally returned to the Marsh test, because using 20 grams of material he could determine arsenic representing about 1/1000 mg. He had not always been successful with the method of making zinc sensitive mentioned by Mr. Chapman. He found hydrochloric acid always contained arsenic and he got rid of the arsenic by heating the acid with a copper-zinc couple. He confirmed the benefit of cooling the tube as practised by Dr. Monier-Williams.

Mr. H. Droop Richmond thought the insensitiveness of zinc was largely due to the presence of iron.

Mr. Webster preferred the electrolytic Marsh method. Using platinum, he considered the limit of sensitiveness at 1/500 mg. Platinum electrodes became less sensitive in time, and it was necessary to polish them occasionally and sometimes to reverse the current.

Mr. Jenson said his experience of the electrolytic process showed it was very successful, the limits of sensitiveness being about 1/1000 mg.

Mr. Ellis Richards expressed his satisfaction at the Joint Meeting.

Dr. Dyer said pure zinc was very slowly attacked by acids and it was useful to alloy it with 0·1—0·2 per cent. of pure electrolytic copper and then to coat this insensitive metal with cadmium. He did not purify hydrochloric acid, but bought it specially pure.

Mr. Weaver and Mr. Bolton also took part in the discussion.

MANCHESTER SECTION

A meeting was held on February 2, Dr. E. Ardern in the chair. Members of the Manchester Geographical and Mining Society, the Manchester Section of the Institute of Mechanical Engineers, and the Manchester Association of Gas Engineers, attended by invitation, and about ninety persons were present.

A paper, entitled "A New Process for the Manufacture of Sodium Thiosulphate," by Mr. Luke Hargreaves and Dr. A. C. Dunningham, was read by the latter. Before the war, practically all the sodium thiosulphate manufactured in this country was prepared from Le Blanc waste, which contains a large percentage of calcium sulphide. On exposing this waste to air for oxidation considerable quantities are formed of calcium thiosulphate, which is extracted and treated with sodium carbonate or sodium sulphate to precipitate the insoluble lime salt; the sodium thiosulphate left in solution is crystallised out. Since the Le Blanc process has been definitely superseded by electrolytic methods, the exhaustion of the raw material is only a question of time, whilst the heavy cost of the labour and fuel necessary now militate very seriously against the process.

To prepare sodium thiosulphate directly sodium sulphite and sulphur are caused to react, according to the equation $Na_2SO_3+S=Na_2S_2O_3$. This reaction is well-known, but the conditions for carrying it out on a commercial scale have, apparently, never been worked out before. If sodium sulphite and sulphur are agitated with water in the correct proportions to form a concentrated solution of thiosulphate, the rate of reaction decreases with increase of thiosulphate concentration, owing to the reduced reacting contact between the sulphur and sulphite. The most effective way of increasing this contact is to use a large excess of one or both of the solid reacting substances. By this means solutions of thiosulphate of sufficient strength to crystallise without concentration can be prepared directly. All the ordinary impurities are only slightly soluble in concentrated thiosulphate solutions, so that after filtering or settling such solutions are of great purity. A commercial process was described for preparing thiosulphate in this way, and also a further development, in which sodium carbonate, sulphur dioxide, and sulphur in the presence of water react simultaneously to produce a similar concentrated solution of thiosulphate.

Dr. A. C. Dunningham also read a paper on "The Factors Determining the Choice of Materials for Stone Dusting of Mines, with Special Reference to Carbonate of Lime." Under the Coal Mines Act the stone-dusting of coal mines has been made obligatory, the only alternative allowed being treatment with water. The efficiency of a stone dusting-material depends upon its capacity to absorb heat rapidly, so that the mixture of dust and coal does not reach a sufficiently high temperature for explosive combination to take place. The physical properties of stone dusting-material are most important, since the rate of absorption of heat depends mainly upon them. An amorphous and finely-divided material with a large surface in relation to mass, *e.g.*, precipitated carbonate of lime, is particularly good from this point of view. A stone dusting-material should therefore: (1) be incombustible; (2) be very finely divided; (3) possess a large surface relative to mass, and its structure should preferably be amorphous and porous; (4) be dry; (5) easily form a cloud when disturbed; (6) be harmless to health; (7) be uniform in composition in order to simplify proper control over the stone dusting process; and (8) it should be white or very light in colour, so as to lighten the mine. Precipitated carbonate of lime approximates most nearly to the ideal substance for stone dusting, owing to its efficiency in use, and economy of production, due to the elimination of an expensive grinding process.

Shales, on the other hand, vary greatly in composition and properties (thus necessitating chemical control), but have the advantage of being obtainable at the mine. Grinding, however, is costly and this is often realised only after a period of working long enough to show the full extent of the wear and tear on the plant; further, the degree of fineness obtained does not often approach that of precipitated carbonate of lime. The effect of any shale upon the miner's health is a matter for experience, besides being uncertain owing to its varying composition. Precipitated carbonate of lime is free from all these disadvantages, and in the future it will probably largely replace shale as a material for the stone dusting of mines.

The third paper, on "Some Developments in Gas Producers," was by Mr. T. Roland Wollaston, M.I.Mech.E. The ammonia-recovery gas producer of ten years ago was said to be capable of (1) giving gas of 160 B.Th.U. higher value; (2) working at 70 per cent. thermal efficiency; (3) running upon a wide range of bituminous slacks with high ash and moisture contents; and of (4) yielding about 70 lb. of sulphate of ammonia per ton of coal per 1 per cent. nitrogen in the coal fed to producers. Undoubtedly, such results were sometimes obtained, and then only under special conditions of upkeep and skilled attention. The average gas produced did not exceed 130 B.Th.U. higher value, nor the thermal efficiency 60 per cent. The range of fuels which could be worked was distinctly limited in chemical composition, physical structure and condition, and the gas produced largely depended on hydrogen for its thermal value, a feature unattractive for many industrial applications. Of the total fuel consumed a considerable proportion generally went in raising the large amount of steam required (over 2 of steam to 1 of coal by weight), and yielded no by-products. The removal of ash in large plants using low-grade fuels was a very formidable problem, and the tar obtained was of low value. There seemed to be three axioms:—

1. Coke is always a good producer fuel. There is enough heat in the gas leaving a producer to coke, or at least semi-coke, the incoming fuel. If this coking is obtained by direct contact between gas and fuel the more volatile constituents of the latter will be taken up by and enrich the former. The final issuing gas will be cooled down considerably. Coke or semi-coke only will reach the producer.

2. High blast saturation in early recovery producers was adopted for physical rather than chemical reasons—*i.e.*, to reduce the temperature of the combustion zones, to avoid decomposition of ammonia, and to prevent the formation of clinker. Such moderation of temperature should be obtainable as well by useful radiation as by direct contact. The heat thus radiated is sufficient to raise all the steam necessary.

3. The water-bottom type of producer is at once best and cheapest. Mechanical and controllable discharge of ash is sound and economical.

A detailed description of a new plant fulfilling all the above requirements was then given.

Pre-coking leads to wide extension of the range of common fuels available, to practical elimination of clinkering, to great ease and economy of working, and to the production of a gas of unusually high value as for example:—Saturation, 74° C.; CO_2, 10·6%; O_2, 0; CO, 18·8%; H_2, 24·4%; CH_4, 3·9%; Total combustible, 45·1%; higher C. V., 182·5; lower C. V. 164·5.

Engineering problems have now been so far surmounted that continuous tests over long periods can be organised and it will soon be possible to present detailed records demonstrating clearly that the recovery gas producer must play an important part in industry.

In some supplementary notes Mr. Booth pointed out that the high value of the gas obtained extends the field for use of producer gas very considerably and the range of possible fuels almost indefinitely. He adduced evidence to show that the yield of by-products, ammonia and tar will be superior to those hitherto obtained and that still higher efficiencies will be obtained.

GLASGOW SECTION

The sixth meeting of the session was held in the Institute of Engineers and Shipbuilders, Glasgow, on February 2, Mr. W. E. Moodie presiding.

The meeting was arranged in accordance with the scheme whereby Fellows of the Chemical Society might give brief accounts of papers to be published in the Transactions of that Society, or raise points of general or theoretical interest to members of the local sections. The chairman intimated that the Committee had decided to offer a prize for the best original thesis presented by a Student Associate of the Section.

The following papers were read and discussed :—

(1) "Double Salts," by Mr. J. Ferguson, B.Sc. An account was given of researches on the dissociation pressures of double salts. Those investigated had been the hydrated double sulphates of the type $RSO_4, M_2SO_4. 6H_2O$. In the series where "R" was copper and "M" was one of the alkali metals it was found that the affinity or "free energy" at 50° C. increased in the order potassium, rubidium, ammonium and caesium, whilst the dissociation pressures decreased. In the course of the investigation the double dihydrates of copper and rubidium, ammonium and caesium had been prepared for the first time, and it had been proved that the vapour pressures of the hydrated salts depended on the electrochemical properties of the metals.

(2) "The Strength of Ammonia as a Base," by Prof. R. M. Caven, D.Sc. In this communication, theoretical conclusions were drawn from the results of the investigation reported in the previous paper. Attention was directed to the fact that ammonium salts stood high in the series of the alkali metals, whereas ammonium hydroxide was a weak base.

It was shown that there was no necessity to assume first the existence of the compound, ammonium hydroxide, and its subsequent dissociation in solution.

(3) "Some Comparative Experiments on the Dyeing Properties of Lichens," by Prof. T. S. Patterson, D.Sc. Experiments were described that were conducted during the war—and for the Board of Agriculture for Scotland—to discover natural dyestuffs. The tests were comparative and consisted of boiling flannel with similar quantities of various lichens, water and concentrated ammonium hydroxide. In many cases the flannel did not dye evenly and many of the colours were unsatisfactory. Amongst these were the various "crattles." It was concluded that many natural substances have tinctorial properties and that "the colouring matter" could be extracted with a solvent such as alcohol. The quantities of "raw material" available, however, varied greatly.

(4) "The Estimation of Inorganic Impurities in Organic Compounds Soluble with Difficulty in Water ; as Sulphuric Acid in Picric Acid," by Prof. T. S. Patterson and Mr. K. L. Moudgill, B.A., B.Sc. The method consists in bubbling steam through picric acid contained in a flask immersed in a boiling solution of concentrated sodium carbonate at 130° C. The aqueous layer which formed was filtered off and tested for sulphuric acid.

LONDON SECTION

Mr. W. J. U. Woolcock presided at the meeting of the London Section at the Engineers' Club, on February 5.

The first paper was entitled "Explosions in Liquid-Air Plants," by Dr. E. Fyleman. This paper, which appeared in full in our issue for January 26, p. 37 T, described investigations which led to the conclusion that the explosions were caused by acetylene produced by oxidation of the oil used to lubricate valves and other parts of the compressors.

Dr. W. R. Ormandy said the paper obviously bore upon the mysterious explosions which occurred at times in the air compressors used with Diesel engines, in which air at a pressure of from 1000 to 1200 lb. per sq. in. was sent into the cylinder. The danger of explosion had been reduced by using steel coils instead of copper coils to bring the air from the compressor to the engine, and that suggested that acetylene had something to do with it, since acetylene would form an explosive acetylide with copper. It would be extremely interesting to investigate the relationship between temperature and pressure of air under which lubricating oils formed acetylene or di-acetylene bodies. The question was also of interest in relation to internal-combustion engines in which very high temperatures and fairly high pressures occurred during the compression stroke.

Mr. Napier Prentice (Past-President of the Diesel Engine Users' Association) said the matter was of interest to Diesel engine users, because the deleterious material which formed in the compressors and led to explosions was really wanted in the cylinder of the engines. If the pressure and the temperature at which acetylene was formed could be ascertained, it foreshadowed a most important development in regard to internal-combustion engines, and especially those for aeroplanes, as possibly a fuel could be used at a lower ignition temperature.

Dr. Symons referred to explosions due to compressed-air plants where it was subsequently found the lubricating oil was to blame, inasmuch as at high temperatures it formed a gaseous mixture with oxygen or highly compressed air.

Dr. J. A. Harker, F.R.S., emphasised the importance of keeping a liquid-air plant well away from any place where acetylene was being used. The difficulty was encountered during the war at plants for fixation of nitrogen for munitions. These were on the site of a big carbide works in order to make cyanamide, and there was also a liquid-air plant to separate the nitrogen from the air. At the largest cyanamide plant in the world, Muscle Shoals, in the United States, very great precautions were taken to keep acetylene away from the liquid-air plant. A large conduit half a mile north and another half a mile south of the works were constructed so that they could take air in to the liquid-air plant uncontaminated by the acetylene produced at the cyanamide factory. In many works in Switzerland, Italy and Norway the same trouble had been experienced, but they did not take such elaborate precautions as had been taken in America, and seemed to hope that the acetylene would not get into the liquid-air plant.

The discussion was continued by Dr. Thorne, Mr. Horner, and Dr. Dvorkowitch.

Dr. Fyleman, replying to the discussion, said that even if a long conduit were used for the air inlet to the liquid-air plant, great care had to be taken to avoid leakages. The difficulty in the oxygen industry was quite different from that which he had referred to. Even if there were only traces of acetylene, that would collect in the solid state in the oxygen. The reason why liquid oxygen exploded so violently was that its latent heat of evaporation was only 50, so that the total heat of combustion of the carbon or, worse still, the acetylene, was diminished by this quite small amount of latent heat, and the results were really startling.

A paper by Messrs. G. T. Bray and F. Major on "The Estimation of Fat in Casein" concluded the meeting.

MEETINGS OF OTHER SOCIETIES

INSTITUTE OF CHEMISTRY

At a meeting of the Huddersfield Section held on January 24, Dr. A. E. Everest gave a lecture on "Plant Pigments."

The chairman, Dr. Hodgson, in his opening remarks, referred to the pioneer work in the exact science of these pigments carried out by the lecturer in collaboration with the German chemist, Willstätter.

Dr. Everest said that the industrial application of these pigments was small and was likely to become smaller. Nevertheless, he thought it was sometimes a good thing to turn to subjects of only scientific interest. Plant pigments could be divided into groups—viz., chlorophyll, the insoluble pigments, and the sap pigments; indigo and madder were quoted as isolated examples of colouring matter. As he had worked mostly with the sap pigments, he proposed to give a short account of the stages in the elucidation of the chemical constitution of these bodies. He clearly explained the connexion between the flavones, the flavonols and the anthocyanins, and described his own contributions to the chemistry of this subject. The initial difficulties of the investigation of the blue colouring matter of the cornflower were indicated. Several hundredweights of dry cornflower petals were required to give sufficient material to work upon, the petals had to be taken from flowers recently opened, and the actual extraction had to be carried out very rapidly in order to avoid decomposition. With one or two exceptions, all these pigments were attached to some sugar as a glucoside. With regard to the tinctorial value, a variety of pleasing shades could be obtained from a cold bath on tannined cotton, which are fast to light and dry-cleaning, but fugitive to hot water and alkali. The lecture concluded with the exhibition of specimens of historical interest and of dyeings from radish skins, pelargonium petals, blackberries, etc.

SOCIETY OF DYERS AND COLOURISTS

Two papers were read at the meeting of the Manchester Section held on January 19. In the first, on "The Behaviour of Titanic Acid towards Dyestuffs," by Dr. J. K. Wood and Mr. A. M. Morley, the alpha and beta modifications of titanic hydroxide were discussed, and it was suggested that the alpha acid exists in the form of small particles more readily attacked by reagents than the larger and more complex particles of beta acid. If this is true, the possibility arises of the existence of several modifications of the acids, a hypothesis which is in agreement with the behaviour of oxides of related metals. There will thus be a continuous series of titanium hydroxides gradually increasing in beta character as condensation occurs, owing to the titanium hydroxide functioning in two capacities. The result of this will be the gradual decrease in surface area of the particles. Therefore a sample of titanic acid having a pronounced beta character will possess a smaller absorptive capacity than one in which condensation is less advanced.

Prof. E. Knecht and Mr. G. H. Street presented a paper, entitled "Investigations on the Constituents of Raw Cotton, Part 4," which was devoted to an account of investigations on cotton wax. It was concluded that extraction of the raw cotton with benzene removed about half of the wax, whereas if the fibre is destroyed by chemical or mechanical means the whole of the wax can be extracted, the content being just over 1 per cent. The wax was found to contain what appeared to be another definite compound, differing in solubility, melting point and composition from that described by Schunck.

THE CHEMICAL SOCIETY

Three papers were read at the meeting of the Society on February 1, presided over by Sir William Tilden :—

The first paper, on " Derivatives of Tetrahydrocarbazole Part II.," was by W. H. Perkin and S. G. P. Plant. The latter author gave an account of some of the chemical reactions of tetrahydrocarbazole associated with its peculiar linking. The behaviour on nitration is unusual. Nitration with a mixture of sulphuric and nitric acids led to the nitro group entering para to the NH group ; if, however, the acetyl compound was nitrated the nitro group entered meta to the NH group, the reverse of the usual orientation. Further work was described dealing with addition at the double bond of the partially reduced ring and a new type of nitro compound was evidenced. The results were found to conform to the Lapworth-Robinson hypothesis. In the discussion, Dr. Brady referred to the failure of ring closure when nitro groups are present in certain common synthetic methods for the preparation of carbazole derivatives. It seemed that the unusual behaviour on nitration indicated an abnormal polarity of the remaining carbon atoms which might afford a possible explanation.

In view of the recent communication to *Nature* of January 20, by Professors Coster and Hevesy, working at Copenhagen, of the identification by its X-ray spectrum of a new element which they have named Hafnium and probably has the vacant atomic number 72 (to which place the problematical element Keltium had been earlier assigned), the communication of Dr. Scott was of peculiar interest. He actually showed a sample of the oxide of the new element which was isolated from a sample of black iron sand from New Zealand. The sand is titaniferous, not a monazite, and exhibits none of the properties of the rare earths. It was decomposed by treatment with strong sulphuric acid, and a residue was obtained which was freed from titanium sulphate by repeated extraction with sulphuric acid. It was then fused with sodium bisulphate, and the melt after solution still left a notable quantity of white residue which was fused in a gold crucible with caustic soda and the residue after solution once more put through this process. This final residue, a pale, buff-coloured powder, is presumably the oxide of a new element belonging to the titanium—zirconium group. It further shows the properties of this group, as it was found impossible to form a nitrate, chloride, etc. It does, however, give rise to a double fluoride when treated with hydrogen potassium fluoride. On converting this double salt again into oxide by heating with sulphuric acid and washing out the potassium sulphate formed, data were obtained which allowed the atomic weight to be calculated as 175.

The oxide still, however, shows coloration, which may be due to minute traces of iron. Dr. Scott first isolated the oxide in 1915, 1·4 g. of the substance being obtained. He has only just, however, made the determination of the atomic weight of the metal. Using quartz weights and pure hydrofluoric acid, he hopes to make a more accurate determination of its atomic weight. He has also offered to send a sample of the oxide to Denmark for a comparison to be made by the X-ray spectrograph with Hafnium. Future treatment of the original sand may be made with hydrochloric instead of sulphuric acid, as the former decomposes the iron, leaving a cream-coloured sand residue. There is stated to be a belt of the sand 70 miles in extent on the New Zealand coast, so that ample material will be available for future investigation.

In congratulating Dr. Scott on his discovery, Sir W. Tilden said that it was a notable event, and the Society was also to be congratulated, as few such discoveries had been communicated to it. Prof. H. E. Armstrong expressed his appreciation of the discovery and observed that Dr. Scott was well known as a very exact worker. Attempts to name the element were premature, as the element itself had not been isolated. The new element should be named after Moseley, as Moseley's work had made the discovery possible. Congratulations from chemists outside the London area were voiced by Prof. Smithells, who gave instances of the almost simultaneous discovery of other elements by independent workers.

The last paper, by C. K. Ingold, E. A. Seeley and J. F. Thorpe, was entitled " The Chemistry of Polycyclic Structures in Relation to their Homocyclic Unsaturated Isomerides. Part IV. The Simulation of Benzenoid Properties by the Five-carbon Intra-annular Nucleus."

CORRESPONDENCE

Sir,—How delightful it is to find an original member of the Society of Chemical Industry who can laugh. The laugh is not echoed by the unfortunate representatives of the chemical industry who have expended perhaps a hundred thousand pounds of their shareholders' money in obtaining a legal interpretation—save the mark—of a litigation-inviting schedule appended to a simply expressed Act of Parliament.

Truly, there is but one chemistry. Unfortunately, however, we cannot now produce men who can embrace the whole of " natural philosophy," but have had to separate chemistry from physics and even to subdivide these two quite arbitrarily defined fields of knowledge.

Indeed, Mr. Joseph Barnes himself saw that omniscience could not outlast his younger days; so he talked glibly of "organic" carbon, of "organic" matter and of "organic" substances (J., 1886, **15**, 82; 1898, **17**, 430; 1908, **27**, 212).

Many people sympathise with Mr. Barnes' protest against the intrusion of such novelties as phase rules, ions, isotopes, etc., and share his resentment at the idea that chemistry has progressed since Wöhler's day. But the chemist who fails to realise that science advances, and that electrons, isotopes and the like novelties are living things, will be more at home in the lethal chamber than in the strangers' gallery.—I am, sir, etc., WILLIAM J. POPE

University of Cambridge.
Feb. 5, 1923.

THE FEDERAL COUNCIL

Sir,—I am overjoyed to see from the contents of the first few issues of CHEMISTRY AND INDUSTRY that consideration is now being paid, not only to the taste of the more inconspicuous members of the Society, but also to the more humane aspects of our common profession. The *Journal* seems rejuvenated. I note "editorials" urging us to unite, space is even found for the views of distinguished advocates, and plain men can now actually see themselves in print. All this promises most highly for the future and, stimulated by the new atmosphere, I am impelled to ask for enlightenment, as many of us are not too well informed about the activities of those who control our corporate destinies. In the issue of January 26, p. 76, "One of the Three" writes that the Federal Council should make some real effort to materialise the dreams of a central palace of chemistry. With such dreams every chemist will eagerly sympathise, but may we know by what magic the Federal Council, Aladdin-like, will bring about this "materialisation"? Is it not high time that something more concrete than dreams was put before us?—I am, Sir, etc., P. M. J.

Manchester,
February 3.

PERSONALIA

Prof. A. Miethe has resigned the editorship, which he has held for 30 years, of *Das Atelier des Photographen*, and has been succeeded by his colleague, Prof. O. Mente.

Prof. W. Friedrich, director of the Radiological Institute of Freiburg University, has been appointed director of the newly-founded Institute for Radiotherapy, in the University of Berlin.

Dr. E. K. Rideal has been co-opted as an additional member of the Degree Committee of the Special Board for Physics and Chemistry of the University of Cambridge.

Mr. A. W. Nash has been appointed Senior Lecturer in Petroleum Technology in the University of Birmingham, and Dr. E. E. Turner has been appointed demonstrator in the Chemical Department of the East London College.

The Hon. Charles E. Pellew, who now enters the peerage, owing to the death of Lord Exmouth, is a member of this Society, and was formerly professor of chemistry at Columbia University, U.S.A.

Messrs. J. W. Hawley and J. King have passed the examination for the Fellowship of the Institute of Chemistry, and Messrs. G. W. Bender, A. P. Cattle, J. Lomax, F. C. Madden, J. B. McKean, C. J. Powell, T. E. S. Reynolds, T. W. Dallimore, W. Smith, M. H. Hansford, V. T. Tadman and G. Taylor have passed the examination for the Associateship.

Dr. Thomas B. Downey is the present incumbent of the industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburg, established by the Edible Gelatine Manufacturers of America, Inc., for the purpose of ascertaining the real food value of edible gelatin. In addition to experimental investigations, a correlation of available facts regarding edible gelatin will be made, to be held at the disposal of all users.

Dr. Charles D. Walcott, secretary of the Smithsonian Institute, president of the National Academy of Sciences, and formerly director of the United States Geological Survey, has been elected president of the American Association for the Advancement of Science; Dr. Morris S. Kharasch has been appointed associate professor of organic chemistry at the University of Maryland; and Dr. Richard C. Lord has been elected assistant professor of chemistry and physics at Kenyon College, Gambier, Ohio.

* * *

From Prague the death is announced of Prof. Karl Wrba, president of the Czech Academy of Sciences.

The death is announced of Dr. J. Waddell, Professor of Analytical Chemistry, Queen's University, Montreal, and one of the founders of the Canadian Institute of Chemistry.

From Germany the death is announced, at the age of sixty-three, of Prof. Paul Jacobson, who was for many years general secretary of the German Chemical Society, and had rendered notable services in organising the production of that Society's publications, particularly *Beilstein*. Jacobson was co-author, with Victor Meyer and other workers, of a large treatise on organic chemistry, and had published numerous papers on mercaptans, azo compounds and similar subjects.

ERRATUM.—Under the heading of "Deaths" in the issue for January 26, the address of the late Mr. A. L. Crosfield should have been given as Birkenhead, not Berwickshire.

NEWS AND NOTES

UNITED STATES

A New Chemical Society

The American Institute of Chemistry was organised at a meeting of New York chemists on January 22. This new society will include only chemically trained men who qualify for membership by education and experience. It will act on the same lines as the Institute of Chemistry of Great Britain and the Canadian Institute of Chemistry, which have been successful in giving to the vocation of chemistry a professional status by recognising as entitled to be called chemists only those who satisfy certain standards of capacity. Dr. H. G. Byers, department of chemistry, Cooper Union, and Dr. Lloyd Van Doren, a chemical patent lawyer, are respectively president and vice-president, C. K. Simon, president, Dye Products and Chemical Co., New York, is treasurer, and the secretary is Lloyd Lamborn, editor of *Chemical Age*.

Output of Petroleum in 1922

It is reported that the production of crude petroleum in the United States in 1922 was 550,000,000 barrels, the largest amount ever reported, and an increase of 17 per cent. over the production in 1921. A recent estimate suggests that the output in 1923 will be still larger, but consumption in the United States and elsewhere is increasing steadily, and the shortage of production and transportation of Mexican oils, coupled with the fact that no new fields of any importance are being discovered abroad, makes the situation serious. The percentage of the world production attributed to the United States in 1922 was 66·5, compared with 21·7 for Mexico and 11·8 for the rest of the world.

The production of gasoline was 5,810,000,000 gallons, an increase of 700,000,000 gallons over the figures for 1921. It is estimated that in 1923 over 6,000,000,000 gallons of gasoline, *i.e.*, the production from 600,000,000 barrels of crude oil, will be needed to meet requirements. It is estimated that the United States will be forced to enter foreign fields on a larger scale to ensure supplies of petroleum and its distillates for its own needs.—(*Oil, Paint and Drug Rep., Jan.* 15, 1923.)

CANADA

Production of Iron and Steel in Canada

A report issued by the Dominion Bureau of Statistics states that the production of pig iron during December was 4·7 per cent. above the record of the previous month, the tonnages being 34,289 long tons in November and 35,891 t. in December, 1922. The average monthly production throughout the year was 31,921 t. The total production of pig iron in 1922 was 383,057 t. as compared with an output of 594,354 t. in the previous year. The production of ferro-alloys was well maintained, the output for December being 2246 t. and the total output was 20,749 t. as compared with 22,493 t. in 1921. The number of blast furnaces in operation remained unchanged during December: two at Sydney, one at Hamilton, and one at Sault Ste. Marie. Steel production during 1922 totalled 485,643 t. while 667,484 t. was produced in 1921. The total steel production for the six months ending June 30, 1922, was 177,080 t. whilst 308,140 t. were produced during the last half of the year.

SOUTH AFRICA

The New Coal By-product Plant

The new coal by-product plant of the Dundee Coal Co. at Waschbank (Natal), which cost over £300,000, has begun operations. The plant will produce coke, tar, benzol, sulphate of ammonia, naphthalene, creosote and varnishes, and eventually aniline dyes and other commodities. The annual capacity of the plant is 49,795 tons of metallurgical coke, 412,000 gallons of tar, and 655 tons of sulphate of ammonia. Later on the factory will also produce 98,280 gallons of benzol per annum.—(*S. African J. Ind., Jan.*, 1923.)

BRITISH INDIA

First Forecast of the Winter Oilseeds Crop

Estimates based on reports received from provinces containing 98·7 per cent. of the total area under rape and mustard and 99·2 per cent. of the total area under linseed in British India indicate that the acreage (excluding the mixed crops of the United Provinces) under rape and mustard totals 3,621,000 and under linseed 2,290,000. These figures represent increases of 10 and 14 per cent., respectively, above the areas estimated at the same time last year. The present conditions of the crops are reported to be good.—(*Ind. Tr. J., Jan.* 11, 1923.)

GENERAL

Educational Work of the Paint, Varnish and Colour Industry

Prior to the outbreak of war an appeal was made for subscriptions to a fund to endow a scholarship for students in the Paint, Oil, and Colour Department of the Borough Polytechnic Institute, London. This appeal, which had to be abandoned during the war, has been renewed, and to date £113 has been received. The subscription list remains open until March 31, 1923, by which date it is hoped that a total of £200 will be realised. It is intended to hand over to the Governors of the Institute all monies received, for investment in trustee stock, the income from which is to be awarded annually as the " Trade (1923) Scholarship in Paint Technology." In awarding the scholarship, equal if not greater importance will be attached to the record of the work of the pupil during the year than to the results of answering a single test paper at the end of the session.

The vital need for encouragement of study on proper lines in these industries is keenly felt, and to that end an Advisory Committee of Trade Experts was formed some three years ago. The Committee not only acts in an advisory capacity, but conducts the internal examinations of the Institute in the department concerned—a system which might with advantage be applied in many other teaching institutions. It is felt that the successful work which has been carried on in the past in the Paint, Oil and Colour Department of the Borough Polytechnic should be extended, and manufacturers and old students who have not subscribed to the 1923 Scholarship Fund are invited to send their subscriptions to the Hon. Secretary, Mr. Noel Heaton, 1, Hilly Fields Crescent, Brockley, London, S.E.

REPORT

REPORT OF THE MEDICAL RESEARCH COUNCIL FOR THE YEAR 1921-1922. *Pp.* 125. *H.M. Stationery Office*, 1922. *Price* 3*s.* 6*d. net.*

This, the eighth annual report of the Medical Research Council (formerly Committee) appointed under the National Health Insurance Act, is divided into five sections, dealing with:—I, the work of the National Institute for Medical Research, Hampstead; II, the research work of clinical units; III, the determination of biological standards and the methods of biological assay and measurement; IV, research work on specific subjects; V, industrial medicine and industrial fatigue. It covers the period October 1, 1921, to September 30, 1922. For this purpose a grant-in-aid of £130,000, a modest sum withal, was provided by Parliament, the distribution being effected as follows:—£34,000 for the expenses of the National Institute for Medical Research, Hampstead, £88,000 for research grants to scientific men and for the expenses of the scientific researches in specific subjects, for research work in clinical medicine, and for the work of the Industrial Fatigue Research Board, and £8000 for administration expenses.

A perusal of the report shows that the scope of inquiry is not that embraced by a narrow interpretation of medicine, but by the whole field of medical research covered by the broad-minded conception of medicine as defined in the report itself —" The conception of medicine is concerned not only with the palliation and removal of disorder and pain, but with the prevention of disease, with the maintenance of health no less than with its restoration, and with the choice of conditions in which the body machinery of mankind can develop most harmoniously its fullest powers." No chemist can quarrel with this definition nor with the report itself, representing as it does a stage and only a stage, both of the peaceful penetration of the chemist and of chemistry into a domain where chemistry must be the handmaid of medicine, and of the tardy recognition by the medical sciences of the indissoluble bond linking chemistry and medicine.

Some of the subjects of special interest to chemists may now be briefly noted. On the subject of biological standards, Great Britain lags behind the other great nations. Progress is, however, rapidly being made to remedy this defect, and there is every reason to believe that with the talent available the biological standards and methods of assay will be superior to those of any other country. As a result of work done at the National Institute for Medical Research by Drs. Dale and Burn, by Miss Durham and Miss Marchal on the curative action of Neosalvarsans prepared by British manufacturers on experimental trypanosome infections in mice and of the parallel observations of Major White and Mr. Mills at the Military Hospital, Rochester Row, on the curative effects in human syphilis, Neosalvarsans are now made by British manufacturers of the highest possible therapeutic efficiency. Drs. Dale and Burn have also shown how pituitary extract may be standardised so that obstetricians are guaranteed a uniform product. These workers found an 800 per cent. variation in activity in the products from the five firms who supply it in this country. British standards for diphtheria and tetanus antitoxin are being prepared by Dr. Hartley, and the first serum standard for Britain is promised shortly. The National Collection of Type-Cultures under the curatorship of Dr. St. John Brooks at the Lister Institute is steadily being enlarged, and the Standards Laboratory of Oxford under Professor Dreyer supplies standardised agglutinable cultures and agglutinating sera to approved applicants.

In the field of biochemistry and pharmacology there is much solid progress. The problem of the isolation of the pituitary principle to which Dr. Dudley has devoted so much attention appears insoluble by present means and methods. This principle is undoubtedly one of the most active substances known; a crystalline picrate was isolated, which, after several crystallisations, had an action on uterine muscle equivalent to that of the intensely active substance histamine, and yet this picrate was an inert substance, potassium creatinine picrate, with a trace of the true active principle adherent. Sir T. Lewis and his colleagues have established the value of the cinchona alkaloids, particularly quinidine and hydroquinidine, in the amelioration of auricular fibrillation, and parallel clinical observations have been made by Drs. Clark-Kennedy and Ellis. Dr. King has contributed to the fundamental stereoisomerism of the cinchona alkaloids, and, in addition, has isolated the alkaloid muscarine, the poisonous constituent of the Common Fly Agaric. Every medical student is familiar with the effect of this intensely active poison on the frog's heart, but contrary to previous conceptions Dr. King finds no evidence for a relationship with choline. An adequate supply of *Amanita muscaria* is, however, required before the build of the muscarine molecule conferring its intense localisation in the living tissues can be visualised. Professors Browning and Cohen and their co-workers are continuing their co-operation in the investigation of antiseptics, and the group of photographic sensitisers represented by the cyanine dyes have been found to be highly bacteriostatic.

The vitamins and problems of nutrition find many devoted workers. The beneficial effects of cod-liver oil find an explanation in the observation of Professor Drummond and Dr. Silva that the poorest samples are many times richer in vitamin A than average samples of butter. Many workers have contributed to the problem of rickets, and the present conclusion is that absence of the anti-rachitic vitamin is probably the most important factor in the causation of rickets in winter, and sunshine may be the chief preventive factor in summer. A vitamin appears essential for the growth of pathogenic bacteria *in vitro*. Dr. Laidlaw is concerned with this problem and its important applications in media for bacteria. Experiments are in progress with a view to isolating this constituent.

This list might be indefinitely extended, as the major portion of the report deals with purely medical subjects; but sufficient has been said to show that whatever arguments may be adduced against State-aided research, the work guided by the Medical Research Council is of inestimable and lasting benefit not only to the British Empire but to the world at large.

REVIEWS

The Theory of Allotropy. *By* Prof. A. Smits. *Translated by Dr. J. Smeath Thomas. Pp.* 397. *London: Longmans, Green & Co.,* 1922. *Price* 21*s. net.*

This volume forms one of the well-known Text Books of Physical Chemistry edited by Professor F. G. Donnan and the late Sir William Ramsay. It appears to be well translated, and is well printed; and it deals with a most interesting chapter of physics and chemistry. It is not, and does not profess to be easy reading; most of the books on physical chemistry we have come across are child's play compared with this one. The distinguished author has applied the phase rule to the theory of allotropy, both in elements such as phosphorus and in organic compounds such as benzoyl-camphor, but the non-mathematical reader who expects an easy explanation of the chemical facts of allotropy should attempt some more elementary book than this. This book is not written for the general run of chemists who never knew or have forgotten the calculus "by whose grace the elect enjoy their sacred aloofness."

Gesammelte Abhandlungen. *By* Dr. F. Kehrmann. *Vol.* I. *Pp. viii*+203. *Leipzig: G. Thieme,* 1922. *Price paper,* 8*s.*

Chemists are often apt to lose the thread of a prolonged research or series of researches that appear at intervals in detached contributions and often in different journals. This difficulty has been met here and elsewhere by the publication of monographs on topics of special interest connected with different branches of chemistry. The *Ahrens Vorträge* fulfilled this demand to some extent and it was soon followed in this country by the appearance of monographs on biochemistry, physical, inorganic and industrial chemistry. More recently, again in Germany, the series of "Einzeldarstellungen" has added to the number of publications of this type of scientific literature. It is with the object of giving a clear and consecutive account of the large mass of observations which have appeared in various journals that Prof. Kehrmann, of the University of Lausanne, has been induced to collect them together and publish them in a single volume.

The subjects dealt with are mainly two. The first series of reprints, which date back to 1887, have reference to the constitution of phosphotungstic, arsenotungstic and silicotungstic acids and their salts, a subject which has gained in interest since the publication of Werner's theory of complex salts. The second set of papers deals with the quinoneoximes and the effect of various nuclear substituents on their formation, thus affording a notable contribution to the theory of steric hindrance. The majority of these papers have appeared since 1888 in the *Berichte*. J. B. Cohen

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Joural for February* 1)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W.1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Pharmaceutical products, patent medicines	150
Australia, New Zealand	Tinplate, galvanised sheets, enamel ware	113
Belgium	Steel	124
British India	Druggists' supplies, patent medicines	117
Bulgaria	Glass cells, lead, tin, hydrochloric acid (tenders for)	9861/F.E./E.C.
Canada	Whiting	*
France	Leather	128
,,	Raw sugar, palm kernels, groundnuts	129
,,	Iron and steel	18375/F.W./E.C.
Latvia	Fats for soap-making	131
,,	Iron and steel	6820/F.R./E.C.
New Zealand	Copper wire (tender for)	10505/E.D./E.P.
,, ,,	Photographic materials	3164/E.D./C.C.
Norway	Tinplate, terneplates, galvanised plates	140
,,	Vegetable oils	141
Poland	Hæmatite pig iron	6759/F.R./E.C.
South Africa	Hollow-ware	122
,, ,,	Electrical cables and wires	10529/E.D.
Spain, Portugal	Tinplate, tin, earthenware, galvanised sheets, copper sulphate	113
Switzerland	Paper	145
Yugoslavia	Tin	143

* Canadian Government Trade Commissioner's Office, 73, Basinghall Street, London, E.C. 2.

TARIFF CUSTOMS EXCISE

Brazil.—Modifications in the customs tariff affect asphalt, various vegetable extracts, grape sugar, oxides of lead, starch, copper and brass rods and waste, gypsum, and chloride of lime. Certain of the consumption taxes have been increased. Raw material for coal and gold-mining companies, fertilisers, and plant for making paper pulp and for extracting vegetable oils pay only the 2 per cent. "expediente" tax.

British Guiana.—From December 4, 1922, a revised customs tariff has come into force. The specific and *ad valorem* duties are mostly unchanged, but the additions to the specific duties have been increased from 15 to 20 per cent. of the prescribed duties. The *ad valorem* rates on unspecified goods are 16⅔ and 33⅓ per cent. under the British preferential and general tariffs, respectively.

British India.—Opium derivatives may only be exported when the consignment is covered by an official certificate from the country of destination.

Egypt.—Revised valuations have been issued for assessing the duties on various iron and steel goods.

St. Vincent.—Revisions of the export duties affect cotton, starch, sugar, syrup, molasses, groundnuts, and copra.

Sudan.—Regulations have been issued governing the importation of alcoholic liquors.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The general firmness of the chemical market in view of the unsettled state of Continental politics may be taken as a very hopeful sign, but the depression which might have been expected is no doubt more than counterbalanced by the prospects of shortage of supplies from Germany. A definite settlement of terms in connexion with our American debt is sure to have a beneficial effect on this as on every other trade, and the outlook to-day cannot be considered in any way unsatisfactory when the unstable conditions on the Continent are fully taken into account.

Acid Acetic, 40% ..	£21 per ton. Position very firm, with a strong tendency for prices to rise further. Spot supplies none too plentiful.
Acid Hydrochloric ..	4s. to 5s., carboy d/d.
Acid Nitric, 80° Tw. ..	£25 10s. per ton. Still in very poor demand.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 to £8 per ton. Very fair inquiry for both home and export.
Arsenic (White) ..	£70-£75. Still in very limited supply.
Bisulphite of Lime ..	£7 per ton, packages extra and returnable.
Bleaching Powder ..	£10 10s. per ton. In rather better demand, but still very great room for improvement.
Calcium Chloride ..	£6 per ton d/d. Continental supplies freely offered at low prices.
Copper Sulphate ..	£26 10s. per ton f.o.b.
Potash Caustic, 88/90%	£29 per ton.
Potass. Bichromate ..	6¼d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.-£5 10s. per ton. Home trade no change. Considerable inquiry for export.
Soda Caustic, 76% ..	£20-£21 per ton. Slight improvement maintained.
Soda Crystals	£5 10s. per ton carriage paid. Steady demand.
Sod. Bicarbonate ..	£10 10s. per ton. Improved inquiry.
Sod. Bisulphite, 60/62%	£19-£20 10s. per ton f.o.b. or f.o.r. London.
Sod. Chlorate	Market dull, with offers of Continental make at low prices.
Sod. Sulphide, solid, 60/62	£16 per ton carriage paid. Very quiet.
Sod. Sulphite, Pea Cryst.	£17-£17 10s., 1-cwt. wooden kegs included.
Sod. Acetate, 97/98% ..	£23 per ton.
Sod. Nitrite	£30 per ton 100% basis d/d.

WOOD DISTILLATION PRODUCTS

No alterations in prices are reported this week.

Acetate of Lime—	
Brown	£9 per ton d/d.
Grey	£15 10s. per ton d/d.
Liquor	9d. per gall., 32° Tw., d/d.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
	1s. 2d. .. ,, 24° Tw.
Red Liquor	1s. 3d. .. ,, 14/15° Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	7s. ,, ,, 60% O.P.
Solvent	5s. ,, .. 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead ..	£36 per ton d/d.

TAR PRODUCTS

Acid Carbolic, Crude 60's	2s. 5d. to 2s. 6d. per gall. Numerous inquiries.
Acid Cresylic, 97/99 ..	2s. 3d. per gall. Market active.
Acid Cresylic, Pale, 95%	2s. 1d.-2s. 2d. per gall.
Acid Cresylic, Dark ..	1s. 10d.-2s. per gall.
Anthracene Paste, 40%	7d. per unit per cwt.
Anthracene Oil—	
Strained	8½d. to 10d. per gall.
Unstrained	8d. per gall.
Benzole, Crude, 65's ..	1s. 1d.-1s. 2d. per gall.
Benzole, Standard Motor	1s. 8d.-2s. 2d. per gall. Not much inquiry.
Toluole, 90%	1s. 10d.-2s. per gall.
Toluole, Pure	2s. to 2s. 4d. per gall.
Xylol	2s. 6d.-3s. 6d. per gall.
Creosote—	
Cresylic, 20/24% ..	10d.-11d. Fair inquiry.
Middle Oil	8¼d. per gall. Very firm, with plenty of business.
Heavy	8d. ,, ,,
Standard Specification	7¾d.-9¾d. ,,
Naphtha—	
Crude	9d.-10d. per gall.
Solvent, 90/160 ..	1s. 7d. to 1s. 10d. per gall.
Solvent, 90/190 ..	1s. 7d. per gall.
Naphthalene, Crude—	
Drained Creosote Salts	£6-£9 10s. per ton, according to quality.
Whizzed or Hot Pressed	£9 10s.-£12 10s. per ton, according to quality.
Pitch, Medium Soft ..	135s. to 145s. per ton. Market continues to be very active.
Pyridine, 90/140 ..	11s. 6d.-12s. 6d. per gall.
Pyridine, Heavy ..	8s. 6d.-9s. per gall. Little or no business.

INTERMEDIATES AND DYES

Business in Aniline Dyestuffs during the past week has been considerably better than we have reported for the last week or two. Trade seems to be reviving somewhat and orders are coming in freely. Prices are firm but have not yet risen. This may be imperative in future owing to the rise of various raw materials and coal.

Acid H.	5s. 1d. lb., 100% basis.
Acid Naphthionic ..	2s. 7½d. lb., 100% basis.
Acid Neville and Winther	6s. lb., 100% basis.
Acid Sulphanilic ..	1s. 6d. lb., 100% basis.
Aniline Oil and Salts ..	10d. lb. naked at works.
Benzidine Base	6s. 6d. lb., 100% basis.
Dinitrobenzene	11d.-1s. lb. naked at works.
Dinitrotoluene, 48/50 ..	8d.-9d. naked at works.

Dinitrotoluene, 66/68	1s. 2d.-1s. 3d. naked at works.
Diphenylamine	4s. 1d. lb.
α-Naphthol	2s. 9d. lb.
β-Naphthol	1s. lb.
α-Naphthylamine	1s. 6½d. lb.
β-Naphthylamine	4s. 6d. lb.
p-Nitraniline	2s. 9d. lb.
Nitrobenzene	7½d. lb., drums extra.
Nitronaphthalene	1s. lb.
Naphthionate Soda	2s. 8½d. lb., 100% basis.
Diethylaniline	4s. 6d. lb., packages extra.
Metanitraniline	5s. 6d. lb.
Para Toluidine	5s. lb.
Para Phenylene Diamine	12s. lb., 100% basis.
Meta Phenylene Diamine	5s. 6d. lb.
Meta Toluylene Diamine	5s. lb.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Although the seizure of the Ruhr should, according to economic law, result in higher prices being required by German chemical manufacturers, yet the opposite is being experienced in many cases, due to the manufacturers requiring sterling. Bromides and salicylates, for example, have been offered at lower prices from Germany since France entered the Ruhr district, but these offers are for specified stocks and must soon cease.

Acid Acetic, 80%	£45-£47 ton. Prices advancing.
Acid Acetyl Salicylic	3s. lb. Still a very firm market.
Acid Benzoic	2s. lb. Firm with little spot supply.
Acid Boric, B.P.	£61 ton crystals, £65 ton powder, packages in 2-cwt. bags, carriage paid U.K. Market very steady.
Acid Citric	1s. 7d-1s. 8½d. Market firm, with fair demand. Raw material still inclined to advance.
Acid Gallic	3s. lb.
Acid Pyrogallic	5s. 6d. lb.
Acid Salicylic	1s. 6d. lb. The rise in the cost of carbolic acid will soon necessitate higher prices being quoted for this article.
Acid Tannic	3s. 3d. lb.
Acid Tartaric	1s. 2½d.-1s. 3d. lb., less 5% for English makes. Heavy buying still taking place. Tendency of market upward.
Acetanilide	1s. 6d. lb. Unchanged.
Amidopyrin	14s. lb.
Atropine Sulphate	12s. 6d. oz.
Benzaldehyde, free from Chlorine	3s. lb.
Benzonaphthol	5s. lb., without much demand.
Bismuth Salts	Prices per lb. for cwt. lots are as follows:—Carbonate 13s., Citrate 11s. 7d., Nitrate cryst. 6s. 11d., Oxide 14s. 5d., Salicylate 10s. 5d., Subchlor. 12s. 8d., Subgallate 9s. 6d., Subnitrate 11s. Fairly good market.
Bromides	Some very cheap offers being made from the Continent. Market unsettled.
Chloral Hydrate	4s. to 4s. 3d. lb. for duty pd.
Guaiacol Carbonate	8s. 6d. lb. Chiefly required for export.
Hexamine	3s. 9d. lb. Still very firm with much inquiry.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	No change. Rather quiet, with small demand.
,, ,, ,, B.P.	2s. 5d. lb.
,, ,, ,, Green	3s. 1d. lb.
Magnesium Carbonate, Light Commercial	£40 per ton.
Magnesium Oxide—	
Light Commercial	£85 per ton.
Heavy Commercial	£29 per ton.
Menthol	37s. 6d. lb., less 2½% for original cases. Small quantities 38s. nett.
Methyl Salicylate	2s. 2d. lb. on a firm market.
Methyl Sulphonal	13s. lb. still neglected.
Mercurials	Much weaker in view of the lower cost of quicksilver.
Formaldehyde, 40% Sol.	£98 10s.-£100 ton.
Paraformaldehyde	3s. 6d. lb. Much advanced.
Paraldehyde	1s. 6d. to 1s. 9d. lb. In short supply.
Phenacetin	5s. lb.
Phenazone	7s. lb.
Phenolphthalein	5s. 3d. lb. Slightly weaker in view of larger supplies being available.
Pilocarpine Nitrate	21s. 6d. oz. Slightly lower.
Potass. Bitartrate—99/100% (Cream of Tartar)	98s. 6d.-100s. per cwt. for ton lots, less 2½%. Market firm.
Potass. Iodide	15s. 8d. lb. for cwt. lots. Cases free. Demand still good.
Potass. Metabisulphite	8d. lb.
Potass. Permanganate	8½d. lb. still wanted for good quality.
Quinine Sulphate	2s. 3d.-2s. 4d. oz., bulk packages. Fairly steady market.
Resorcin	6s. lb. Less would be accepted for quantity.
Salol	2s. lb. Much firmer.
Sod. Benzoate	2s. lb. Spot supplies very limited.
Sod. Citrate	U.S.P. quality, 2 mols. water, quoted at 2s. 2d. lb. for cwt. lots. B.P.C. quality, 5½ mols. water, 2s. lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.-85s. cwt. Fair demand.
Sod. Salicylate	2s. powder, 2s. 1d. crystal. Still unchanged.
Sod. Sulphite—	
Anhydrous	£27 10s.-£28 10s., according to quantity. F.o.r. London, drums included.
Crystals	£17-£17 10s. ton, according to quantity.
Thymol	17s. to 19s. lb., according to quality.

PERFUMERY CHEMICALS

Amyl Acetate	2s. 3d. lb.
Amyl Butyrate	8s. lb.

Amyl Salicylate	3s. 3d. lb.
Anethol (melting point 21/22° C.)	4s. 6d. lb.
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. lb.
Benzyl Alcohol free from Chlorine	3s. lb.
Benzaldehyde free from Chlorine	3s. lb.
Benzyl Benzoate, 19·5° C.	3s. lb.
Cinnamic Aldehyde—98/100% Natural	14s. 9d. lb.
Citronellol	22s. 6d. lb.
Citral, 100%	10s. 6d. lb.
Ethyl Phthalate	4s. 3d. lb.
Eugenol, 100%	11s. lb.
Geraniol (Palmarosa)	30s. lb.
Geraniol	5s. 6d. to 12s. 6d. lb.
Iso Eugenol	17s. lb.
Linalol ex Bois de Rose	21s. lb.
Linalyl Acetate	22s. 6d. lb.
Methyl Benzoate	8s. 6d. lb.
Phenyl Ethyl Acetate	10s. lb.
Phenyl Ethyl Alcohol	17s. 6d. lb.
Rhodinol	45s. lb.
Terpineol	3s. lb.

ESSENTIAL OILS

Almond Oil	2s. 6d. lb. Quiet.
Anise Oil, Red Ship Brand	2s. 1d. lb. forward., 1s. 10d. to 1s. 11d. c.i.f. In poor demand,
Bergamot Oil	12s. lb. forward, 11s. 3d. to 11s. 6d. c.i.f. Quiet.
Bourbon Geranium Oil	26s. spot, forward 22s. 6d. Very firm, with good enquiry.
Camphor Oil, White	85s. cwt. No change. No Brown offering.
Cananga Oil, Java	9s. to 10s. lb.
Cinnamon Oil, Leaf, Ceylon	4d. to 4¼d. oz. Inclined to be easy.
Cassia Oil, 80/85%	8s. 6d. to 8s. 7½d. lb. Very strong demand. Spot stocks low.
Citronella Oil, Java, 85/90%	3s. 6d. lb. Steady.
Citronella Oil, Ceylon	3s. 1d. to 3s. 3d. lb. Advancing.
Clove Oil	7s. 3d. lb. Inclined to be easy in harmony with the market for spice.
Eucalyptus Oil, 70/75%	1s. 6d. to 1s. 10d. lb.
Lavender Oil	11s. 6d. to 13s. 6d. lb., according to percentage.
Lemon Oil, Spot	2s. 10d. to 2s. 11d. New crop for shipment 2s. 9d. More enquiry and slightly firmer.
Lemongrass Oil	2½d. oz. spot. Very quiet.
Orange Oil, Sweet	8s. 6d. to 9s. 6d. Quiet.
Otto of Rose Oil	20s. to 25s. oz.
Anatolian	24s.
Bulgarian	28s.
Palma Rosa Oil	17s. 6d. lb.
Peppermint Oil—English	70s. to 80s. lb.
Mayne County	13s. 6d. lb.
Japanese	7s. 3d. to 7s. 6d. lb.
Pettigrain Oil, Paraguay	7s. 6d. lb.

TRADE NOTES

Sampling of Imported Goods for Test as to Liability to Customs Duty

The Commissioners of Customs and Excise desire to draw the attention of importers and agents to the fact that when chemicals or other articles of value are sampled by their officers for the purpose of determining by analysis the question of liability to customs duty, any portion of the sample which may remain unused by the Government Chemist will be returned to the importer if a request to that effect is made to the officer at the time of sampling. In this connexion the Government Chemist desires to point out that the quantity used for test would in many cases be substantially reduced if importers would assist by furnishing information to the best of their ability as to the constituents of the articles sampled. Such information will be treated as confidential, and if preferred may be forwarded direct to the Government Chemist, Government Laboratory, Clement's Inn Passage, London, W.C. 2.

The Commissioners desire further to observe that in the case of compound articles not chargeable with duty as a whole, but merely in respect of one or more dutiable ingredients or parts, the assessment of duty would be materially facilitated and delay consequently avoided, if arrangements could be made for the value of the dutiable ingredients or parts to be shown on the invoice in addition to the total value.

An International Bill of Lading

The text of the draft International Bill of Lading Convention, passed by the Diplomatic International Conference at Brussels in October last, with a short history of the events leading up to drafting of this Convention, are contained in a booklet just issued by Messrs. Furness, Withy and Co., Ltd., a member firm of the Federation of British Industries, for the benefit of shippers and consignees. An earlier publication containing the text of the Hague Rules, 1921, upon which the International Convention is based, was in wide demand in shipping circles.

PUBLICATIONS RECEIVED

Richter's Organic Chemistry. Vol. III. Heterocyclic Compounds. *Translated from the eleventh German edition by* Dr. E. E. Fournier D'Albe. *Pp. xviii+326. London: Kegan Paul, Trench, Trubner and Co., Ltd.,* 1923. *Price* 25*s*.

Report of the Medical Research Council for the Year 1921–22. *Committee of the Privy Council for Medical Research. Pp.* 125. *London: H.M. Stationery Office,* 1922. *Price* 3*s*. 6*d*.

Die Luftstickstoff-Industrie. Dr.-Ing. Bruno Waeser. *Pp. vii*+586. *Leipzig: Otto Spamer,* 1922. *Price, paper* 11,200 *marks, bound,* 14,000 *marks, plus* 200 *per cent. increase.*

Cements, Limes and Plasters. *By* Edwin C. Eckel, C.E. *Second edition revised and partly re-written. Pp. xxxi*+655. *New York: John Wiley and Sons, Ltd.; London: Chapman and Hall, Ltd.,* 1922. *Price* 32*s*. 6*d*.

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EDITORIAL

PROFESSOR VON RÖNTGEN, whose death we regret to announce, made important discoveries and did much to increase our knowledge and to benefit mankind. He made such an addition to the earlier work of Crookes and Lenard as to well deserve the fame to which he attained. These workers had investigated the electric discharge in highly exhausted tubes containing a little gas, and they showed how cathode rays, which we now know to be discharges of units of negative electricity, were given off and how these could be studied and made use of. Professor Röntgen discovered a new radiation started by the discharge of cathode rays against a solid substance. A vibration, or radiation, is set up in the solid and communicated to the neighbourhood; this new vibration has a very short wave-length corresponding to the extreme ultra-violet spectrum of light. Its waves are so short that they can penetrate through solids opaque to ordinary light, but they have a considerable photographic power so that records may be taken, as Röntgen himself showed, of the structure of various opaque bodies, and by means of the developments made by Moseley, von Laue, the Braggs, and others, we can now obtain a photographic guide to the internal structure of opaque or transparent crystals. Röntgen was assistant to Professor Kundt at Würzburg, Professor of Mathematics and Physics at Hohenheim, Professor of Physics at Strasbourg, Giessen, Würzburg, and finally Munich. He received honours in many countries, and lived a long and useful life. His discovery, so soon as it was published, attracted unusual attention, and its possibilities in surgery, the arts and sciences, and in manufacture were at once apparent. In its scientific uses it has recently been supplemented by the positive ray, which in the hands of Sir J. J. Thomson and Dr. Aston, has led to such valuable results. The simplicity of X-ray work rendered its adoption in many branches of research speedy and widely spread.

How the X-ray photographs have helped surgeons to locate fractures, foreign bodies, or the results of disease, is known to us all. The extent to which X-rays will be of value in effecting cures is still a matter of doubt, but that Professor Röntgen's discovery has done much to alleviate human suffering is not open to argument. It was only last month that we recorded the discovery of a new element by means of X-ray spectrum analysis, and it may be confidently stated that X-rays have been as important to scientific investigations as they have been to the surgical and medical professions. During the last thirty years such great and interesting advances have been made in our knowledge of the various vibrations which matter can produce under suitable conditions that a whole new domain of science has been rendered available for exploration. Whatever discoveries will be made in the future, the work of the earlier workers will remain the starting point for those who succeed them. The advance of science would be impossible but for the outstanding discoveries of logarithms, the calculus, the microscope, the spectroscope, the Wheatstone bridge, the dynamo and the steam engine. On that splendid roll which includes the names of Napier, Newton, Liebnitz, Watt, Descartes, Crookes, Darwin, and Pasteur, Fame will also inscribe that of Wilhelm Konrad von Röntgen.

* * *

It is announced that the French Chamber of Deputies has, at last, passed the Bill authorising the convention concluded by Monsieur Loucheur in 1919 with the Badische Anilin- und Sodafabrik for the grant of a concession to manufacture synthetic ammonia at Toulouse by the Haber process. The imminent presentation of the above Bill was recorded in this *Journal* so long ago as in May, 1921, and the delay in obtaining official approval of the project has been due to no small extent to the sharp controversy over the respective merits of the rival Haber and Claude processes. Now, apparently, the controversy is to be decided by the sole final test, that of economic competition and, in view of the propaganda which has been conducted in favour of both processes in this country, the results will be awaited with interest, especially as it is understood that a modified form of the Haber process is actually being worked in the North of England. As might be expected, a storm of controversy has been raised in Germany by the passage of the Bill and the announcement by M. Loucheur that even if Germany refused to deliver the plant France had the necessary technical data to enable the installation to be erected and operated. The German Press angrily accuses the directors of the Badische Co. of having betrayed their country for 11,500 million marks (at present rates!) to the "hereditary enemy." But, as a correspondent of *The Times* remarks, the real source of this anger is the knowledge that ammonia is an essential ingredient of explosives, and significant reference is made to the heavy penalties imposed on two German chemists who tried to sell the secret of a certain dye process to American interests. We hope shortly to publish an account, contributed by our correspondent in Paris, of French views of the situation.

* * *

In our correspondence columns Prof. W. A. Bone draws attention once more to the desirability and urgency of finding a solution of the smoke problem. Prof. J. B. Cohen and Prof. H. E. Armstrong have already contributed opposing views on the subject, and Prof. Bone, who disagrees with the views of Prof. Cohen and supports those of Prof. Armstrong, suggests that as "coal and its combustion is a chemical matter," the Society of Chemical Industry should set up a committee to find some really practical solution of the problem that would command serious consideration. That the discovery of a really practical method of abating the smoke evil and ensuring economy in fuel consumption is no easy task is shown by the fact that two such distinguished chemists as Prof. Bone and Prof. Cohen fail to agree on the subject. Further, in view of recent experience of the Governmental attitude towards such questions, it is legitimate to wonder whether "departmental interference" would not nullify the effect of the constructive suggestions which would be evolved by such a committee. With these points in mind, we commend the pioneer work, mentioned by Prof. Bone, of the Technical Sub-Committee of the Federation of British Industries in advising manufacturers on fuel economy and smoke abatement. It is on such lines as these, directed towards enlightenment rather than compulsion, that we feel the question will ultimately find solution, for the problem is primarily one of economics and only secondarily one of sentiment. In the meantime, however, the pollution of our skies and the waste of our prime asset, coal, continue, and until these blemishes on our scientific reputation are removed constructive suggestions from our readers will be welcomed.

SOME EARLY YEARS AT THE CHEMICAL SOCIETY

BY SIR WILLIAM A. TILDEN, F.R.S.

EVERY Fellow knows that the Society was founded in 1841 and that the first President was Thomas Graham. But there are not many now remaining who have any personal recollections of the men or the doings connected with the first years of the Society, the oldest of the kind in the world. It was not a time of the greatest intellectual activity. On the Continent Dumas, in France, and Liebig, in Germany, were the chief authorities, and the great events on which public attention was concentrated were the International Exhibitions, of which the first was held in 1851 and the second in 1862. The first I remember only dimly, being a child at that time, but the two great exhibits were the Koh-i-noor and the great nugget of gold from the newly-discovered Australian goldfields. Of the second I have vivid recollection chiefly concerning the magnificent display of crystallised coal-tar dyes, the discovery of which had much to do with increased activity in the chemical world.

Previously to this time there were but few communications made directly to the Chemical Society, as all the chemists then engaged in research preferred to send their results to the Royal Society. The *Journal* of the Chemical Society during the first few years was made up chiefly of papers from foreign sources and from the Philosophical Transactions of the Royal Society. In 1862, however, a new series of transactions was started under the editorship of Henry Watts, who soon afterwards began the compilation of his famous dictionary. In 1862 I entered the private research laboratory of Dr. John Stenhouse in Rodney Street, Pentonville, and to him I owe my first introduction to the Chemical Society. Stenhouse has never received from the British chemical world the credit which is his due. A pupil of Liebig at Giessen, his first paper is dated 1839, and from that time till 1863 the catalogue of scientific papers attached to his name contains no fewer than sixty-four distinct memoirs almost entirely on subjects connected with organic chemistry, the most important of them relating to products from the lichens. A very remarkable record at any time, but all the more so when it is remembered that having been lecturer in chemistry at St. Bartholomew's Hospital, he was in 1852 deprived by a stroke of paralysis of the use of his limbs, so that from that time forward he was unable to perform any operations with his own hands, and was dependent wholly upon assistants. This did not, however, extinguish his enthusiasm in the pursuit of science. The constitution of one of the substances left by him has recently been made out by M. O. Forster (Picrorocellin. *Trans.* C.S., May, 1922, p. 816), and Field's rhymes in the little pamphlet called "A Chemical

Review," printed in 1863, bear witness to his fresh activity:—

> Stenhouse the veteran, game as any bird,
> We hail once more thy voice to science heard,
> Linguist of lichens, each fair herb and flower
> Hath yielded trophies to thy chemic power, etc., etc.

It was then owing to the influence of this good man that I was led to attend the meetings of the Chemical Society and though not yet twenty-one and really very ignorant, I can recall the meetings of those days, and in the mind's eye can see many of the men who were the leaders of the time. The meetings were held in a part of the building then undergoing reconstruction, the ground floor of which has since become the entrance to the RoyalAcademy. Visiting the building now, no trace of the meeting rooms can be discovered, as they have disappeared in the rearrangement of the entrance hall and adjoining apartments. The two rooms assigned to the Chemical Society were on the right of the main entrance, and appear to have been merged in the space where catalogues are now sold. There was, first, a small library, and it was used as a place of assembly, from which Fellows passed directly into the meeting room furnished with benches and a table, behind which the secretaries and the President sat. The first president I remembered was Hofmann, then a young and bustling personage, while the secretaries were Odling, a smart young man who often appeared in a white waistcoat, and had a lively way with him, and a disposition to treat things as a joke, which some of his seniors like Williamson, afterwards President, were inclined to regard seriously. His colleague was Redwood of the Pharmaceutical Society, a very dull personage who never offered a remark and is well described by Field as having a "stolid look and philosophic mien." He was succeeded as secretary by Harcourt and after this date seldom appeared.

Of the regular attendants at the meetings I can remember Perkin, a black-bearded man, one of the few who regularly engaged in research and brought papers to the Society, some of which, beside those on mauve and other colouring matters from coal tar, were of great theoretical and practical importance. Then there was Matthiessen, at that time lecturer at St. Bartholomew's Hospital whose researches on the preparation of the metals of the alkalis and alkaline earths by electrolysis resulted in the specimens of lithium and other metals which it is believed still exist in the chemical collection at the Imperial College of Science at South Kensington. He suffered from a nervous affection which caused twitching in the face and he died unhappily in 1864. He was an able man and an active worker. "Clever Müller, bald before his time," was a frequent attendant, also Abel, Frankland, Russell and others, whose figures I cannot now recall In those days, it must be remembered, ideas of constitution were based chiefly on the theory of types, and discussions at the meetings of the Chemical Society turned very often on the question as to which type particular compounds should be referred. I remember, for instance, a speaker saying, "you might as well refer nitrous oxide to the ammonia type," and the rejoinder of Odling with a smile, "I certainly should," after which the speaker shut up. Soon after this the influence of Gerhardt led to the recognition of the law of Avogadro, so long neglected, and the clear distinction between atoms and molecules, was at last recognised. Previous to that time, though the methods of taking vapour densities had been taught in the chemical schools, no one seems to have realised what they meant and the results were used chiefly to control the analysis of volatile compounds. The successful synthesis of such a compound as coumarin by Perkin was, therefore, an important achievement in the days of ignorance and uncertainty in which the paper was read to the Chemical Society, though probably this was not realised by the chemists who were present.

A great advance which had its effect on ideas in chemistry at that time arose out of the introduction of the spectroscope and the consequent discovery of the metals rubidium and cæsium and a little later thallium. The discovery of thallium by Crookes was, in the first instance, communicated to the columns of his own paper, *The Chemical News*, and afterwards to the Royal Society. Crookes was not at that time a regular visitor at the Chemical Society's meetings.

In 1864 appeared the two perhaps most active members of the Chemical Society—namely, J. A. Wanklyn and Ernest Theophron Chapman. The latter, a few years later, lost his life in an explosion at a chemical works in the Harz. But, for the first few years, they jointly kept up an almost uninterrupted series of papers to the Chemical Society, and, undoubtedly, did good work, which raised questions contributing in no small degree to the progress of chemical theory in England.

One of the earliest recollections I retain is of the lecture delivered before the Society in the rooms of the Royal Society, adjacent to those of the Chemical Society, by Berthelot on the subject of organic synthesis. Williamson, the new President, was in the chair, and the lecture, delivered in French, was illustrated by experiments. Here, for the first time, I remember seeing the absorption of carbonic oxide by hot caustic potash and other experiments. This was in the summer of 1863: a translation of the lecture is printed in the *Journal* of the Society for 1864.

The strength of the Society at that time was under 400, with a few Associates, a class of members which has since disappeared. The progress of the Society had been comparatively slow, both in numbers and in finance. It is true that some important contributions to science had been recorded as, for example, Williamson on etherification in 1851, but the number of men who were steadily devoting themselves to research was very small, and of these many devoted themselves to mere analysis of natural products such as tea, or enquiries into the composition of water supply, and questions of more or less practical importance. Even so late as 1864, water analysis was a subject which was frequently discussed, and a year or two later I remember being sent by the editor of the *Pharmaceutical Journal* to the Royal College of Chemistry in order to see the apparatus introduced by Frankland and Armstrong for use in their process. The article in the *Pharmaceutical Journal* in 1868 was probably written by me.

During the years referred to, the Society continued to meet in the rooms already described within the precincts of Burlington House, which had then become the property of the Government and was undergoing reconstruction with the view of providing accommodation for the Royal Society and other learned bodies, but it was not till 1874 that Professor Odling, then President, was able to congratulate the Society on having entered into possession of the rooms, which it has occupied ever since, and which he described as satisfactory in all respects except the meeting room. In 1882 alterations were introduced which converted the room into what it is now, with the presidential chair at one side and the seats for the Fellows all on a level. The lapse of time, however, has led to immense accessions to the number of Fellows and especially to the books in the Library, in consequence of which the rooms can no longer be considered so satisfactory as they were represented by Odling fifty years ago. Since that time, the Fellows of the Chemical Society have increased from a few hundreds to nearly four thousand, and the library, now used by members of several other societies, has grown proportionately, so that the apartments assigned to the Society by the Government are altogether insufficient for its every-day accommodation.

In this review one matter deserves to be mentioned, though I took no part. This was the existence of the dining club called the Bs, which met for dinner at 6 o'clock at the "Cheshire Cheese" and afterwards at the "Rainbow," Fleet Street. The club came to an end in the early 'seventies, but was soon followed by the formation of the "Chemical Club," of which the first secretary was Alexander Pedler, who continued to act until he went to India.

FROM HIDE TO LEATHER*

BY S. HIRST

THE object of tanning is to render stable and non-decayable animal skin, which in its original condition is easily putrefiable, to give it toughness and pliability, at the same time making it waterproof and durable.

The original pelts are of a very complex chemical nature, but by combining them with tanning agents definite chemical compounds are produced. These tanning agents are divided chiefly into two classes—vegetable and mineral tannages. Roughly speaking sole and upholstery leather is mostly vegetable tanned and upper leather and fancy leathers are mostly chrome tanned. Whichever process is used, certain stages in the process are common to both.

The raw skins are received by the tanner in various conditions. Some are delivered fresh from the butcher, others, which have to be kept for a time, must be heavily salted to preserve them, but in hot countries, where transport is difficult and salt is not easily procurable, the hides or skins are dried. The first thing the manufacturer has to do is to bring back these skins as nearly as possible to the state they were in when they were taken off the animal, and to accomplish this they are soaked in water.

When soft, the pelts are put into lime liquor. The liming process, and in the case of sole leather, the subsequent tanning, is usually carried out in pits sunk in the ground. Liming serves several purposes. It enables the hair to be removed, and it opens the fibres of the pelt, removing at the same time some of the cementing substance which binds the hide fibres together. Where the finished leather is required to be firm, the object in liming is to remove as little hide substance as possible from the pelt, but by means of the alkaline liquor, to swell the skins to their full original natural state, and saponify any of the natural grease that might otherwise show in the finished leather. Where the final leather is required soft, more of the internal hide substance is removed in the lime, and not so much attention is given to plumping the skins.

The next operation is to remove the loosened hair, and then any adhering flesh and tissue from the other side of the skin. Formerly, unhairing and fleshing was accomplished by hand, but now these two operations are usually carried out by machinery. It should be remarked that of the two sides of a hide or skin the "grain" is the outside on which the hair grows, and the "flesh" is the inside lying next to the animal. The skins of different animals have quite distinct and characteristic grain formations, and in this lies a means of identifying the skin from which a certain leather is made.

Having completed the liming process and cleaned the pelts of hair and flesh, they are now ready for tanning. Lime left in the skins after the liming process must, however, first be removed, and this is accomplished by the use of acid solutions. Different classes of leather require different treatment at this stage. In the case of sole leather, in which good substance is required, it is not desirable to remove completely all the lime, or the hides will fall and the substance be reduced, but for soft upper leather, all traces of lime are removed. With the finer leathers, such as glazed kid, in which the skins are required very soft and flaccid, deliming is accomplished by the use of fermentative substances such as dog-dung, though synthetic substitutes have been introduced with a view to overcoming the disagreeable nature of this operation.

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*Abstract of a paper read before the Bristol Section on Nov. 2, 1922

There are many methods of tanning different skins, and many agents capable of converting pelt into leather. The two most important methods of leather manufacture are, however, the vegetable and chrome tannages. The vegetable tannage is the oldest method, and to-day finds its chief importance in the production of sole leather, though there is also chrome sole leather. Vegetable tanning materials are many and varied, and consist of woods, barks, leaves, nuts and pods of several trees. Enormous quantities are imported from all over the world.

Although some of these vegetable tanning materials are received in the natural dried condition, vast quantities of solid and liquid extracts are used. These extracts are prepared by extracting the tannin from the raw materials with water, and concentrating the liquor thus obtained by evaporation.

Vegetable tanning consists in soaking the hides in infusions of these various tanning materials, different results being obtained by the use of different materials. The hide fibre absorbs the tannin, combining with it to form leather. The tanning liquors are prepared by leaching the tannin from the dry materials with water, and by dissolving tanning extracts, the desired results being obtained by blending.

The goods first of all go into very weak tan liquors, and proceed through the tanyard gradually, being removed into liquors of increasing strength until they are completely tanned. Too strong tan liquors have to be avoided at the commencement of the tannage, as the result would be to tan the surface of the hide too quickly, impeding tannage of the interior, and producing what is known as case-hardening. The aim in tanning sole leather is to produce a firm, solid and well filled leather, which is sold by weight. It must not be too heavily, nor yet too lightly tanned, and the demand for an article of good colour has to be borne in mind throughout all the processes.

Sole leather, of course, takes much longer to tan then dressing leathers, which receive a much shorter tannage, and are then curried with oils and fats. For upper leather (glazed kid for instance), which is sold by measurement, the tannage is very much lighter, and is completed in a very much shorter period. In dealing with vegetable tanned sole-leather, when the tannage is complete, the hides are left to drain for a while, and are then taken to the drying sheds. Before hanging up to dry they are given a coating of oil, which is usually cod oil, as this has been proved to be generally the most satisfactory. If the leather was dried out at this stage and used on boots, it would not resist water, would not stand hard wear and would get spongy in the damp. This is overcome by half drying the leather, and then laying it down in piles. In this process the moisture inside gradually becomes equally distributed throughout the pile, and the leather takes on a sort of indiarubber feel. Great care has to be exercised in bringing the goods to the correct temper for different processes. First of all they are struck out to make them smooth, and then in a dryer temper they are rolled under a heavy roller, which in their medium moist state solidifies the leather. It is then hung up and after drying is ready for use.

For vegetable tanned soft leather, such as is used for gloves, etc., the process would roughly be the same, viz.: Having removed all traces of lime by treating with acid, the skins would be tanned in weaker liquors made from materials which do not yield quite so hard or solid a leather, and would from this stage follow very much the same process as will be described under chrome tannage.

In the preparation of skins for upper leather, after liming and removing the hair and cleaning the flesh, every trace of lime is removed. In this state the skins will not keep long, and must be tanned as quickly as possible. Here again the process varies according to the nature of the skins, and the use of the finished leather, and this leads up to chrome tannages.

When goat skins are converted into glazed kid, the two-bath process is used, but chrome tanned leather for most other purposes is treated in the one-bath process. Chrome sole leather is made by the one-bath process, in which the hides are tanned in a basic chrome-salt liquor. This tannage is only a very light one, and weight and water-resisting properties are then imparted to the leather by impregnating it with hot waxes. The production of chrome sole-leather is a very much shorter process than that of vegetable-tanned sole leather.

In the two-bath chrome tannage the skins are first put into a chrome liquor, which is made by dissolving bichromate of potash or of soda in water, and adding hydrochloric acid. This turns the skins a brilliant yellow colour, due to absorption of the chromic acid. From this bath they are transferred to a liquor consisting of a solution of hypo and acid. The sulphurous acid evolved causes reduction of the chromic acid, which is fixed in the fibre as a basic chrome salt, the skins becoming blue coloured, and sulphur is deposited in the leather. It should here be remarked that in the manufacture of these lighter classes of leather, mechanical means are employed, and the tannage and subsequent operations are usually conducted in revolving drums or paddles. When the chrome tannage is completed, the skins are removed and thoroughly washed free from acid. The next process is dyeing, and if the skins were dried out at this stage, the leather would become hard and unworkable. To remedy this the skins are thoroughly drummed in a fat-liquor, which is an emulsion of soap and oil in water. After this they are dried out, stretched by machine to make them soft, and are then ready for finishing, the final operation to produce glazed kid being that of glazing the grain.

Careful control of the processes is necessary at every stage of manufacture. For instance, in the early stages in soaking back the pelts ready for liming, if the salt is not removed there will be a tendency for the pelt to remain tight and not swell properly. Too much soaking will result in the loss of hide substance, and the finished leather will be poor or thin and hard. Over-stale soaks, especially in warm weather, can result in considerable loss of hide substance in a comparatively short time. The same loss has to be guarded against, especially in the case of sole leather, in the liming liquors. These liquors do not discriminate in their solvent action on the hair roots and cementing substances, which it is required to dissolve, and true hide substance, and here the chemist is up against a difficulty as the Kjeldahl method will only show the total dissolved nitrogenous matter and does not discriminate between those substances which it is desired to remove and those which should be retained. Under-liming will not open up the fibres of the pelt properly for the ensuing tannage, whilst excessive liming will result in loss of hide substance and will produce a harsh-natured leather. Ammonia is, of course, evolved in the action of the lime liquor on the hide, and an excessive smell is a pretty sure indication that pelt is being lost. When skins are being prepared for upper leather, insufficient liming tends to produce a hard horny leather, which cannot be remedied.

Deliming processes also require very careful control. In the case of sole leather if all the lime is immediately removed the pelt falls and the substance, which is required plump, is reduced, but if lime is free on the surface of the hide when it is introduced into vegetable tan liquors a tannate of lime is deposited in dark brown patchy stains which unfortunately remain right through the process, spoiling the appearance of the finished leather and leaving it "cracky" if present in excess.

Where fermentative substances, such as dog-dung, are employed for deliming, as in the case of goat skins for glazed kid, even greater care is necessary, and the time and temperature factors have to be very carefully controlled. So rapidly can the bacterial activity develop, that lack of control can result in very serious loss.

The water supply is one of the most important considerations. A hard water containing a large proportion of lime salts, will certainly result in loss of tannin, and probably discoloured leather, if vegetable tanned. As is well known, iron salts react with tannin to give black-coloured stains, and so intense is the reaction that even a trace of iron in the water supply, or introduced from any other source, is fatal to the production of vegetable-tanned leather of good colour, and must therefore be strictly guarded against.

Vegetable tan liquors are all liable, in varying degree, according to the materials used, to fermentation with the production of acid. These acids serve to remove any lime remaining in the hide, and at correct concentrations they plump the fibre so that good substance is obtained, and it is therefore necessary to control and adjust the acidity to obtain the desired results. Too much acid, and in particular mineral acid, will result in hard leather, which will easily crack when dry, one of the dangers to be most strictly avoided.

In light leathers like glazed kid, which are tanned by the two-bath chrome process, washing free from acid after the hypo reducing-bath is very important, as any acid left in the skins will act on the fat-liquor forming fatty acids, which will ultimately "spue" out of the leather and show as a disagreeable greasy exudation on the surface of the finished leather.

Temperature plays an important role, but chrome-tanned leather will withstand much higher temperatures than vegetable tanned. The use of too hot liquors in the production of vegetable-tanned leather will shorten and destroy the fibre, and result in tender leather. On the other hand, successful dyeing, and fat-liquoring operations in the case of chrome-tanned leathers must be carried out in quite hot liquors. The fibre is not damaged, and, indeed, one of the tests as to whether a skin is properly chromed is to boil a piece in water. If the tannage is correct, the nature of the skin will not alter, whereas a piece of vegetable-tanned leather would be completely ruined.

Similarly, much higher temperatures can be utilised in the drying sheds to dry chrome leather, which, therefore, will dry more quickly than vegetable-tanned leather. If the latter is dried at too high temperatures, especially in the beginning, when the leather is wet, it will be likely to be hard and cracky when finished. The drying and finishing of vegetable-tanned leather (sole leather) presents many difficult problems. Oxidation of the surface tan liquor will result in dark colour. Chill winds and draughts must be guarded against, the atmosphere must not become too charged with moisture, and the possibility of mould must be precluded. Many types of plant have been devised to secure perfect drying conditions.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments of his contributors, but does not necessarily agree with them.

STILL MORE LETTERS

have reached me in reply to my question as to the outstanding discovery of the past thirty years or so. I am very much obliged to my correspondents, and welcome the interest shown in these columns. May I suggest to all of them that as their numbers seem to be increasing that their communications should be addressed to the Editor of this paper and marked "Eye-Witness" on the left hand top corner of the envelope. This will enable me to receive them by an early post and to comment at once on any items which may be of urgent as well as of sufficient general interest.

THE FIXATION OF ATMOSPHERIC NITROGEN

receives the first place in this week's letters. One or two of the writers are fearful lest I should overlook this great achievement. It is pointed out to me that at least four conditions must be fulfilled in order that a process may rank as a first class applied chemical achievement. (The word I used was "discovery," but let that pass.) It must be developed initially on sound scientific lines; it should show engineering skill; it should yield a product of wide utility; the product should be made at only a reasonable cost. I suppose the contact process for the manufacture of sulphuric acid fulfils each of these requirements, and also the catalytic production of hydrogenated oils, and possibly the Bakelite process satisfies the conditions. Pre-eminent, however, stands the synthetic ammonia process for the brilliance of the application of physical chemistry to its solution, and for the wonderful engineering skill displayed. But greatest of all we must recognise the profound influence which a cheap source of ammonia will exert on the most vital problem of the feeding of the rapidly growing population of the world by the intensive cultivation of the land with the aid of fertilisers.

POETICAL CONTRIBUTIONS

"R.T.M.H." seems to be unwilling to profit by the excellent counsel I recently gave him—or is it perhaps her? In his letter this week I notice no sign either of gratitude or of repentance. He denies the youth with which I credited him and I suppose he is:—

> "Now in wintry delights and long fireside meditation
> 'Twixt studies and routine paying due court to the Muses."

But a weekly scientific journal is for the diffusion of useful knowledge, not the gratification of poets—whether spring or otherwise. Let him consider the large majority of our readers, grave men thirsting for knowledge, who unroll this ample page rich with the spoils of time. What is it *they* desire?

> "The unhappy man, who once has trail'd a pen,
> Lives not to please himself, but other men."

"R.T.M.H." has indeed pointed out an error which probably the printer and everyone else concerned noticed so soon as the *Journal* was printed, but he has written nothing in answer to my warning which is at all to the point. Let him contribute a few articles to the *Philosophical Magazine* or translate Professor Smits' book on Allotropy into Esperanto, or do something else really useful and not squander his opportunities in frivolous verse. If, on the other hand, he cannot keep away from poetry, let him render Dr. Hicks' brochure on "The Analysis of Spectra" into harmonious hexameters; a nice little pocket edition of these would be a popular book, and if "R.T.M.H." is engaged in industry he should dedicate it to the Chairman of his Company; he may be rewarded by a seat on the board. Stranger appointments have been made!

I trust the Editor will not be too lenient with regard to flippant remarks or jesting rhymes; a due proportion should be observed between the suet and the currants, and we have not all got a sweet tooth.

THE CLERGY IN SCIENCE

I was very pleased to read a contribution in our journal from a north-country clergyman. I don't happen to know the district he describes, but it seems to be a pleasant one. Country parsons have often had the time and the inclination to work at Science; there were Gilbert White, who wrote the "Natural History of Selborne," Kirby the entomologist, and many others. And plenty of clerics have made valuable additions to Science—Pascal, Sedgwick and Priestley, if one's definition of a cleric is wide enough to include Roman Catholics and Unitarians. But the most striking example is perhaps Watson, who was Professor of Chemistry at Cambridge, afterwards Regius Professor of Divinity there, and finally Bishop of Llandaff, or Landaff as he always spelled it. I remember being rather interested to read how some time towards the end of the eighteenth century he discovered a means of improving the manufacture of charcoal and increased the efficiency of gunpowder so that a cannon could fire a sixty-pound cannon ball some 270 feet, about a hundred feet further than was previously possible. The range of artillery has improved a good deal since then. But whether the destruction of mankind is a suitable study for a bishop is open to question. I have a sort of idea that Schönbein discovered gun-cotton, but am not at all clear who made the other discoveries about explosives. Perhaps someone will tell us about these.

FORTHCOMING EVENTS

Feb. 15. The Institution of Mining and Metallurgy, the Rooms of the Geological Society, Burlington House, W. 1, at 5.30 p.m. "Liquid Oxygen in Mining," by A. James. "The Aneroid Barometer and Barograph in Engineering," by R. H. L. Lee. Succeeding General Meetings on March 15, April 19, and May 17.

Feb. 15. The Chemical Society, Burlington House, Piccadilly, W. 1, at 8 p.m. (1) "Spinacene: its Oxidation and Decomposition," by A. C. Chapman. (2) "Investigations on the Dependence of Rotatory Power of Chemical Constitution. Part XIX. The Rotatory and Refractive Dispersion of d-γ-Nonyl Nitrite," by R. H. Pickard and H. Hunter. (3) "Investigations on the Dependence of Rotatory Power on Chemical Constitution. Part XX. The Rotatory Dispersive Powers of Oxygen Compounds containing the Secondary Octyl Radicle," by H. Hunter.

Feb. 16. Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W. 1, at 6 p.m. "Some Mechanical Problems in the Rubber Industry," by H. C. Young.

Feb. 17. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Atomic Projectiles," by Sir Ernest Rutherford.

Feb. 19. Institution of Rubber Industry, the Midland Hotel, Manchester. "A Review of all Solvent Recovery Processes," by J. H. Wild.

Feb. 19. The Faraday Society, at the Chemical Society, Burlington House, W. 1, at 8 p.m. "The Law of Distribution of Particles in Colloidal Suspensions with Special Reference to Perrin's Investigations." Part II. By Prof. A. W. Porter and J. J. Hedges. "On a Relation between the Viscosity of a Liquid and its Coefficient of Expansion," by D. B. McLeod. "Crystal Growth in Cadmium," by M. Cook. "Electrolysis with an Aluminium Anode the Anolyte being (1) Solutions of Sodium Nitrate, (2) Solutions of Potassium Oxalate." "Electrical Potential of Antimony-Lead-Alloys," by S. D. Muzaffer.

Feb. 20. Society of Chemical Industry, *Birmingham and Midland Section*, the University Buildings, Edmund Street, Birmingham, at 7 p.m. A Special Meeting, under the Scheme of Co-operation with the Chemical Society. "Hydrogen Ion Determination," by S. R. Carter.

Feb. 20. The Royal Photographic Society of Great Britain, 35, Russell Square, W.C. 1, at 7 p.m. "On Static Trouble with the Kinematograph and Means for its Elimination," by A. S. Newman.

Feb. 22. The Chemical Society, Institution of Mechanical Engineers, Storey's Gate, S.W. 1, at 8 p.m. "Some Constitutional Problems of Carbohydrate Chemistry," by Principal J. C. Irvine, C.B.E.

Feb. 23. Ramsay Chemical Dinner, Grosvenor Restaurant, Glasgow.

Feb. 24. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Atomic Projectiles," by Sir E. Rutherford.

NEWS FROM THE SECTIONS

BRISTOL SECTION

The fifth meeting of the Session, held at Bristol University on Thursday, February 1, took the form of a joint meeting with the local Section of the Institute of Chemistry. Dr. F. W. Rixon presided over a large gathering, and Mr. Edward Russell, City Analyst for Bristol, read a paper on "The Necessity for a Change in the Milk Standard."

Mr. Russell said that milk standards first began to be applied in the middle of the nineteenth century, as the result of a Royal Commission's investigation. The instruments used then were rather crude compared with those in use now, but it led to an Act, which was passed in the 'sixties, which left no general standard. In 1874 general standards for various foods were fixed, the standard for milk being 9·0 per cent. of solids and 2·5 per cent. of cream, but in the 'eighties the standards were altered to 8·5 for solids and 2·75 for fat. Even then, however, there was no means of estimating fat accurately. The position now was that a man must be proved to have tampered with the milk before he could be fined in a court of law, but it was felt that the standard was still inaccurate. Improved processes had been developed, and it was found that good milk should contain 8·5 per cent. of solids and 3·5 per cent. of fat. In 1891 a standard was fixed by the Board of Agriculture stipulating 8·5 per cent. of non-fatty solids and 3 per cent. of fat. An average sample should contain, per cent., 3·9 of fat, 3 of casein, 4 of albumen, 4·75 of lactose and 0·75 of ash. There was no such thing as one standard combining the fatty and non-fatty solids. The composition of milk varied, both when taken from a single cow and when taken from a whole herd. In a number of tests he made recently, Mr. Russell found that the yield of 22 per cent. of 30 or 40 cows gave below 3 per cent. of fat on the morning's milk. There was a risk in taking 3 per cent. as the standard, some injustice might be done, and there were arguments that the standard should be reduced. But for blended milk, including the morning and evening milk of a herd, although there might be a hard case now and then, the 3 per cent. standard should be maintained. There were variations at various periods of the year, but the range might be taken as from 3 to 4 per cent. of fat and 8·4 to 9·2 per cent. of non-fatty solids. The average fat content shown was 3·4 per cent. in January; there was a fall until June, and the records rose in July until September, when there was a slight fall, but the average rose again until the end of the year to 3·75 or 4 per cent. A consideration of the seasonal curves for herds that had been milked and fed properly, suggested that the present standard was too low rather than too high. There was a similar alteration in the curves for non-fatty solids. In revising the standard the figures should be left as they were for January until the autumn and then strengthened, as the autumn milk was richer than in the rest of the year. There was a much bigger proposition, *i.e.*, whether milk was clean. Upon that a great deal of investigation had been carried out. He had prepared a table as the result of his experiments, but the Government had thrown over standardisation and decided upon a scheme by which milk might be sold in different classes, such as pasteurised milk. He suggested that standards of sediment and bacteria should be instituted for vended milk.

In the ensuing discussion Mr. O'Brien said that if the standard of fat were raised it would operate against farmers keeping breeds of cattle that gave large total yields of milk in which the percentage of fat was known to be on the low side and would also tend to make milk dearer. It was well known that when cows were milked at irregular hours, say at 6 a.m. and 4 p.m., there was a decrease in the percentage of fats. That occurred especially on Monday morning, because the cows had been milked earlier than usual on Sunday.

Mr. Russell, in replying, said that whilst economic considerations might induce farmers to keep cattle that gave a large yield, they could maintain the general standard of cream by including some Channel Islands cows in their herds.

Another speaker remarked that when cows had calves running with them they were not milked to the fullest extent. Some of the milk was left for the calf, and that portion contained the larger percentage of cream.

Dr. Rixon, in proposing a vote of thanks to Mr. Russell, said that the doctors disagreed about the sterilisation of milk, as boiling the milk destroyed the vitamins and boiled milk did not help the persons drinking it to develop the powers of germ resistance so much as unboiled milk did.

SOUTH WALES SECTION

Prof. Thompson presided at the meeting held in Cardiff on February 2, and Mr. E. A. Rudge, B.Sc., read a paper entitled "Notes on the Manufacture of Crucibles." Investigations on the physical properties of clays and graphites in mixtures were described, and it was pointed out that the measurement and definition of plasticity and refractoriness are still in an unscientific state, being based on empirical and loose standards. In discussing the process of weathering it was suggested that this seems to be connected with the fermentation of organic matter and oxidation of sulphides which produce flocculating substances; it is remarkable that graphite in mixtures oxidises more slowly when the particles are small than when they are large. The surface-factor principle is applicable to the clay-grog aggregates, the best results being obtained when a flaked graphite is arranged tangentially to the surface, but suitable bond clay and clay-graphite mixtures are not controlled so much by proportions or chemical formulæ as by undefined standards of refractoriness and binding power obtained by trial and error. The colloidal theory of plasticity was discussed, also the separation of clay by electrical endosmose and the possible application of this to crucible manufacture.

A discussion followed in which Messrs. Thompson, Bailey, Bird, Cox, Jones, Grounds and Webb took part, mainly on the general theory of the coagulation of clay and its binding power.

The annual meeting of this section will be held in Cardiff on March 2. Capt. Hugh Vivian has been nominated chairman and Mr. W. R. Bird vice-chairman for next session. Prof. C. M. Thompson, the retiring chairman, will give an address on "Rare Earths in Relation to Incandescent Lighting."

YORKSHIRE SECTION

The third meeting of the Session was held on January 29, Dr. L. L. Lloyd in the chair.

The first paper read was by Mr. G. W. Douglas on the Separation of Propionic Acid from Pyroligneous Acid. It was a critical examination of the methods hitherto proposed for estimating small amounts of this acid in acetic acid. These were based on differences in the rate of distillation, differences in volatility in a current of steam, solubility of their salts or fractional precipitation from solution, and all were found to be unreliable for the purpose and only moderately satisfactory when large proportions were present. Examination, too, of the basic salts did not give the desired results. In the course of a short discussion the possibility of a physico-chemical method, such as conductivity, was emphasised.

"The Colour Measurement of Brown Solutions" by Professor H. R. Proctor, was read by Mr. F. C. Thompson. The simple method devised by the author is likely to prove of considerable service in the tanning industry, depending as it does on an arithmetical relationship and not as is usual on a logarithmic one. It gets over the difficulty, too, of matching colours by a synthetic method, as these differ in differing lights, whereas by a spectroscopic one a match can be obtained which does not differ in different conditions of lighting, unless, of course, a chemical change is occurring.

Brown solutions are easy to deal with as the absorption spectrum measurements give a smooth regular curve and it is only necessary to measure 3 or 4 points on it. With ordinary analytical strengths, the relationship $c \times t = \text{const.}$ is exact where c is concentration, and t depth, and it is only necessary to have a standard.

This is supplied by a 20 per cent. iron alum solution, which, however, cannot be diluted, but the tannin extract can, as within limits dilution does not affect the colour. Half light is used and the depth of a tannin solution compared with that of the iron alum at three lines in the spectrum gives the colour measurement. The prism has been found not to be required and it is only necessary to use red and green glasses, but for the blue a cuprammonium solution is used. This makes for still further simplification. When the colour value given by the relation between the depth of iron solution and the depth of extract is greater than unity, the colour is darker than the standard. The apparatus was exhibited. For tannin work it is better and easier to use than the Lovibond Tintometer.

LONDON SECTION

A paper on "The Estimation of Fat in Casein" was read by G. T. Bray and F. Major, B.Sc., at the meeting held on February 5 (*cf. Chem. & Ind.*, Feb. 9, p. 127).

In this paper the authors state that a sample of Indian casein in which they had determined the percentage of fat by the Werner-Schmidt method to be 7·4 had also been examined by Gangolli and Meldrum in India, who found 0·24 per cent., using the Soxhlet ether-extraction method and subsequently confirmed their figure by the use of a new "absolute method" which they had devised (*Dept. Industries, Bombay Pres.*, 1921, *Bull.* No. 4; this J., 1921, **40**, 746 A.) The difference being of such a fundamental nature the published methods for the estimation of fat in casein were subjected to a comprehensive review at the Imperial Institute with the result that it was shown that the Werner-Schmidt method gives the most satisfactory results. Experiments were described showing that the fat is not completely extracted by ether from dry casein, using a Soxhlet extraction apparatus, even after a period of thirty-one hours. Concordant results were not readily obtained by the Rose-Gottlieb method; the results were low compared with those found by the Werner-Schmidt method, and in the former method it was often difficult to get the casein to dissolve satisfactorily in the dilute ammonia, even on warming.

The Werner-Schmidt method was found to give concordant and most reliable results. According to the details recommended by the authors, the casein is dissolved by warming with 4 parts of hydrochloric acid (sp. gr. 1·16) and 2 parts of water for forty minutes on a boiling water-bath prior to extraction with ether, the ether extract being extracted with petrol to isolate the fat. The contention that the fat obtained by this method contains products of the hydrolysis of the casein and that this method therefore gives results that are too high was shown to be wrong. Experiments carried out by the authors indicated that more favourable conditions for the hydrolysis of the casein do not influence the percentage of fat obtained and also that the petrol-soluble matter (fat) obtained does not contain sufficient nitrogenous hydrolytic products to vitiate the accuracy of the estimation. The method recommended by Gangolli and Meldrum was shown to be thoroughly unreliable and to give low and inaccurate results, as by this method the fat is not completely extracted. The casein does not dissolve satisfactorily in the caustic-soda solution used, and it was found that the whole of the fat is not removed completely by the one extraction with ether, which, according to the details of the method, is stated to be sufficient. The authors concluded by stating that their experiments showed that the Werner-Schmidt method was the best and most reliable method for the estimation of fat in casein and that the percentage of fat (7·4) found by them in a sample of Indian casein and considered by Gangolli and Meldrum to be inaccurate is correct.

BIRMINGHAM AND MIDLAND SECTION

In the continuation of the discussion on Fuel Problems held on February 6, Mr. E. C. Evans said that these problems had to be attacked from a national standpoint. The production of coke of uniform composition from different types of coal was equally important to the three great industries most dependent on fuel, viz., the iron and steel, gas, and mining industries. Mr. E. R. Sutcliffe and himself had shown that by utilising finely divided coal, a coke could be produced which, in chemical composition and physical characteristics, was much better than anything which had been adopted in the past; such a coke promised revolutionary economies in the production of pig iron. The production of smokeless fuel was primarily a question for the gas industry. Recent developments allowed of the production of such a fuel with, at the same time, a high yield of gas. With reference to the problems of the mining industry, many of the waste fuels of the country could be readily converted into a high-class industrial or domestic fuel by blending coals from different fields. The solution of many of the problems of fuel utilisation depended upon a national aspect of the question being taken, and on co-ordination of the research work in various districts.

Various aspects of coal firing was discussed by Mr. R. E. Keeling, who said that firing with powdered coal was new in this country. Two systems, the "central" and "unit" systems, were used; of these the "central" system, largely adopted in the United States, was responsible for the objection in this country to the use of powdered coal because of its liability to cause explosions. In the "unit" system coal was powdered as required. By using powdered fuel, the fuel consumption could be reduced by from 30 to 50 per cent., and low-grade coal costing from 5s. to 6s. per ton could be used, realising a saving in fuel of from 60 to 70 per cent. With "unit" plants working in the Birmingham district great economies had been obtained.

Dr. W. E. Smith advocated that gas undertakings should produce smokeless free-burning fuels instead of coke. No great headway would be made in the production of smokeless fuel until gas works produced solid fuel (free burning and smokeless) as well as gaseous fuel. Only in this way would the ideal solid fuel be produced at a reasonable price. Progress was being retarded owing to the patent position, but there was nothing in this that should inconvenience honest workers. Surprise was expressed at the action taken by one W.A.B. in raising the CO "bogey" in the correspondence columns of *The Times*: the nett result had been an increase in the number of people who preferred the "gas way" to end their lives than the more generally accepted ways. It was fortunate that the gas industry was well established, otherwise when it was found that wireless enthusiasts were courting dangers of explosions and fires by earthing their equipment to gas pipes, W.A.B. might demand an enquiry—by unbiassed men of the highest scientific attainments—to advise the Board of Trade as to whether it was safe for gas to be distributed in houses, inhabited by the poor, in iron pipes. Although it was important to increase the efficiency of production of fuel it was still more important to increase the efficiency of the utilisation of fuel. This had been done in connexion with lighting and gas fires, but much more required to be done in connexion with industrial heating furnaces.

SOUTH WALES SECTION

The last meeting was held at the Technical College, Swansea, on February 9, and Mr. F. G. Bloomer, F.I.C., presided, in the unavoidable absence, through illness, of Capt. Hugh Vivian.

Mr. H. B. Hitch read a paper on "Stainless Steel," which was illustrated with many lantern slides of micrographs and diagrams. As is well known, so-called "stainless" steel contains about 14 per cent. of chromium and 0·3 per cent. of carbon, and has the remarkable property of resisting atmospheric and subaqueous corrosion when the surface has not been deformed by cold working, such as drawing into wire. Some pieces of this steel were shown which were perfectly bright after six months under sea-water, as well as steam-valve seatings which after several months' use exhibited no signs of staining. The lecturer went fully into the properties and heat-treatment of various similar steels, containing larger and smaller percentages of chromium, and also touched upon stainless iron; an iron containing, per cent., chromium 11·7, nickel 0·57, manganese 0·12, silicon 0·08, and carbon 0·07, had excellent properties. A short discussion followed, in which Prof. C. A. Edwards advocated co-operation between chemists and metallurgists.

CHEMICAL ENGINEERING GROUP

The meeting held at the Chemical Industry Club, on February 9, was devoted to a discussion on "Leaching and Evaporating." Mr. J. A. Reavell (chairman of the Group) was in the chair.

Professor F. G. Donnan opened the discussion by giving a series of elementary formulæ which he had prepared as the result of a visit made during the war to Chile, where he investigated the working of six or seven nitrate factories. They were elementary mill formulæ, designed to improve the efficiency of the factories in question, which was very low, namely, between 50 and 60 per cent., instead of the 90 per cent. or more which ought to have been obtained.

The chairman then showed a number of lantern slides of modern leaching plants of the open and closed types for extracting tan from barks or wood. He drew special attention to a plant which was designed by Sir John Thornycroft during the war, for treating sugar, and was described as one of the best systems of leaching that had ever been designed. This apparatus gave a perfect counter-current effect, and was of the greatest use during the war, as the leaching systems for sugar, although very complete, were not as satisfactory as they could have been. Another form of leaching apparatus, which had recently been put to work in India, was a gas-agitation tanning extraction process. Indian barks differed from other barks, in that the fibre tended to block up the mesh or the perforated copper bottom of the apparatus; this was avoided by replacing the air for circulating by gas taken from the engines driving the mill, the gas engines using charcoal as fuel. Kauwa bark, which was used in this particular case, was found to contain 35 per cent. of tan, and also 40 per cent. of pure calcium oxalate. This oxalate was a by-product of the tan factory, and it might eventually be found that the tan factory would be a by-product of the calcium oxalate. It was found that it was difficult to get the charcoal ovoids made from the spent bark to burn properly, and after examination in the laboratory the surprising discovery was made that the Kauwa bark contained this large percentage of calcium oxalate.

Dr. Gordon Parker asked Mr. Reavell what objection he had to the press leaching system in preference to the battery system for bark or tanning material. The press leaching system saved steam, and he was surprised that Mr. Reavell in his plant should use a pumping system, which he considered as somewhat antiquated. One point about the Thornycroft plant was that it would help to save the cost of the leaking doors of the ordinary apparatus. If any material got around the edges of the door the average workmen just jammed the door in order to close it and did not trouble to remove the material; as a result even the best doors soon leaked.

Mr. P. Parrish said the question of leaching had got to be looked at from at least three points of view. He had had a good deal of experience in connexion with the calcining of cupreous pyrites, which was a totally different proposition from the one which Professor Donnan had dealt with. Professor Donnan's proposition was essentially the same as that which arose in preparing sodium sulphide, but even in that case there was a preliminary operation and all sorts of factors operating, which either assisted or retarded the efficiency of the leaching. In much the same way the efficiency of the extraction of copper was either assisted or retarded by the efficiency of calcination. Then there was a third case, such as that which arose in extracting ferrocyanides or spent oxide. Two years ago he visited a country somewhat allied to Chile, and had had a similar difficulty to that experienced by Professor Donnan, in that those responsible for the works had no efficiency figures. The result was that it had been necessary to determine, first of all, the overall efficiency of the extraction by leaching, which he found did not exceed 30 per cent. Then he had to determine in a very short time the source of this inefficiency, and he found that it was due primarily to the fact that they were using an inordinate quantity of lime in relation to the Prussian blue content of the spent oxide, and polysulphides were being formed which converted the ferrocyanides into sulphocyanides, thus causing loss. The leaching was by no means efficient, but even that did not account for the low overall efficiency of 30 per cent. In order to obtain satisfactory leaching with pyrites a special screening test must be applied to every variety of cupreous pyrites, and the physical condition must be correlated to the physical characteristics of the material. The same thing applied to spent oxides used at gas works. Spent oxide which was of a granular character after purification by hydrogen sulphide and hydrocyanic acid was reasonably porous and admitted of satisfactory leaching but if they took bog ores from Holland or Belgium, or even the German Lux, which contained alumina and also iron in a peculiar colloidal form, it was very difficult indeed to leach that material and to get it absolutely free from Prussian blue. He did not think there was any great difficulty in working to the 90 per cent. efficiency which Professor Donnan had indicated, but there was a tendency in a number of works throughout the country either to discard the mother liquor or to leave the material in a wet condition before it was discharged from the lixiviators, and a great deal of loss arose there, because after the first wash there was a highly concentrated solution that was occluded in the pores of the mass to be subsequently leached. All sorts of trouble arose by reason of the fact that the mass which was to be leached was not strained or pumped sufficiently well.

Dr. W. R. Ormandy referred to the extraction of soluble material from vegetable matter by cataphoresis, which had been worked out by Count Schwerin in Germany, and had been applied on a large scale for the production of sugar from sugar beet. A much purer sugar solution could be obtained in a concentrated form in that manner, but the actual cost of the apparatus and electric current was too great to render it possible as a commercial operation, whereas the cost of ordinary leaching was comparatively small after allowing for the first cost of the plant.

Mr. A. Reid criticised the Thornycroft leaching apparatus on the score that it seemed to be expensive, especially where a large volume of material had to be dealt with.

Prof. J. W. Hinchley thought that the formulæ given by Professor Donnan were by no means so unnecessary for some works in this country as might be imagined. His experience suggested that the efficiency in works in this country could be considerably improved by more careful methods of control. He regarded the Thornycroft plant as an extremely clever one, but it did not follow that the form shown on the screen was that in which it would be applied for every class of material. Such a high figure of efficiency as 90 to 95 per cent. might be purchased at too great a cost, and the real point to be borne in mind was ways and means of increasing efficiency without increasing cost.

Mr. J. A. Reavell, in replying, said that pumping was adopted in his firm's plant because it enabled the exact temperature at any time to be obtained; with the press leaching system that was not possible. The cost of the Thornycroft apparatus could, obviously, be considerably reduced by building it of wood. Prof. Donnan also briefly replied.

* * *

Prof. U. Pratalongo, of the Royal Higher School of Agriculture, Milan, has been awarded the Cagnola Prize of 2500 lire and a Gold Medal, by the Lombard Institute of Science and Letters for his paper on "The Importance of Catalysis and Enzymes in General, Biological and Applied Chemistry."

From Germany the following deaths are announced:—Prof. A. Fischer, director of the department of applied chemistry of the Technical *Hochschule*, Aachen; Dr. A. Schaitberger, chemist to the Siemens-Schuckertwerke; Dr. J. Vogel, director of the Bacteriological Institute of the University of Leipzig; Prof. K. E. Bessel, formerly director of the Physikalisch-Technische Reichsanstalt.

MEETINGS OF OTHER SOCIETIES

SOCIETY OF PUBLIC ANALYSTS

The Annual General Meeting was held in the Chemical Society's Rooms, Burlington House, on February 7, when the President, Mr. P. A. Ellis Richards, delivered his annual address. The following were elected as Officers and Council for the ensuing year :—*President :* P. A. Ellis Richards. *Past Presidents :* Leonard Archbutt, A. Chaston Chapman, Bernard Dyer, Otto Hehner, Samuel Rideal, Alfred Smetham, E. W. Voelcker, J. A. Voelcker. *Vice-Presidents :* F. W. F. Arnaud, F. H. Carr, G. W. Monier-Williams. *Hon. Treasurer :* Edward Hinks. *Hon. Secretary :* E. R. Bolton. *Assist. Hon. Sec. :* R. G. Pelly. *Other Members of Council :* H. Ballantyne, S. F. Burford, S. Elliott, B. S. Evans, E. M. Hawkins, Harri Heap, H. F. E. Hulton, Andrew More, A. E. Parkes, W. R. Schoeller, G. R. Thompson, and J. F. Tocher.

Of the two papers read, the first, entitled "Titanium in Nile Silt," was by Mr. E. Griffiths-Jones, who has examined silts from various parts of the Nile and determined the titanium by a colorimetric method after freeing the sample from silica. Amounts varying from 1·3 to 2·55 per cent. of titanium oxide on the dried silt were found, but an examination of Egyptian straw, a likely source of titanium, only showed 0·4 per cent. of titanium oxide on the ash.

"Notes on the Examination of Preserved Meats, etc." were read by Mr. Osman Jones, who stated that the presence of a trace of zinc chloride in the tin container (which sometimes arises through the use of this salt as a soldering flux) caused a more rapid absorption of tin by the food contents, and that the use of a sealing fluid containing a high boiling-point solvent gave the food material a disagreeable flavour. Methods for detecting such a solvent were given. The absorption of tin by the meat contents of a can was found to be greatest at the time of processing and almost to cease after about four months. The author also mentioned a test for agar in the presence of gelatin :—A dilute solution of iodine in potassium iodide gives a crimson colour with agar, whereas with gelatin an orange coloured precipitate is produced.

SIR JOHN CASS TECHNICAL INSTITUTE

The Annual Prize Distribution was held at the Sir John Cass Technical Institute on January 31, when the prizes and certificates were distributed by Sir Thomas Holland, K.C.S.I., K.C.I.E., F.R.S., Rector of the Imperial College of Science and Technology. The Chairman of the Governing Body, the Rev. J. F. Marr, in summarising the work of the Institute during the past session, said that during this period a total of 1,073 students had been in attendance, the highest figure yet attained. The year had not been an easy one, as financial considerations were still conspicuously in the foreground. Although the need of economy was realised, the best objectives of education were being, to some extent, lost sight of. The needs of technical education could not be satisfied, and progress would never be obtained without mutual trust and confidence between the public authorities and those administering the funds placed at their disposal and without a full belief in the national value of technical education. Despite the restricted accommodation in the Science Departments, 31 students had been engaged in research work and five papers had been published, bringing the total number of original investigations issued from the Institute to 120. Twenty-five students had been successful at University of London Examinations, six having gained the B.Sc. Degree with Honours in Chemistry. For the second year in succession a student of the Metallurgy Department had been awarded the First Prize (Silver Medal) in the City and Guilds of London Institute examination in non-ferrous metallurgy.

In an address on "Humanism in Technical Education," Sir Thomas Holland referred to the divergence of opinion and the clash of ideals that have long existed with regard to education, and after giving several examples of opposing views he stated that it was impossible to stress any one truth without apparently being unfair to some other truth. Did this apply to the education of the technologist ? He must become an expert in the workshop, but in addition he had duties as a citizen and must face relations with other human beings. In order to be appreciated he must understand and be understood by others, or in other words, he wants the "humanities." Scientists were liable to succumb to that form of pedantry which in classics exchanged humanism for grammar and rhetoric. We must not claim that science could give a mental training as good, when really we mean as bad, as that afforded by classics. Unfortunately this was the attitude assumed by some teachers of science who had yet to learn that the stimulation of curiosity would give human interest to a student's work, and was a large part of the teacher's task. Sir Thomas Holland concluded by stating that he would like to try the experiment of covering the syllabus of, say, metallurgy or chemistry by lectures on biography alone. He felt sure that students could be trusted to fill in the historical framework on their own account and to find out technical details for themselves, and whether they succeeded wholly or partially, they would be better men for having made an effort inspired by a natural and healthy curiosity.

Dr. Charles A. Keane, the Principal of the Institute, thanked Sir Thomas Holland for his inspiring address and gave a brief account of the activities and progress of the Institute.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

The newly-created "Fuel Group" held a meeting in Paris on January 31 at which Monsieur A. Kling, director of the Municipal Laboratory, read a paper entitled "What is Coal?"

After considering the treatment of coal at the pit-head, attention was devoted to the extraction of the valuable constituents of the coal and the utilisation of the residue as a fuel. A historical summary was given of researches on the origin and composition of coal, and it was pointed out that further investigation was required of the action of certain basic organic solvents, taking into account the benzenoid structure of the constituents of coal. An account was given of the work of Bergius, who has treated pulverised coal suspended in a hydrocarbon with hydrogen under a pressure of 230 atmospheres at a temperature of 430° C., and has transformed the coal, exception being made of the ash, entirely into liquid hydrocarbons of unknown constitution, but giving, on distillation, 30 per cent. of light fuel oils, 30 per cent. of Diesel-engine oils, 30 per cent. of fuel oil or binder for briquettes, and 10 per cent. of gaseous hydrocarbons. Monsieur Kling put forward the hypothesis that the chief constituent of coal consisted of a molecule formed by a substituted benzenoid or hydrobenzenoid nucleus, the molecule being capable of condensation by reactions similar to those leading to the formation of proteins from amino-acids.

At present it was considered that the main body of the coal mass had resulted from splitting of the lignocellulose molecule, followed by the destruction of the cellulose and finally the transformation of the lignone. In addition, the main constituent was mixed with products which were due to the breaking down of the pecto-, muco-, adipo-, and cuto-celluloses and represented the bituminous constituents of coal; the nitrogenous constituents were derived from degration production of plant proteins. In conclusion, Monsieur Kling reviewed the work of research organisations devoted to the study of fuels in England, Germany and France, and outlined an interesting programme of research on coal from the standpoints of chemistry, mining, gas production, geology, commerce and industry. This programme is to be considered by the French Coalmines Committee and the Société de Chimie Industrielle.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held on February 8, Sir William Pearce presiding in the absence of the chairman, Sir Max Muspratt, Bart., who was unable to attend owing to slight indisposition. The following letter was received from Dr. Carpenter intimating his acceptance of the position of Honorary Vice-President of the Association for life:—

Dear Mr. Woolcock,—The share I took in the formation of the Association will always be regarded by me with a certain satisfaction, for I believe I not only contributed thereby to the welfare of a great industry, but also to the well-being of the Nation it serves.

The friendships I have made in the Association have repaid many times over the small services I was privileged to give.

The honour your Council proposes was quite unlooked for, and in accepting it I can only say that I regard it as the greatest compliment British industry could bestow, and as such I shall ever value it.—Believe me, Yours very truly (Sgd.) Charles Carpenter.

Messrs. Oliver Wilkins & Co., Ltd., were admitted to membership of the Association.

The General Manager reported that over 30,000 sq. ft. of space had been applied for in the Chemical Section of the British Empire Exhibition, 1924. The question of a Scientific Exhibit in the Chemical Section was considered and the Council agreed to contribute a sum of £1000 towards the expenses in connexion therewith.

The Society's *Journal* was discussed and recommended to members as their advertising medium.

It was agreed to oppose the Oakham Gas and Electricity Bill, which seeks to obtain powers to make, produce, work up, convert, store, sell and deal in any products and materials directly and indirectly arising from or used in the generation, transformation or distribution of electricity and any by-products of coal, etc.

A letter from the Chief Inspector of Factories regarding the form of register to be kept in connexion with the inspection of bleaching powder chambers under the Factory and Workshop Act—Chemical Regulations—was considered.

The Council re-appointed Mr. W. J. U. Woolcock, C.B.E., as General Manager of the Association for a further period of five years.

Trade with Occupied Germany—Warning to Traders

The Board of Trade desires to draw the attention of British traders to the fact that, in virtue of recent measures taken by the French and Belgian Governments, the control of the importation and exportation of goods by firms situate or established both in the former Occupied Territory of Germany and the Ruhr, and the power of fixing the conditions under which import and export licences may be granted, is now vested in a Special Allied Committee. The German Government has, however, refused to recognise the validity of any licences issued by the Allied authorities in the Occupied Territory since January 23 for importation into, or exportation from the Ruhr or former Occupied Territory. Goods so licensed should, therefore, not be forwarded by any route which involves transit through German territory not occupied by the Allies.

MR. ARTHUR CAREY

Many of our members—more particularly those of the Liverpool Section—will learn with deep regret that for reasons of health Mr. Arthur Carey has felt it necessary to relinquish his position as District Manager of the Widnes and St. Helens Works of the United Alkali Co., Ltd. His father, the late Mr. Eustace Carey, played a very prominent part in founding the Society—he was President in 1906-1907—and Arthur Carey from the beginning of his career followed his father's lead and by papers and other means did all he could to promote its activities and aims. Recognition of his efforts led to his election to the Committee and later to the Chairmanship of the Section.

After an education started in London and completed with distinction at University College, Liverpool, he entered the service of the United Alkali Co., Ltd., in 1891, as assistant to the late Dr. Hurter. In 1892, when Dr. Hurter took command of the newly completed central laboratory, Mr. Carey was appointed Chief Chemist of the Company's Gaskell Deacon Works, and his efforts there are well illustrated in the *Journal* of the Society and in the Patent List, in problems relating to hydrochloric-acid condensation; improvements in the Deacon process; sodium hypochlorite manufacture, etc.

In 1897 he was transferred, again as Chief Chemist, to the Company's Sullivan Works, where developments along new lines necessitated skilled supervision and advice. Here, in addition to improving manufacture, he was largely responsible for instituting industries new to this country; more particularly as regards the manufacture of nitrochlorbenzene derivatives. This pioneer work proved of great importance in the war, inasmuch as a further step led to the production of picric acid from benzol instead of from the hitherto usual and practically unobtainable phenol. This development has played a large part in the founding of the dyestuffs industry in this country—how great such part may prove only the future can tell. In 1914 Mr. Carey succeeded the late Mr. Joseph Morrison as District Manager in the Widnes area. The advent of the war a few months after his appointment added materially to his work and responsibility, but his wide knowledge and practical experience enabled him to deal with the numerous new problems confronting the industry during that period.

Public work connected with education, pensions and unemployment also claimed not a small share of his time, and despite a visible failing in health he insisted on attending to his duties and was never known to spare himself. It is our sincere wish that the present period of rest will lead to such restoration of health as will enable him to do further work for the industry to which he has devoted his life's energies.

CORRESPONDENCE

ARSENIC IN MALT

Sir,—In the report of the meeting of the Nottingham Section of the Society of Chemical Industry, published in your issue of February 9 (of which I was not given the opportunity of seeing the proof in time for correction), my remarks are seriously misrepresented.

I said that (as is well known) malts formerly contained appreciable traces of arsenic, but I did not say that "this often gave rise to beer having a percentage above the legal limit," as this is not the case. For absolute safety to the consumer the legal limit was fixed by the Royal Commission at the extremely low figure of one hundredth of a grain to the gallon of beer (*i.e.*, only one part in seven millions). But present-day beers scarcely ever contain even half that amount—are, indeed, to all intents free from arsenic.—I am, Sir, etc.,

L. T. Thorne

Belmont, Surrey.
February 11, 1923.

"R.T.M.H." REPLIES TO "EYE-WITNESS"

Sir,—May I thank kind "Eye-Witness," who for my "moral state" feels sore, for warning me with such distress not to write verses any more. He knows, too well, the verse-fiend's fate; he clearly trod the same dark track, and, like the beery reprobate who sees youth, drunken, go to wrack and bids him halt ere he should be as blear and beery, so this seer attempts to give me pause. But he is much too late I greatly fear. My "youth" (assumed extreme) is far behind, and further, year by year, becomes. In time no doubt I'll mar the virgin sheet with prose. But this I promise, while I keep my brains, "verses which seems" and like remarks I'll miss, and try to write good grammar. R. T. M. H——s.

PROFESSOR ARMSTRONG AND THE SMOKE ABATEMENT COMMITTEE

Sir,—Having read Prof. J. B. Cohen's letter on the above subject in your issue of February 2 last, as well as Prof. H. E. Armstrong's recent strictures upon the Committee and its Report, I desire to express my general agreement with the latter's view of the matter, which (so far as I am able to judge) is widely held in industrial and technical circles.

The composition of the Committee did not inspire much confidence in its ability to deal with the subject comprehensively on really practical lines; and its Report is, to me, a singularly disappointing production, lacking in constructive thought and outlook. It would be interesting to know how many of its members were familiar from first-hand knowledge with the chemistry of coal, its gasification and combustion, with industrial heating operations, and with the wide range of practice comprised in modern fuel technology. For, unless the majority of them had such knowledge at first hand, how (it may be asked) could they possibly arrive at a sound judgment upon the evidence submitted by the 130 witnesses about how to abate smoke, or what was the use of them touring industrial centres "in order to inquire on the spot into the cause of the smoke and other nuisance from noxious fumes" or to hear complaints, etc. ?

What was wanted on the Committee was not so much the experience (valuable as it was) of people who had measured the evils of smoke and fog—which, indeed, are now so universally admitted as to be no longer in dispute—as of those who know how boilers can be stoked so as to give efficient combustion with a minimum of smoke, and could advise as to the most practical steps which could be adopted for the mitigation of industrial smoke generally.

It is, of course, high time that something really practical were done both to deal with the smoke nuisance and to promote fuel economy in industrial operations; but the subject is beset with complications and difficulties of all kinds, and amateurish incursions into it are to be deprecated. During the past three years the Federation of British Industries has established a Technical Sub-Committee which is doing good pioneering work in advising manufacturers as to economising in coal and, incidentally also, smoke abatement; but although this is a good beginning on right lines, it has so far only touched the fringe of the problem and needs to be extended. It is chiefly to such well-directed efforts, rather than to Government Committees and their Reports, that in future we must look for enlightenment and progress.

Seeing, however, that coal and its combustion is a chemical matter, why should not the Society of Chemical Industry set up a committee to consider the subject of smoke abatement and on what lines it may best be promoted by both education and legislation ? From such a body we might get something that would "cut ice" and be worthy of serious consideration. Meanwhile, chemists may feel grateful that Prof. Armstrong has called attention so incisively to the present unsatisfactory position of the matter.—I am, Sir, etc.,

William A. Bone

London, February 10, 1923.

EXPLOSIVES IN LIQUID AIR RECTIFICATION PLANT

Dear Sir,—In your editorial of February 9 you were good enough to refer to a paper read by me on the above subject before the London Section of the Society of Chemical Industry, and already published in the *Journal* of the Society. In the course of your remarks you wrote that "various explanations were suggested as to the possible origin of these" explosions. I feel that this phrase might quite inadvertently convey to some of your readers the impression that there was still some doubt as to the essential facts, and in view of the importance of the question to certain industries I write to emphasise the facts, firstly, that these explosions are caused by an accumulation of acetylene or other acetylenic hydrocarbons in the liquid oxygen bath of the rectifying column, and secondly, that these compounds are invariably formed if through lack of adequate cooling the lubricating oil in the air compressor attains too high a temperature. The only question as to which uncertainty still exists is, in my opinion, the exact nature of the impulse which leads to detonation of the highly explosive contents, so produced, of the liquid oxygen bath.

In view of these facts the necessity, firstly, for keeping cool an oil-lubricated air compressor feeding a liquid air plant, and secondly, for the most stringent precautions to avoid any possibility of acetylene entering the compressor from without, can not be too strongly insisted on or too widely known. Weight for weight a mixture of solid acetylene and liquid oxygen is an explosive very much more powerful than dynamite.—I am, Sir, etc.,

Ernest Fyleman

Sutton, Surrey.
Feb. 10, 1923

PERSONALIA

Mr. E. R. Bolton has been appointed to represent the Society of Public Analysts on the Federal Council for Pure and Applied Chemistry in place of Dr. Rideal.

* * *

With great regret we announce the death, at the age of 78, of Prof. W. K. von Röntgen, the discoverer of X-rays. The discovery that a Crookes vacuum tube emitted rays that would penetrate solid bodies was made almost simultaneously by Professors Lenard and Röntgen, and for this they were jointly awarded the Rumford Medal of the Royal Society in 1896. Not only has the application of the discovery proved of incalculable value in medicine and surgery, but in the hands of experimenters such as Moseley and Bragg it has been the means of throwing new light on the structure of the atom. Röntgen, who had been professor of experimental physics and director of the Physical Institute in Munich for many years until his resignation in 1919, and was an honorary member of the Royal Institution of Great Britain, was awarded the Nobel Prize for physics in 1901. His other physical work is not well known, but his method of determining the wave-length of shrill musical notes has been used in investigating the molecular structure of argon and helium.

NEWS AND NOTES

BRITISH INDIA

Glue-making in Madras

Germany formerly imported large quantities of tannery waste from the Madras Presidency, presumably for the manufacture of glue. During the war, the closure of Continental markets led to the accumulation of large quantities of fleshings, and the Madras Department of Industries attempted to utilise the material locally for making glue. The experiment was not completely successful, as the problem of getting the glue solutions to set in the high temperatures of Madras still remained unsolved. In 1917 a method of treating the fleshings was finally evolved which yielded a glue that set under the most adverse climatic conditions, and a glue factory was afterwards established in Madras. According to the *Indian Trade Journal*, the factory was closed for some time owing to trade depression, but re-opened early in 1921. Although the experimental stage is not yet passed, the factory has a capacity of 80 tons of glue a month, but at present is producing 3—4 t. per month from about 15 t. of raw materials. Import statistics reveal that the Indian demand for glue is larger than has been supposed; in the fiscal year 1920-21, 52 t. of glue was imported into Madras alone.

FRANCE

National Office for Scientific and Industrial Research and Inventions

By a recent law, this Office, which is situated at Bellevue and is directed by Senator J. Le Breton, was given financial and administrative autonomy. A decree has now been issued regulating the constitution and functions of this new organisation devoted to research and inventions. The Office is to be controlled by a National Council and an Administrative Council, the latter being appointed by the Minister of Public Instruction and including many of the best-known names of French science and industry. Chemistry is represented by Prof. Charles Moureu, member of the Institute, professor at the Collège de France, and president of the French Chemical Society.

GERMANY

Cultivation of Potatoes for Starch

Prof. E. Parow, head of the Berlin Research Institute for Starch Manufacture and Potato Drying, has written an interesting article in the *Zeitschrift für Spiritus-industrie* on the culture of varieties of potato rich in starch and possessing large starch granules. He shows by means of photographs the great variations in the size of granules from different sources, the range being from 0·002 to 0·087 mm. It is known that a potato with large starch granules will yield not only the greatest quantity but also the best quality of starch flour, and the content of large granules is important in such technical operations as drying and distilling, as well as from the standpoints of food-value, taste, and keeping quality. Such investigations as Prof. Parow has started are likely to be of economic importance.

GENERAL

Al Rāzi (Rhases) as a Chemist

The fame of Al Rāzī as a physician has tended to overshadow his achievements in other directions, especially in chemistry. Yet several chemical works of his are known and two, the "Book of Quotations" and an "Introductory Book to Chemistry," have been partially translated by Stapleton. Prof. J. Ruska, writing in the *Zeitschrift für angewandte Chemie* (1922, 35, 719—721), describes his discovery among the Arabic stone manuscripts in the Göttingen Library of a complete and systematic text-book of ancient chemistry which is undoubtedly the "Kitab sirr alassar" mentioned by Al-Nadim in 987. In the introduction to this work Al Rāzī says: "This book is divided into three sections which deal respectively with the knowledge of matter, of apparatus and of operations. Matter may be divided into three kinds—animal, vegetable and mineral. There are six varieties of mineral matter πνευματα, volatile substances, and σωματα, metals, rocks, vitriols, boraxes, and salts. The volatile substances are quicksilver, salammoniac, sulphur and zarruch (arsenic sulphides); there are 7 metals, 13 rocks, 5 vitriols, 6 boraxes and 11 salts." The author continues with a description of each substance and methods of distinguishing good and bad varieties together with processes for their preparation. The second part of the work describes apparatus for dealing with the metals and non-metals and the third part treats in seven sections of methods of changing one substance into another and includes recipes for the transmutation of base metals into gold and silver.

If this work is compared with various alchemical tracts of Greek origin of the same period, the fact that the former gives special prominence to experimental work, whereas the latter are chiefly concerned with mystical philosophical speculation, shows that chemistry had made greater strides among the Arabians and Persians during the eighth and ninth centuries than among the Greeks. Al Rāzī was evidently one of an advanced school of chemists who could answer, as the result of many careful experiments, many of the questions that were still puzzling the Greeks. Thus, in another book dealing with medicinal substances he describes the colour, taste, smell and method of powdering, burning, washing and subliming substances; the methods of preserving and preparing medicines and the duration of their action, their constitution and suitable substitutes were also known to him. This book also contains a dictionary of medicines in the Greek, Syrian, Persian, Indian and Arabic languages.

Prof. Ruska discusses the possible sources of Al Rāzī's chemical knowledge at some length, and comes to the conclusion that they are chiefly Persian. The Greeks at that time knew nothing of salammoniac, whereas this substance plays an important part in Al Rāzī's chemical theory, being one of the foundations of the theory of the transmutation of metals and also playing an important part in medicine. He had no knowledge of its formation from camel dung, as his supplies were obtained from Khorasan and Bokhara under the name of Nūsādir, a word which is probably of Bactrian origin. Most of the names of rocks, earths, artificial products and apparatus found in his books are of Persian origin, and in many cases were unknown to the Arabians and Syrians. They show by the middle Persian formation of the words that they were probably derived from the medical school at Gondeschapur.

Partition of Austro-Hungarian Industries

The distribution among the Succession States of the chemical and mining industries of the former Austro-Hungarian Empire is shown by the following figures of production before and after the war:—

		Former Austria-Hungary		Succession States			
				Austria	Czecho-slovakia	Hungary	Yugo-slavia
Paper	Metric tons	345,652	63,550	187,000	180,000	2,500	16,000
Sulphuric acid	,,	70,000*		10,000	36,000	12,000	9,000
Hydrochloric acid	,,	—	—	2,500	48,000	1,000	500
Soda†	,,	—	—	40,000	30,000	—	30,000
Caustic soda	,,	36,000	3,600*	—	12,000	—	7,200
Carbide, cyanamide†	,,	—	—	15,000	40,000	2,000	185,000
Matches	Cases (5,000 boxes)	340,000	100,000*	100,000	300,000	30,000	40,000
Coal	1,000 metric tons	16,460	1,320	87	12,675	864	61
Lignite	,,	27,378	8,954	2,600	24,800	5,700	2,997
Iron ore	,,	3,039	2,059	2,000	2,572	200	1,550
Copper	Metric tons	3,684	405	2,860	1,300	—	6,400
Lead	,,	22,312	1,137	4,400	3,457	—	10,900
Sulphur ore	,,	105,605	106,629	3,600	14,600	—	39,000
Graphite	,,	49,456	—	17,300	32,200	—	—
Petroleum	,,	1,063,200	—	—	—	—	—
Magnesite, burnt†	,,	—	—	200,000	100,000	—	—
Magnesite, crude	,,	—	—	40,000	3,000	12,000	—
Cement†	,,	—	—	750,000	900,000	670,000	800,000
Gold	Fine oz.	8,918·12	94,010·56	353·66	12,860·54	128·60	6,108·76
Silver	,,	1,750,120·23	280,588·17	69,125·41	1,527,189·31	—	—

* Output in 1913. † Capacity.

It will be seen that the paper industry is divided almost equally between Austria and Czechoslovakia, that the latter country is responsible for the bulk of the production of sulphuric acid, hydrochloric acid, and matches, and that Yugoslavia produces nearly four times as much carbide and cyanamide as Austria and Czechoslavia combined. Austria, however, has retained important deposits of graphite and magnesite, but has lost half the State salt mines to Galicia, and those in the Bukowina to Rumania. On a pre-war basis Austria could produce about 100,000 t. of salt in excess of her requirements; Czechoslovakia has to import it although she received about one-fifth of the salt resources of Hungary; the remainder of the salt deposits was allotted to Rumania. The bulk of the production of pig iron is centred in Czechoslovakia, although important branches of the iron-working industries remain in Austria. In general, most of the large industries are now to be found in Czechoslovakia and the smaller in Austria. Hungary has lost 50 per cent. of its iron and metal industries, but only 15 per cent. of its engineering industry.

Mianin, a Chloramine Disinfectant

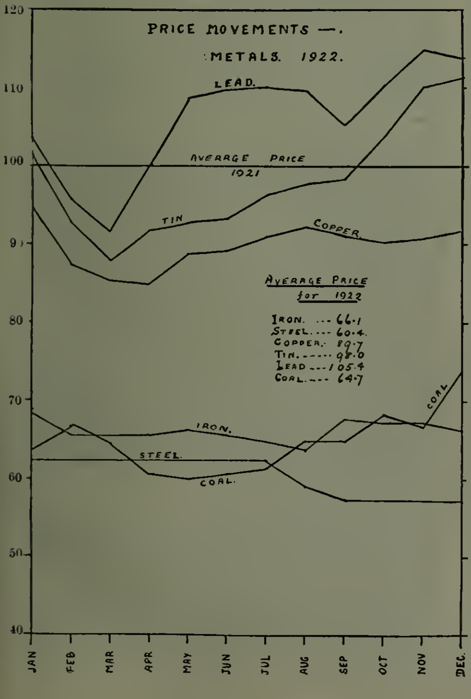
The disinfectant action of hypochlorous acid and its salts is well known and has been made use of in Dakin's solution, which can be prepared either from sodium or potassium carbonate and bleaching powder, or electrolytically, but is unstable. A similarly constituted solution, however, sold under the name of "Antiformin" remains unchanged for months. Bullier and Maquenne, in 1903 (D.R.P. 145,745), obtained a stable solid hypochlorite disinfectant by mixing 60 parts of bleaching powder and 40 parts of sodium sulphate, but this mixture has not achieved importance. A great advance was made in the discovery by Chattaway (in 1905) of the chloramines, compounds prepared by the action of hypochlorous acid on sulphonamides. Whilst certain of these chloramines are of little value owing to their insolubility (toluene-*p*-sulphondichloramide dissolved in chlorinated paraffin wax is known as "Clorcosan"), others, and in particular sodium toluene-*p*-sulphonchloramide, are of considerable practical importance. The last-named substance, having the formula CH_3— —$SO_2Na:NCl,3H_2O$, is prepared from toluene-*p*-sulphonamide and has been placed on the market by the Saccharinfabrik, A.-G. vorm. Fahlberg, List and Co., of Magdeburg-Südost, under the name of "Mianin." The same compound has been widely used in this country under the name or Chloramine T (*cf. Proc. Roy. Soc.*, 1916, [B], 89, 232, and this Journal, 1918, 37, 288 T), but the following notes on its properties, extracted from the *Chemiker-Zeitung* (1922, p. 1103) will be of interest. Mianin crystallises well and is easily soluble in water. It imparts a blue coloration to starch-iodide paper and can be directly titrated with potassium iodide and thiosulphate. It is an extremely powerful disinfectant, a 1:500,000 solution still acting with certainty. It is sold, for general disinfecting purposes, in tablets of 1gm., each containing 0·5 gm. of Mianin coloured with a yellow dyestuff, and also, as a deodorant, in the form of powder, containing 5 per cent. of the active substance. In aqueous solution Mianin is fatal, in 10 mins., to the following organisms at the dilutions stated:—Streptococci, 1:34,000; Diphtheria bacilli, 1:30,000; Pneumococci 1:22,000; Dysentery bacilli, 1:22,000; Typhus bacilli, 1:20,000; Coli bacilli, 1:18,000; Staphylococci, 1:16,000. It is practically odourless, and does not damage metallic objects or stain the finger nails. It may be used for disinfecting water, the taste of chlorine being no longer noticeable at a dilution of 1:20—25,000 and the disinfectant action persisting up to nearly 1:35,000. Mianin is non-poisonous and non-irritant, and can be taken internally in considerable quantity without harmful effects.

Naphthalene as a Wool Preservative

In a letter published in the *South African Journal of Industries* (Jan., 1923), Mr. A. A. Kloot, B.Sc., discusses the use of naphthalene for preserving wool. An inquiry into the cause of stains attributed to naphthalene gave the following results:—Coloured wools often contain as much as 0·5 per cent. of iron. Wool is sometimes treated with aloes, and if this comes in contact with wool containing iron, a stain is formed. This is not the stain generally complained of. A number of samples of discoloured naphthalene used contained traces of phenols. When wool was impregnated with these and then sweated in a steam oven, slight stains (as distinct from colourings) were developed, whereas stain did not develop when pure naphthalene melting at 79° C. was used. The stain is more marked with wools in the grease. Pure naphthalene, to which 0·05 per cent. phenol had been added, developed a marked stain. When the wool was first impregnated with a very weak iron solution, and the process with phenolic naphthalene repeated, a heavy stain which resisted the usual chemical bleaches resulted. These are the usual trade conditions in an exaggerated form. The results, although insufficient to form the basis of any definite conclusion, suggest that amino bodies in wool and grease are diazotised during fermentation, or by the oxidation of the ammonia set free—especially during the sweating process. These diazotised bodies couple with phenolic bodies to form dyes, which are fixed in the wool by the iron acting as a mordaunt. It seems that coloured naphthalene often contains phenols which are a source of stain in wool, so that only pure naphthalene should be used as a wool preservative.

Price Movements of Metals, 1922

The appended diagram, reproduced by permission from the *Bulletin of the Federation of British Industries*, shows the movements of the prices of iron, steel, tin, lead and coal during 1922.



Saltpetre in China

Not inconsiderable quantities of saltpetre-bearing earth are found in the Chinese provinces of Hunnan, Shantung, Chihli, and Chitiang as well as in Mongolia. The material does not occur in definite geological deposits, but the saltpetre is continually being formed by the action of organisms on ammonium salts in the presence of alkali carbonates derived from the weathering of the loess. The action is assisted by the favourable climate, as the temperature rarely falls below 5° C. (41° F.), and in summer rises to 37° C. (98° F.). Saltpetre is recovered from the loose earth by a crude method of leaching, which yields about 2 lb. of the crude salt per 100 lb. of earth. This product on purification yields a fine white crystalline product containing only potassium compounds, of which about 2000 tons is produced per annum. Both the Japanese and the Americans are beginning to turn their attention to these deposits which, with more scientific methods of working, should become very important.

Research on Fireproofing Wood

Recently Messrs. W. O. Banfield and W. S. Peck published in *Canadian Chemistry and Metallurgy* (6, 8, 172), the results of some experiments carried out under the direction of Prof. Archibald at the University of British Columbia to determine the effect of chemicals on the ignition temperature of wood. The furnace used was formed of two circuits of nichrome resistance ribbon mounted inside a suitable outer casing and was thoroughly heated and allowed to cool to 100° C. before insertion of the specimens. British Columbia Douglas Fir was cut into test pieces, 8″×2″×2″, which were dried at 90° C. to constant weight, and after impregnation with various chemicals, again dried to constant weight.

Four methods of impregnation were tried, namely (*a*) immersing the specimen in a cold solution, (*b*) immersing the specimen in a hot solution, (*c*) placing the specimen in a closed vessel and applying solution under pressure of 50 to 60 lb., (*d*) placing the specimen in a closed vessel, and after treatment under a vacuum for 5 minutes, again applying the solution under a pressure of 50 to 60 lb. Of these methods (*d*) gave the highest concentration of salt placed in the wood in one impregnation, the next best being method (*c*), whilst methods (*a*) and (*b*), although differing very little from one another, gave concentrations much below those obtained by the other methods. The results show that wood impregnated with cupric, bismuth, ferric, and stannic chlorides, alum and barium sulphates ignites below 290° C., and these chemicals can therefore be considered as fire promoters; ammonium and sodium chlorides, boric acid and aluminium sulphate have little effect, the burning temperature being 290 to 300° C.; whilst a fire-retarding effect, at a temperature above 300° C., is produced by zinc, magnesium, and calcium chlorides, ammonium sulphate and phosphate, borax, sodium silicate, zinc ammonium phosphate and a mixture of phosphate and borax. The best salt tested was ammonium phosphate, which evolves an incombustible gas and leaves a covering of orthophosphoric acid on the wood fibres. The authors conclude with a list of properties which an ideal fire-resisting medium should possess.

Chemical Industry in the Netherlands

There are more than a dozen large chemical factories in Holland. Two of these, situated in Amsterdam, work in connexion with the quinine factory at Bandoeng, Java, and produce all kinds of quinine salts. A cocaine factory, also in Amsterdam, manufactures, in addition to cocaine salts, homatropine, tropacocaine, and novocaine. Glycerin and organic chemicals such as vanillin, coumarin, pharmaceutical chemicals such as hexamine, silver salts, salol, various alkaloids and nitrogenous fertilisers are made in a factory at Naarden, which, prior to the war, supplied all the glycerin used in the dynamite factories for the South African mines. Flavouring extracts, soluble essences, floral attars, and therapeutic and pharmaceutical products are specialities of a factory in Amersfoort, and an Amsterdam firm makes, at Katwyk, theobromine, hexamethylene tetramine, caffeine, lecithin, quinine, and absolute alcohol. Caffeine is the chief product, the annual output being about 55,000 lb.; it also produces about 130,000 lb. of formaldehyde and quantities of urotropine and tannoform made from it. A firm in Amersfoort specialises in rennet extract, malt extract for the textile industry, butter colours, and a bleaching agent for treating oils and flour. Fertilisers, especially superphosphates, are made in increasing quantities in Zwyndrecht, milk sugar is produced in Uitgeest, and a company in Tilburg has a daily output of about 1 metric ton of coal-tar dyes and 200 kg. of intermediates. Apart from formaldehyde derivatives and superphosphate, Dutch chemicals are mostly exported. The exports during the first six months of 1921 and 1922 were as follows:—

	January—June 1921.	January—June 1922.
	Metric tons.	Metric tons.
Acetic acid	1,150	1,804
Essential oils and turpentine	45	82
Synthetic perfumery	48	102
Soda products	160	378
Potash, caustic, etc.	782	1,521
Magnesia	3,122	5,142
Sulphuric acid	3,150	4,521
Saccharin	7	16
Glue	615	947
Gelatin	314	582
Quinine sulphate	29	85
Flavouring extracts	72	97

Exports of chemicals in the first half of 1922 amounted to 42,198 t., valued at $6,958,722, compared with 25,054 t., worth $5,151,000, during the same period of 1921. Imports during the same period rose from 89,146 t. ($8,428,000) to 123,589 t. ($9,316,746), and included many raw materials as well as products not manufactured in the Netherlands.—(*U.S. Com. Rep., Oct.* 30, 1922.)

The Uses and Properties of Ethylene Glycol

An interesting article is published in the January 24 issue of *Chemical and Metallurgical Engineering*, describing the properties of ethylene glycol, a solvent, reagent, and preservative of unusual properties, which has become available through recent commercial developments. The pure liquid has the formula $C_2H_4(OH)_2$, and is water-white (sp. gr. 1·116), odourless, sweet tasting, and non-volatile. On exposure to air it attracts moisture, thus giving it valuable moistening properties. It has a low freezing point, and serves well to lower the freezing point of water solutions. It has many of the characteristics of ethyl alcohol, being miscible with water, and an efficient solvent for esters, medicaments, resins, flavours, and dyes, but has none of the intoxicating properties of ethyl alcohol, and is quite harmless when taken internally, even in large amounts. Ethylene glycol also possesses marked preservative properties against bacteria. It, however, is so new to industry that all its uses have not been ascertained, but it will probably eventually take rank with ethyl alcohol and glycerin as an industrial material. Already it has found application in the preparation of explosives and of glycol dinitrate as a solvent for cellulose esters, and it apparently may find uses similar to those of the glyceryl acetates used in the printing and dyeing of cotton.

Agricultural Industries in Jamaica

The report of the Jamaican Department of Agriculture for 1921 states that, although the year was favourable for agriculture, it marked a period of severe commercial depression. The sugar industry was saved from ruin only by prompt legislation, but now, in comparison with the neighbouring colonies, Jamaica is not unfavourably placed for further development. In consequence of the drought in 1920, exports of sugar in 1921 fell by 8000 t. to 26,000 t., the value declining enormously. Of the export of sugar, 55 per cent. was directed to Canada and 41 per cent. to England. The banana industry is rapidly regaining its pre-war position, but the export of coconuts declined from 28 to 24 millions, copra showing an increase in quantity but a reduction in value. A slight recovery was made by the logwood industry, exports of wood being valued at £28,000 and of extract at £109,000, compared with £269,000 and £431,000, respectively, in the previous year. Sales of orange oil were valued at £40,000 and the export of citrus fruit continued at the same level as in 1920. There was an increased export of both cacao and coffee, but values were much lower.

Exports of pimento rose from 3000 t. to 4000 t., valued at £11 per ton. The pimento-oil industry has been further investigated by the Industrial Chemist and it is stated that where pimento leaves and wood fuel are available, the manufacture of the oil would be profitable with pimento oil worth 8s. to 10s. per lb. in the world's markets. A local capitalist intends to establish a factory capable of producing 10,000 lb. of pimento oil per annum. The sisal industry is now beginning the manufacturing stage and three factories at Clarendon and the Government factory at Lititz will be in operation during the present year. Experiments at Lititz gave encouraging results, the fibre extracted rising to 5·7 per cent., and the yield per acre being 1433 lb. A crop of 200 t. of fibre is anticipated at Lititz in 1922–23 and in 1924–25 it should be 500 t., equal to the capacity of the factory. There was a poor demand for hides, but goat-skins valued at £21,000 were exported.

The Chemical Market in France

Since the beginning of January, quotations for oil of turpentine have risen from 635 francs per 100 kg. on rail at Bordeaux to 670 fr. (January 13). Consequently there is little demand, and purchasers are holding back. Quotations for industrial fats rose to 242·50 fr. per 100 kg. on the Paris market on January 12; there was a lively demand, but supplies were scarce.

REVIEWS

KOLLOIDCHEMIE, 1914—1922. *By* Dr. R. ED. LIESEGANG. *Pp. viii*+100. *Dresden and Leipzig: Theodor Steinkopff*, 1922. *Price* 3*s*. 4*d*. *net.*

This volume forms one of a series of "Wissenschaftliche Forschungsberichte," the object of which is to give a summary of the work accomplished in various fields of research during the period when the interchange of scientific publications was interrupted by the war and by economic conditions. Such a survey is particularly desirable in the case of colloid chemistry, important contributions to which are to be found in journals of the most varied kind. Dr. Liesegang has for many years edited the abstract section of the "Kolloid-Zeitschrift," and is thus well qualified for a task which he has discharged with skill and discretion. As the small volume gives well over 600 references these are necessarily brief, but they are sufficiently explicit and judicious to tell the reader what publications he ought to study in detail. The book will be found a most useful guide by all interested in colloid chemistry and its numerous applications.

Printing and paper are quite good, and the text is almost free from misprints.

EMIL HATSCHEK

THE THEORY OF EMULSIONS AND EMULSIFICATION. *By* W. CLAYTON, *with a Foreword* by Prof. F. G. DONNAN. *Pp. viii*+160. *London: J. and A. Churchill*, 1923. *Price* 9*s*. 6*d*. *net.*

Dr. Clayton's book is the first one to give a comprehensive account of a class of disperse systems, the importance of which, emphasised in Prof. Donnan's foreword, has been generally realised by authors of works on colloid chemistry. In most of these works some space is devoted to emulsions, although those emulsions which claim the chief interest are all much coarser than typical collodial systems.

After giving a description of the principal properties of emulsions and of the agents used to produce them, the author discusses in great detail the various theories which have been put forward to explain emulsification. Incidentally a clear account of adsorption and of the attempts to verify the Thomson-Gibbs formula quantitatively is given. The author—in common probably with most recent workers—seems to favour the adsorption film theory. Its bearing on the interesting, and still by no means completely explained, phenomenon of the reversal of phases also receives adequate treatment. These chapters furnish the reader with a lucid and impartial statement of the present state of our knowledge.

The title of the book does less than justice to its contents, inasmuch as the two concluding chapters on "Emulsification" and "De-emulsification" contain a great deal of technical information on large scale apparatus and procedure which has not been readily accessible so far. The large number of industrial processes in which the separation of emulsions forms an important and difficult problem may come as a surprise to many readers.

A very complete bibliography, going back to 1865, in which the reviewer has not been able to detect any omissions, completes the book and adds to its value.

Printing and binding conform to the high standard of the series, which includes this book, but it is not very obvious why the size of the page should have been altered from that of the other volumes.

EMIL HATSCHEK

CEMENTS AND ARTIFICIAL STONES. *By the late* JOHN WATSON. *Pp. xii*+131. *Cambridge: W. Heffer and Sons, Ltd.*, 1922. *Price* 6*s*. *net.*

The literature of cement and artificial stones is sufficiently plentiful, and it is a relief to find that this little book is neither a text-book nor a monograph, being indeed a museum catalogue.

To many the museum of the past must have resembled the valley of the prophet, which was full of bones—"and, lo! they were very dry." The question, "Can these bones live?" has been answered admirably by the late Mr. John Watson for the specimens in the Sedgwick Museum, Cambridge. No doubt there are now many similar catalogues, and the modern student is to be congratulated in that his path among the exhibits is not the arid track that his predecessors found it.

In the work before us 136 specimens arranged to illustrate the raw materials, intermediate products and finished manufactures of the industries in question are described for the student of economic geology. The point of view does not admit of discussion of chemical changes and constitution, which is a little refreshing to the chemist, to whom a couple of hours' reading without reference to colloidal chemistry is sometimes restful. The reasons for the selection of material, the processes of manufacture and the properties demanded of the products are, however, lucidly and interestingly expounded.

In the short historical introduction we are reminded that the great Portland cement industry will celebrate its centenary next year; the patent of Joseph Aspdin for the manufacture of a cement which, when moulded, closely resembles Portland stone, being dated 1824. The specification, we may hope, would not have passed the examiner of the present day, for when Messrs. White, of Thames and Medway fame, instructed their manager, Mr. I. C. Johnson, to imitate the Aspidin cement, he failed; this may have been partly due to the analyst to whom Johnson submitted the cement, for that worthy's report, which is set out in full in this book, contains no reference to silica, the main constituent being $Ca_3(PO_4)_2$! It is good to note that "subsequently the London chemist admitted that the analysis was incorrect." Johnson was equal to the task, however, as most will recollect, and lived to see the industry develop in a manner which has been equalled by few; he died in 1911, aged 100.

Commenting on the specimens of chalk marl, the author alludes to the possible extensive production of Portland cement near Larne, where the Antrim deposits of Senonian chalk lie close to marine clays well suited for the purpose; it may be hoped that specimens of Irish Portland cement will soon be added to the museum.

More than once occasion is found to criticise the constructional trades in respect of the lack of interest they show in the training of those whose business it is to apply cement, such as the man who is commonly called the concreter. The architect and engineer are exhorted to look to this, but it may well be submitted that the chemist is here at fault; the Chemical Engineering Group, please note.

The museum contains several specimens of proprietary articles; the descriptions of these smack somewhat too much of the trade circular, but since in most cases instances are given of buildings in the construction of which the materials have been used, the proportion of fact to fancy in the account given is probably greater than is common in the vendor's announcements.

The reviewer is left with the impression that he will live to reside in a house comprising little else than cement and its products; in the meantime he has to thank the author for a pleasant companion to an evening pipe.

A. G. Bloxam

REPORTS

Reports on the Economic and Financial Situation in the Republics of Panama and Costa Rica to September, 1922. *By* W. Ewing, *Acting H.M. Consul, Colon, and* A. Murray, *Acting H.M. Consul, San Jose. Pp.* 32. *Department of Overseas Trade. London: H.M. Stationery Office,* 1922. *Price* 1*s*.

Panama.—One result of the persistent stagnation of trade (*cf.* J., 1922, 136 R) has been the focussing of attention on the commercial welfare of Panama and on the development of local production and industry. Banana exports overshadow all others in importance. Sugar production is increasing and, it is anticipated, will soon be sufficient to supply the home demand. The American firm working the manganese deposits expects shortly to resume shipments from Nombre de Dios.

The total exports from Panama in 1920 were valued at 3,551,895 balboas (balboa=U.S. gold dollar). Full details are not given, but coconuts were exported to the United States to the value of \$364,531, and to the United Kingdom to the value of \$13,750; balata, U.S.A. \$26,722, U.K. \$65,952; medlar gum, U.S.A. \$12,318, U.K. \$39,129; sarsaparilla, U.S.A. \$2728, U.K. \$39,698. Imports, very varied in nature, were valued at \$17,326,430, of which the United States supplied 75·1 and the United Kingdom 9·1 per cent. In 1921 exports fell to \$2,495,407, of which the United States took 97 per cent. and the United Kingdom less than 0·5 per cent. Imports amounted in the same period to \$11,372,370, of which the United States supplied 75·2 and the United Kingdom 7·9 per cent. The volume of the trade of Panama with the United Kingdom was decreased largely in the past few years owing to the headway made by the United States during the war period. It is considered, however, that there is still hope of extending British trade, though at present the outlook is not encouraging. The British goods which have hitherto found the best market have been various textiles, alcoholic liquors, chemical products, castor oil, and soap.

Costa Rica.—The principal products of this country are bananas, coffee, sugar and cacao. Exports in 1921 were valued at £3,095,548 (£2,563,929 in 1920), the United States taking 68·1 and the United Kingdom 25·1 per cent. Among the items were:—Bananas, £1,511,369; gold and silver bullion, £161,660; manganese ore, £4598; sugar and panela, £125,293; coffee, £998,733. Imports decreased from £3,654,873 in 1920 to £2,390,600 in 1921, when the United States supplied 55·9 and the United Kingdom 16·9 per cent. Among the products supplied by the United Kingdom and Colonies were drugs and chemicals, £12,954; soap, £5024; paint, £4041; perfumes, £2817; china and glass, £7956; leather goods, £2966.

Report on the Economic and Financial Conditions in Paraguay, Dated September, 1922. *By* F. W. Paris, *H.M. Consul, Asuncion. Pp.* 19. *Department of Overseas Trade. London: H.M. Stationery Office,* 1922. *Price* 6*d*.

The recovery of Paraguay from post-war conditions (*cf.* J., 1922, 136 R) has been retarded by political unrest, and although industry has received a fresh shock at a most inopportune moment, optimism prevails as to future progress. In 1921 the "Scientific Society of Paraguay" was constituted at Asuncion and proposes to issue a review containing articles by experts. In April, 1922, a small firm, reputed to be supported by powerful British oil interests, applied for a concession granting the exclusive right to prospect for and exploit petroleum within 30 miles of Asuncion. Such concerns as breweries, flour mills, and soap and biscuit factories appear to be holding their own, but owing to slackness in the building trade, lime and brick factories, and allied industries, are passing through a critical period.

Quebracho extract (tannin) was exported in 1921 to the extent of 29,356 tons, or 5295 tons more than in 1920; the price at the beginning of 1922 tended to improve, but constant floods in the Chaco district, where the quebracho tree grows, made transport of the logs difficult during most of the year (see *Chem. & Ind.*, 1923, p. 19). The number of hides exported in 1921 was 190,813, against 198,965 in 1920, and 312,532 in 1913; this apparent fall is probably due in part to the clandestine export which has occurred since the imposition of an export tax in 1916. The output of sugar in 1921 is given as 2579 tons, 1200 tons less than in 1920 and insufficient for local needs. The 1921 output of rectified spirit, 366,409 litres, and of rum, 424,312 litres, is much below that of 1920. Cotton growing is still being extended, and the 1922 crop is estimated at 1000 tons. Exports from Paraguay amounted in 1921 to £1,863,344 (£1=5 gold pesos) against £3,037,116 in 1920. In 1921 the Argentine took 70·2 per cent., the United States 11·8 per cent. and Uruguay 8 per cent. of the total. Imports decreased from £2,623,701 in 1920 to £1,671,784 in 1921, when they included iron and steel valued at £359,074; chemicals, etc., £129,091; leather manufactures, £18,244; glass and chinaware, £17,099. Of the total the United Kingdom supplied 21, the United States 17, Argentina 39 and Germany 7 per cent. Probably a large proportion of the merchandise imported from Argentina is of British origin.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for February* 8)

TARIFF CUSTOMS EXCISE

Argentina.—It is proposed to introduce a new Customs tariff, under which the valuation tariff may possibly be increased.

Australia.—The "dumping exchange" duty has been applied to aspirin of German origin and the "dumping preference" duty to scientific glassware and apparatus of German origin.

Belgium.—The export is prohibited of bricks, tiles, scrap-metals, coal-tar, pitch and bones. A licence is required for the export of sugar.

Canada.—Under the British preferential tariff pulp board is admitted duty free, and under the other tariffs at the rate of 5 per cent. *ad valorem.*

French West Africa.—The "coefficient of increase" applied to the export duty on hides and skins has been raised from 1 to 5.

Morocco (French).—Increased consumption duties have been applied to sugar.

New Zealand.—Regulations have been issued controlling the application of the special duty on goods from countries with depreciated currencies.

Poland.—The consumption taxes on lubricating oils, paraffin wax, candles, asphalt, coke and tar have been increased, as have the excise duties on alcohol, coal, pressed yeast, matches and sugar.

United States.—Goods affected by the "countervailing" (retaliatory) duties include bricks, calcium acetate, chloride, nitrate and cyanamide, coal, etc., certain explosives, paper board and pulp board.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Galvanised sheets, tinplate, paper, chemicals, sodium silicate, soda crystals	189
Australia ..	Hardware, enamelware	155
,, ..	Iron and steel	156
,, ..	Copper sulphate (tender for)	10544/E.D./C.C./2
,, ..	Copper wire	10539/E.D./E.P.
,, ..	Ammonium chloride ..	10542/E.D./1/C.C./2
,, ..	Leclanché porous cells and earthenware outer jars	10542/E.D./2/M.C./2
Belgium ..	Copper bars, sheets, tubes	18519/F.W./E.P.
Brazil ..	Galvanised and black sheets, copper and brass bars, etc. ..	192
British India	Cement, soap, perfumery, paper, glassware ..	158
Canada ..	Tinplate, brass	159
France ..	Pharmaceutical products	171
Italy ..	Chile nitrate	174
Netherlands	Cottonseed oil	177
Norway ..	High-speed steel ..	178
,, ..	Copra	179
South Africa	Industrial raw materials	164
,, ,,	Oxygen gas	10549/E.D./C.C./2
Sweden ..	Cut glass	184
,, ..	Varnish, dyes	185
Syria ..	Potash alum	187
United States	Shellac	18088/F.W./C.C./2

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

There is little or no change to record in the chemical market. The demand for "heavies" continues well maintained in most directions, but any development of better trade is still hampered by uncertainties in the direction of foreign politics.

Acid Acetic, 40% tech.	£22 per ton. Firmness of position continues with tendency for price to rise.
Acid Hydrochloric	4s. to 5s. carboy d.d.
Acid Nitric, 80° Tw.	£25 10s. per ton. Still in very poor demand.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d. to £8 per ton. Rather quieter tone.
Arsenic (White)	£75 per ton. Shortage continues, but inquiry not quite so brisk.
Bisulphite of Lime	£7 per ton, packages extra and returnable.
Bleaching Powder	£10 10s. per ton. Not much change.
Calcium Chloride	£6 per ton d.d. Considerable quantities reported imported from Continent.
Copper Sulphate	£26 10s. per ton f.o.b.
Potash Caustic, 88/90%	£29-£30 per ton. No change.
Potass. Bichromate	6¼d. per lb. d.d.
Salammoniac	£32 per ton d.d.
Salt Cake	£4 10s. to £5 10s. per ton. Considerable American inquiry, but not much business passing up to the present.
Soda, Caustic, 76%	£20-£21 per ton. In slightly better request.
Soda Crystals	£5 10s. per ton carr. paid. No change.
Sod. Acetate, 97/98%	£23 10s. per ton. In fair demand. Price firm.
Sod. Bicarbonate	£10 10s. per ton. Still in fair demand.
Sod. Bisulphite Powder, 60/62%	£19-£20 10s. per ton f.o.b. or f.o.r. London.
Sod. Chlorate	Market very dull and prices not at all firm.
Sod. Nitrite	£30 per ton 100% basis d.d.
Sod. Sulphide, solid	£16 per ton carr. paid. Price unsteady and demand still very poor.
Sod. Sulphite, Pea Crystals	£17-£17 10s., 1-cwt. wooden kegs included.

WOOD DISTILLATION PRODUCTS

There is a brisk inquiry for products generally and prices remain firm or show a slight upward tendency. Charcoal is in good demand, particularly the higher grade home-produced retort variety. Naphtha prices remain steady and unchanged, but American quotations are falling, a factor that will speedily influence the home market.

Acetate of Lime—	
Brown	£9 per ton d.d.
Grey	£15 10s. per ton d.d., but prices as high as £19 per ton are reported for imported parcels.
Liquor	9d. per gall. 32° Tw. d.d.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	7s. ,, ,, 80% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 per ton d.d.
Brown Sugar of Lead	£38 per ton d.d.

TAR PRODUCTS

Acid Carbolic, Crude, 60's	2s. 6d. to 2s. 10d. per gall. Fair inquiry for spot and forward.
Acid Cresylic—	
97/99	2s. 3d. per gall. Good business being done.
Pale 95%	2s. 1d. to 2s. 2d. per gall.
Dark	1s. 10d. to 2s.
Anthracene Paste, 40%	7d. per unit per cwt. Price still nominal.
Anthracene Oil—	
Strained	9d. to 11d. per gall. Fair enquiry.
Unstrained	8¼d. per gall.
Benzole—	
Crude, 65's	1s. 1½d. to 1s. 2d. per gall. f.o.r. makers' works.
Standard Motor	1s. 8d. to 2s. per gall.
Pure	2s. to 2s. 2d. per gall.
Toluole—90%	1s. 9d. to 2s. per gall.
Pure	2s. to 2s. 2d. per gall.
Xylol	3s. 3d. per gall.
Creosote—	
Cresylic, 20/24%	10½d. to 1s. per gall.
Middle Oil	7¾d. to 9¼d. per gall. Good demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d. to 10d. per gall.
Solvent, 90/160%	1s. 7d. to 1s. 10d. per gall. Not much enquiry.
Solvent, 90/190	1s. 7d. per gall.
Naphthalene, Crude—	
Drained Creosote Salts	£6 to £7 10s. per ton. Market short.
Whizzed or Hot Pressed	£9 10s. to £12 per ton.
Pitch, Medium Soft	140s. to 150s. per ton f.a.s. Numerous inquiries, market strong.
Pyridine—90/140	10s. 6d. to 12s. 6d. per gall.
Heavy	8s. 6d. to 9s. per gall. Not much inquiry.

INTERMEDIATES AND DYES

Business in Aniline Dyestuffs has been good during the week. Orders have increased both in quantity and weight. Customers have got more confidence and are certainly buying freer with more tendency to look forward than in the past. Prices remain the same but firm.

Acetic Anhydride ..	1s. 5d. lb. 100% basis.
Acid H.	5s. 1d. lb. 100% basis.
Acid Naphthionic ..	2s. 7½d. lb., 100% basis.
Acid Neville and Winther	6s. lb. 100% basis.
Acid Sulphanilic ..	1s. 6d. lb. 100% basis.
Aluminium Chloride, anhyd...	1s.
Aniline Oil and Salts ..	10d. lb. naked at works.
Antimony Pentachloride	1s. 1d. lb.
Benzidine Base	6s. 6d. lb. 100% basis.
Benzyl Chloride ..	1s. 4½d. lb. 100% basis.
Dinitrobenzene	11d.-1s. lb. naked at works.
Dinitrochlorbenzol ..	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene—48/50 ..	8d.-9d. naked at works.
66/68 ..	1s. 2d.-1s. 3d. naked at works.
Diphenylamine	4s. 1d. lb.
Dichloraniline	2s. 2d. 100% basis.
Dichloraniline S. Acid ..	2s. 4d. 100% basis.
Diethylaniline	4s. 6d. lb., packages extra.
Metanitraniline	5s. 6d. lb.
Meta Phenylene Diamine	5s. 6d. lb.
Meta Toluylene Diamine	5s. lb.
Monochlorbenzol ..	£70 per ton.
α-Naphthol	2s. 9d. per lb.
β-Naphthol	1s. 1d. lb.
α-Naphthylamine ..	1s. 6½d. lb.
β-Naphthylamine ..	4s. 6d. lb.
p-Nitraniline	2s. 8d. lb.
Nitrobenzene	7½d. lb., drums extra.
Nitronaphthalene ..	1s. lb.
Naphthionate Soda ..	2s. 8½d. lb. 100% basis.
Orthonitrochlorbenzol ..	2s. lb.
Paradichlorbenzol ..	£55 ton.
Paranitrochlorbenzol ..	1s. 4d. lb.
Paranitrophenol ..	1s. 9d. lb. 100% basis.
Parachloraniline ..	3s. lb. 100% basis.
p-Nitro-o-amido phenol	4s. 6d. lb. 100% basis.
Para Phenylene Diamine	12s. lb. 100% basis.
Para Toluidine	5s. lb.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The general demand for pharmaceutical chemicals is still poor and most prices are unchanged in consequence. Stocks of some items are none too plentiful, and in the event of any material demand higher prices will be asked.

Acid Acetic, 80% B.P...	£45-£47 ton. Good inquiry. Prices have upward tendency.
Acid Acetyl Salicylic ..	3s. lb. Market exceedingly firm owing to continued increase in cost of raw materials.
Acid Benzoic	2s. to 2s. 2d. lb. Not much on offer for spot delivery.
Acid Boric, B.P. ..	£61 ton Crystals, £65 ton Powder. Packages in 2-cwt. bags. Carr. paid U.K. Market very steady.
Acid Citric	1s. 7d. to 1s. 9d. lb. A little more inquiry.
Acid Gallic	3s. lb.
Acid Pyrogallic, cryst. ..	5s. 6d. lb.
Acid Salicylic	1s. 6d. lb. Without much demand at this higher price.
Acid Tannic	3s. 3d. lb. Unchanged.
Acid Tartaric	1s. 2½d., less 5%, with foreign make in fair supply at 1s. 2d. lb.
Acetanilide	1s. 6d. lb. neglected.
Amidopyrin	14s. lb.
Ammon. Benzoate ..	Still 3s. lb. for good makes.
Ammon. Sulphocyanide	2s. 6d. lb. for recrystallised.
Barbitone	12s. 6d. lb.
Benzonaphthol	5s. lb.
Bismuth Salts	Prices per lb. for cwt. lots are as follows :—Carbonate 13s., Citrate 11s. 7d., Nitrate cryst. 6s. 11d., Oxide 14s. 5d., Salicylic 10s. 5d., Subchlor 12s. 8d., Subgallate 9s. 6d., Subnitrate 11s. Fairly good market.
Bromides	Still in plentiful supply. Market unsettled.
Chloral Hydrate ..	4s. 3d. lb. A firm market.
Formaldehyde, 40% ..	£90-£98 ton.
Guaiacol Carbonate ..	8s. 6d. lb. for small quantities. 8s. lb. would be accepted for 1-cwt. lots.
Hexamine	4s. lb. now asked for spot parcels.
Homatropine Hydrobromide	30s. oz.
Iron Ammon. Citrate— B.P.	2s. 5d. lb. Market steady but not much doing.
Green	3s. 1d. lb.
Magnesium Carbonate— Light Commercial ..	£40 ton.
Magnesium Oxide— Light Commercial ..	£85 ton.
Heavy Commercial ..	£29 ton.
Menthol	37s. 6d. lb., less 2½% for original cases. Small quantities 38s. nett.
Methyl Salicylate ..	2s. 3d. lb. Slightly higher.
Methyl Sulphonate ..	13s. lb.
Mercurials	Much weaker in view of the lower cost of quicksilver.
Paraldehyde	1s. 6d. lb.
Phenacetin	5s. lb. Unchanged owing to lack of demand.
Phenazone	7s. lb.
Phenolphthalein ..	5s. 3d. lb. Still asked but lower prices would be acceptable for definite orders.
Potass. Bitartrate 99/100% (Cream of Tartar)	97s. 6d.-100s. cwt. for ton lots, less 2½%. Market firm.
Potass. Iodide	15s. 8d. lb. for cwt. lots. Cases free. Demand still good.
Potass. Metabisulphite..	8d. lb.
Potass. Permanganate ..	8½d. lb.
Quinine Sulphate ..	2s. 3d.-2s. 4d. oz. Bulk packages. Fairly steady market.
Resorcin	5s. lb. now quoted for good "white."
Salol.	2s. lb. Unchanged.
Sod. Benzoate	2s. 2d. lb. Still in short supply.

Sod. Citrate	U.S.P. quality, 2 mols, water, quoted at 2s. 2d. lb. for cwt. lots. B.P.C. quality, 5½ mols. water, 2s. lb.
Sod. Salicylate	2s. for powder, 2s. 1d. for crystal. These prices show little profit to the manufacturers and higher rates are expected in the near future.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s., according to quantity, f.o.r. London, drums included.
Sod. Sulphite Pea Crystals	£17-£17 10s. ton, according to quantity.
Thymol	17s. to 19s. lb., according to quantity. Much firmer.

PERFUMERY CHEMICALS

Amyl Acetate	2s. 3d. lb.
Amyl Butyrate	8s. ,,
Amyl Salicylate	3s. 3d. ,,
Anethol, melting point 21°/22° C.	4s. 6d. ,,
Benzyl Acetate, from Chlorine free Benzyl Alcohol	3s. ,,
Benzyl Alcohol, free Chlorine	3s. ,,
Benzaldehyde, free Chlorine	3s. ,,
Benzyl Benzoate, 19·5° C.	3s. ,,
Cinnamic Aldehyde, 98/100% Natural	14s. 9d ,,
Coumarin	12s. 6d. ,,
Citronellol	22s. 6d. ,,
Citral 100%	10s. 6d. ,,
Ethyl Phthalate	4s. 3d. ,,
Eugenol, 100%	11s. ,,
Geraniol (Palmarosa)	30s. ,,
Geraniol	5s. 6d. to 12s. 6d. lb.
Heliotropine	5s. 9d. lb.
Iso Eugenol	17s. ,,
Linalol, ex Bois de Rose	21s. ,,
Linalyl Acetate	22s. 6d. ,,
Methyl Benzoate	8s. 6d. ,,
Musk Xylol	8s. 9d. ,,
Phenyl Ethyl Acetate	10s. ,,
Phenyl Ethyl Alcohol	17s. 6d. ,,
Rhodinol	45s. ,,

ESSENTIAL OILS

Anise Oil, Red Ship Brand	2s. 1d. lb.
Bourbon Geranium Oil	23s. 6d. for shipment, Spot 26s. lb.
Cananga Oil, Java	9s. lb. Firm.
Cinnamon Oil, Leaf	4d. oz.
Cassia Oil, 80/85%	8s. 7½d. lb.
Citronella Oil—	
Java, 85/90%	3s. 6d. ,,
Ceylon	3s. 3d. ,,
Clove Oil	7s. 3d. ,,
Eucalyptus Oil, 70/75%	1s. 10d. ,,
Lavender Oil, Mont Blanc 38/40%	13s. 6d. ,,
Lemon Oil. Spot	2s. 11d. ,, New crop for shipment, 2s. 9d.
Orange Oil, sweet. Spot	9s. 6d. lb.
Otto of Rose Oil—	
Anatolian	24s. ,,
Bulgarian	28s. ,,
Palma Rosa Oil	17s. 6d. ,,
Peppermint Oil—	
English, Mitcham	80s. ,,
Mayne County	13s. ,,
Japanese	7s. 3d. ,,

TRADE NOTES

Pasteur Centenary Exhibition

At the Pasteur Celebrations which will be held in Strasbourg in May, an exhibition will be opened, designed to show the advances made in the domains of medicine, hygiene, industry and agriculture as the result of the labours of Pasteur. All British manufacturers who are interested in the exhibition and are willing to assist, are asked to communicate with Professor Borrel, 3, rue Koeberle, Strasbourg.

Rubber Exports from British Malaya in 1922

An official cablegram from Singapore states that the exports of rubber from British Malaya in December amounted to 18,427 tons (41,276,500 lb.), as against 21,642 t. in November and 18,354 t. in the corresponding month of 1921. Transhipments amounted to 798 t. (1,787,200 lb.) and foreign imports to 4569 tons (10,235,000 lb.). The total export of plantation rubber from British Malayan ports in 1922 was, approximately, 248,157 t. Transhipments during the year amounted to about 21,838 tons.—(*Bd. of Trade J., Jan.* 11, 1923.)

Output of Coal, July—Sept., 1922

Statistical summary of output of the coal mining industry for Great Britain for the quarter ended September 30, 1922:—

	Output of saleable coal, less mine consumption and miners' coal.	Output of saleable coal per man-shift. cwts.	Earnings per man-shift. s. d.
Scotland	7,310,000	19·52	9 3
Northumberland	2,958,000	17·13	8 4
Durham	8,239,000	17·74	8 11
South Wales and Monmouth	10,737,000	16·74	9 7
Yorks, Notts, Derby, Leicester, Cannock Chase, etc.	17,577,000	20·50	9 11
Lancs, North Staffs and Cheshire	4,991,000	14·43	8 8
North Wales	620,000	12·91	7 11
South Staffs and Salop	364,000	17·43	8 0
Cumberland	413,000	13·64	9 7
Bristol	76,400	11·08	7 10
Forest of Dean	154,000	13·65	7 9
Somerset	170,000	13·45	7 2
Kent	84,000	19·82	12 10
Summary	53,694,000	17·94	9 4

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WEYLS METHODEN DER ORGANISCHEN CHEMIE. *By* PROF. J. HOUBEN. *Vol. II. Second edition, revised and enlarged. Pp. xxvii+1115. Leipzig: Georg Thieme,* 1923. *Price, paper 33s., bound 36s.*

ORGANIC SYNTHESES. *By* J. CONANT. *Vol. II. Pp. vii+100. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.,* 1922. *Price 7s. 6d.*

LEHRBUCH DER CHEMIE. *By* PROF. MAX TRAUTZ. *Vol. II. Pp. xxxiv+634. Berlin and Leipzig: Vereinigung Wissenschaftlicher Verleger,* 1922. *Price 25s.*

ALUMINIUM, INCLUDING BAUXITE AND CRYOLITE. *Statistics,* 1919–21. *Mineral Industry of the British Empire and Foreign Countries. Imperial Mineral Resources Bureau. Pp.* 31. *H.M. Stationery Office,* 1923. *Price* 1*s.* 6*d.*

OUTLINES OF THEORETICAL CHEMISTRY. *By* DR. FREDERICK H. GETMAN. *Third edition revised and enlarged. Pp. x+625. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.,* 1922. *Price* 18*s.* 6*d.*

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EDITORIAL

THE opening of the new Botanical Laboratory of the Imperial College of Science and Technology by the Duke of Devonshire, recorded elsewhere in this issue, marked further and most gratifying progress in the provision of facilities for training men capable of applying science to industry. Ever since its inception, the Imperial College has steadfastly kept this aim in view and due recognition of the importance and success of its work has been provided by the generous contribution by the Rubber Growers' Association of London of £30,000 towards the cost of the new building. That such a large sum should be contributed by representatives of an industry that has only just passed through the most difficult period in its history affords striking proof of the growing appreciation of the vast benefits that can be obtained by the judicious application of science to technological ends. No small credit is due to Professor J. B. Farmer, professor of botany in the Imperial College, for his foresight, over a quarter of a century ago, in anticipating the inevitable and growing demand for men with a training fitting them to investigate industrial problems. Plant technology is comparatively a new science, but its importance cannot be over-estimated, as it insures the supplies of raw materials that are essential to the industrial existence of this country. Calling, as plant technology does, for the collaboration of the botanist, zoologist, physicist and chemist, the words of an experienced rubber-grower, quoted by Sir A. Dyke-Acland, are of especial interest, as he asked not for rubber technologists but for men with a sound scientific training, because such men would learn more about rubber in a month on the plantation than in years spent in the laboratory. This advice, it would appear, has been acted on by the Imperial College, and its wisdom in so doing is exemplified by the erection of the new laboratory. Facilities are provided in the building for work in bacteriology, or what is now called microbiology, and in biochemistry as well as in pure botany, and it is to be hoped that, as in the past, the training will continue to produce whole chemists and whole botanists and not sterile hybrids.

The scientific journals and the daily newspapers have, during the last few days, contained quite a number of references to Hafnium and this element seems likely to produce an extremely interesting discussion. Professors Urbain and Dauvillier, in a letter published in *Nature* on the 17th instant, recall that two lines of the element whose atomic number is 72 were observed in the X-ray spectrum in the last fractions remaining after fractionating some nitrates of the ytterbium group. As these could not be attributed to any known element they were ascribed to a new element, celtium. (G. Urbain, *Comptes rendus*, t. 152, p. 141, 1911.) The other rays of this element seemed to coincide with rays of lutecium and neo-ytterbium. One of these French professors has recently investigated a sample of zirconium and finds that it produces rays which exactly coincide with the rays of the ytterbium fraction already mentioned; the wave-lengths of two of these lines have been found to be β_2-1322 and α_1-1564 U.X. According to Professors Coster and Hevesy, the wave-lengths of hafnium are α_1-1565, β_2-1323, so that the agreement seems to be good. Urbain and Dauvillier point out that the tetravalency of element 72 is not an objection to an element associated with the rare earths. Cerium is both tervalent and tetravalent and a constant equilibrium is maintained between the two varieties. Thorium also is always found in the ores of the rare earths, germanium is found with arsenic and molybdenum, and indium with zinc.

To add to the confusion it is now announced that the sample of "oceanium" which Dr. Scott sent to Coster and Hevesy does not show the X-ray spectrum of "hafnium." It is not yet perfectly clear whether the discussion and the experiments concern one element or two, or three, but in a few weeks this point should be cleared up, and we have good reason to hope that very shortly we shall receive communications from the five distinguished investigators who are working at this most fascinating problem. So soon as further information is available we will deal with the X-ray analysis of the rare earths and the elements which immediately follow them in greater detail than was possible in our previous notes on this subject.

The problem of the composition of coal is one which has, for a number of years, attracted many workers, and although progress has been made, and a vast mass of data accumulated, it cannot be claimed that we are, as yet, near the desired goal. This is hardly surprising, in view of the complexity on the material, and the ease with which it is decomposed. A large part of our knowledge of the nature of coal is based upon observations of the selective action of solvents on its constituents. De Marsilly in 1862 appears to have been the first to make a systematic study on these lines. Since that time much work has been done with benzene, chloroform, ether, phenol, pyridine, and other solvents, which has resulted in the separation of three fairly well-defined types of substances, namely, those insoluble in pyridine (the so-called α-compounds), those soluble in pyridine but insoluble in chloroform (β-compounds), and those soluble in pyridine and in chloroform (γ-compounds). As a natural consequence, perhaps, of our lack of definite knowledge of the subject, the nomenclature of coal is in an unsatisfactory state. The α- and β-compounds, which are derived from the vegetable celluloses and proteins, were formerly termed "cellulosic" compounds and the γ-compounds (resins, hydrocarbons, etc.), "resinic" compounds; whilst various other names, including humins, ulmins, etc., have been, from time to time, applied to the various components. It will also be recalled that coal can be separated, by hand, into four portions, "durain," "fusain," "clarain," and "vitrain," differing in appearance, but similar in composition and in the products they yield on heating. In a paper in the current "Transactions," Mr. A. R. Pearson puts forward a new terminology, in that he uses the names α- and β-ultrahumins in place of the above-mentioned α- and β-compounds, whilst he gives the name γ-ultrahumins to that portion of the coal substances which is soluble in pyridine and in chloroform, but is precipitated by ether. Mr. Pearson has studied the action of sulphuric acid on the separate ultrahumins, and has obtained a series of substances containing more oxygen than those from which they are derived; these he terms oxahumins, and he has further subjected them to the action of bromine. In both the oxahumins and their bromine derivatives the greater part of the nitrogen of the original compounds was retained, indicating the presence in the ultrahumins of a nitrogenous complex of considerable stability. The account of this work will be appreciated by those who are interested in this fascinating subject, but we may be permitted to question the desirability of adding a new phraseology to a subject regarding which so little definite is known.

THE BASIC STRENGTH OF AMMONIA AND ALLIED BASES

By PROFESSOR R. M. CAVEN, D.Sc.

In a recent number of "Chemistry and Industry" Professor T. M. Lowry has defined a base as "an acceptor of hydrogen nuclei," and has illustrated the acceptance of such nuclei or ions in the case of ammonia by the equations :—

$$NH_3+\overset{+}{H}\rightleftarrows\overset{+}{N}H_4 \text{ and } NH_3+HOH\rightleftarrows\overset{+}{N}H_4+\overset{-}{O}H$$

The purpose of the present communication is to develop this valuable idea, and to show how it elucidates the relations between ammonia and the ammonium salts, between ammonia and its alkyl derivatives, and between other non-metallic hydrides and their derivatives and salts. Since an aqueous solution of ammonia resembles one of sodium hydroxide in being alkaline it has long been supposed to contain ammonium hydroxide, NH_4OH. It has been assumed that when ammonia dissolves in water it combines more or less with the water to form ammonium hydroxide, which is then ionised to some extent thus :—

$$NH_3+H_2O\rightleftarrows NH_4OH$$

$$NH_4OH\rightleftarrows\overset{+}{N}H_4+\overset{-}{O}H$$

Whilst the hydroxidion concentrations of ammonia solutions of different strengths are known, no information has been furnished as to the proportion of non-ionised ammonium hydroxide present in these solutions.

That ammonia ordinarily behaves as a weak base cannot be disputed. The relative strengths of a number of bases in fortieth-normal solution are given by the following figures derived from the rate of saponification of methyl acetate which they cause (Walker: Introduction to Physical Chemistry, 8th ed., p. 311). Side by side with these are shown the hydroxidion concentrations of different ammonia solutions indicated by their electric conductivities (Bredig: Zeit. Physik. Chem., 1894, **13**, 269).

Base.	Relative strength.	Hydroxidion concentration of NH_3 aq.	
LiOH	100		
NaOH	98		
KOH	98		
$N(C_2H_5)_4OH$	75		
$N(C_2H_5)_3HOH$	14	N/100	4%
$N(C_2H_5)_2H_2OH$	16	N/10	1%
$N(C_2H_5)H_3OH$	12	N/1	0·3 to 0·4%
NH_4OH	2		

It may be noted that if lithium hydroxide in N/40 solution is assumed to be completely ionised, 2 per cent. of the ammonia in an equivalent solution is shown to have given rise to hydroxidions, and it appears that this degree of ionisation is roughly in agreement with that indicated by conductivity measurements.

The fact should be emphasised that the ammonia solution used as an analytical reagent contains upwards of 96 per cent., probably upwards of 99 per cent. of its ammonia as NH_3, apart from the assumption that any considerable proportion of non-ionised NH_4OH molecules are present.

Professor Lowry's view makes this assumption unnecessary and leads at once to the question whether ammonium hydroxide has any existence at all. Sodium hydroxide has been formed as an individual substance because sodions and hydroxidions have been produced in solution in sufficient concentration to be held together by electrostatic attraction. An alkaline solution of sodium hydroxide results from the dissolution of the union thus produced—union by electrovalency—through the action of the solvent. If ammonium hydroxide exists it must be formed similarly, by the mutual approach of its constituent ions. Ammonium- and hydroxide-ions are formed in aqueous solution of ammonia in low concentration. Is this concentration sufficient to cause electrostatic union so that individual molecules—if the term is now allowable—of NH_4OH are formed in solution ? The evidence for the existence of an electrolytic compound must be either that the compound has been isolated, or that it confers upon the solution in which it is said to exist distinctive and recognisable properties.

A hydrate of ammonia, $NH_3.H_2O$, exists at low temperature (Rupert, J. Amer. Chem. Soc., 1909, **31**, 866 ; Smits and Postma, Proc. K. Akad. Wetensch. Amsterdam, 1909, **12**, 186), but it cannot be asserted that this is ammonium hydroxide. If this compound were NH_4OH and it dissolved in water without decomposition it would produce, as will appear from what follows, a solution as strongly alkaline as, say, rubidium hydroxide. No properties of aqueous ammonia, however, compel belief in the existence of NH_4OH in solution.

The conclusion that this compound does not exist in solution in appreciable quantity is fortified by the fact that ammonium is an extremely strong basic radicle. It has been shown by Tutton (Chem. Soc. Trans., 1903, **83**, 1049), and by J. Ferguson in conjunction with the author (Chem. Soc. Trans., 1922, **121**, 1406), that in the series of the alkali metals ammonium occupies a very high place near to cæsium. It is unlikely, therefore, that in a N/100 solution of ammonia any but a minute quantity of undissociated NH_4OH exists, so that if this compound is formed at all this can only be because the interaction of its ions necessarily produces it. The difference between NaOH and NH_4OH in equilibrium with their ions in solution thus becomes clear : it is that the equilibrium is approached from opposite ends in the two cases. In the case of NaOH the ions are separated from the individual compound by dissociation ; in the case of NH_4OH the compound, if formed at all, is produced by the association of its ions. That is why we know that NaOH exists, but cannot affirm the existence of NH_4OH.

It may be objected, however, that progressive increase in relative concentration of $\overset{+}{N}H_4$ and $\overset{-}{O}H$ ions on dilution of ammonia solution appears to point to the progressive ionisation of previously existing NH_4OH. The alternative explanation is, however, simpler, viz. : that the more effective distribution of NH_3 molecules amongst the rarely occurring hydrions of water, or stated otherwise, the relative increase of hydrion concentration, when the solution is diluted, causes a relatively greater proportion of ammonium and hydroxide ions to be produced, *i.e.*, the effective mass action of water may be supposed to cause the direct formation of these ions rather than their indirect formation from NH_4OH.

Ammonia then forms so weak an alkali because it has little power of combining with the hydrions of water and there is no other means by which it can form alkali. This disability it shares with the alkylated ammonias so far as reacting with water is concerned. The case of tetraethyl ammonium hydroxide is quite different. This base does not depend for its formation upon a reaction with the hydrions of water, since it is produced by the interaction of tetraethylammonium iodide and moist silver oxide. It resembles sodium hydroxide in properties, and therefore when dissolved in water produces a hydroxidion concentration approaching that of the strong caustic alkalis. Thus an explanation is given of the great discrepancy in strength between $N(C_2H_5)_4OH$ and the three bases which follow it in the table.

That mono-, di-, and tri-ethylamine are about seven times as strong as ammonia shows, however, that the substitution of alkyl groups for hydrogen atoms increases the power of reaction with the hydrions of water. Nevertheless it by no means follows that the alkylammoniums are stronger basic radicles than is ammonium itself. There is little possibility of their being much stronger, since the ammonium ion itself approaches the cæsium ion in strength. Further evidence on this point is desired.

It may be pointed out in this connexion that ionic strength and ionic stability are not necessarily associated together. Ammonium is an exceedingly powerful ion, but it is not an exceedingly stable one. Ammonium salts are not very hydrolysable, but they appear to be more hydrolysable than the corresponding sodium salts. This is because the ammonium ion breaks down into ammonia, which leaves the solution on boiling, and hydrion, which produces acidity. This reaction is not really hydrolysis, since water does not act chemically on the salt.

The conclusions reached concerning ammonia and its derivatives may be applied to analogous compounds of non-metals other than nitrogen, *e.g.*, to the phosphonium, sulphonium and iodonium bases.

Phosphine is not basic enough to appropriate the hydrions of water to yield an alkaline solution; therefore it is concluded that phosphonium hydroxide does not exist. Phosphonium iodide, formed by the union of phosphine and hydrogen iodide is decomposed by water with the separation of hydrions thus :—

$$PH_4I \rightarrow \overset{+}{PH_4} + \overset{-}{I} \rightarrow PH_3 + \overset{+}{H} + \overset{-}{I}$$

The alkyl phosphines are more basic than phosphine itself, but less basic than the corresponding ammonia derivatives. Thus no alkylated phosphine appropriates hydrion from water to produce an alkaline solution; and the salts of the primary, but not those of the secondary or tertiary phosphines are decomposed by water. Tetra-alkylphosphonium hydroxide, formed by the interaction of the iodide and moist silver oxide is strongly basic and alkaline. Thus phosphine and phosphonium reproduce on a lower level of basic strength the properties of ammonia and ammonium.

With hydrogen sulphide the boundary line between base and acid has been passed; for instead of appropriating hydrions from water hydrogen sulphide in aqueous solution adds to their number. It is not surprising therefore that whilst the alkylated phosphines combine with acids to form salts, the alkylated sulphines, *e.g.*, C_2H_5SH and $(C_2H_5)_2S$, do not. Nevertheless the completely alkylated sulphonium halides $(C_2H_5)_3SX$, react with moist silver oxide, like the analogous ammonium and phosphonium halides to produce alkaline hydroxides, *e.g.* $(C_2H_5)_3SOH$. Thus a condition is reached in the case of sulphur in which hydrion cannot be appropriated in aqueous solution, even although it is present in the state of concentration furnished by a mineral acid. That an alkyl group can, however, be attached to the sulphur atom under other conditions emphasises the contrast between completely alkylated basic radicles and those in which one or more hydrogen atoms occur in place of alkyl groups.

The iodonium bases, *e.g.* $(C_6H_5)_2IOH$, show the extreme case of the phenomena under consideration, since hydrogen iodide, to which these are related, is, unlike hydrogen sulphide, an acid of maximum strength.

It is surprising that these bases contain aryl rather than alkyl groups, but this circumstance depends primarily on the power possessed by phenyl and other aromatic iodides to form additive dichlorides.

That $(C_6H_5)_2IOH$, formed in an indirect and unique manner, is actually alkaline, is the last and most striking example of the power of nonmetals to form basic radicles when attached to hydrocarbon residues. That this base is not stable enough to be isolated in the solid state is not to be wondered at. What are the relative basic strengths of the radicles :—

$$[\overset{+}{N(C_2H_5)_4}],\ [\overset{+}{P(C_2H_5)_4}],\ [\overset{+}{S(C_2H_5)_3}],\ [\overset{+}{I(C_6H_5)_2}],$$

is a question upon which information would be enlightening.

PASTEURISATION OF MILK

By JOSEPH RACE,
Formerly City Bacteriologist and Chemist, Ottawa

In this article it is proposed to review briefly the scientific evidence as to the effect of pasteurisation upon milk. Pasteurisation, as applied to milk, has, in the past, been a very indefinite term, but now that the new regulations are in force the term is taken to mean the heating of milk to 145° F., and holding at that temperature for thirty minutes.

CHEMICAL

Various claims have been made that chemical changes are produced during pasteurisation, and that they are the cause of various intestinal and nutritional disturbances.

The effect of heat upon the chemical constituents of milk was investigated by Rupp in 1913, and his conclusions were :—(1) Milk pasteurised by the holder process at 145° F. for 30 minutes does not undergo any appreciable change: (2) The soluble phosphates of lime and magnesia do not become insoluble; at 155° F. the quantity of phosphoric acid, lime, and magnesia in the serum of both raw and pasteurised milk is practically the same: (3) The albumin does not coagulate at 145° F., but at 150° F. 5·75 per cent. of the albumin is rendered insoluble; at 155° F. the quantity increases to 12·75 per cent., and at 160° F. it amounts to 30·78 per cent.: (4) The temperature required for coagulating the casein by rennin is slightly less in milk pasteurised at temperatures up to 149° F. than it is in raw milk; at 158° F. there is a slight retardation, whilst at 167° F. the time has almost doubled: (5) The acidity as determined by titration is slightly diminished in pasteurised milk.

The results obtained by the writer confirm the observations of Rupp that pasteurisation slightly reduces the acidity as determined by titration with phenolphthalein as indicator. A series of several hundred samples indicated that the average reduction was approximately 10 per cent., a value which is somewhat less than the normal variation in raw milk. The loss of acidity is due to the loss of carbonic acid gas (Van Slyke and Baker) during pasteurisation, and the amount is determined by the nature of the plant. Closed heaters and coolers will tend to re-absorption of the gas given off during heating.

Milk fat is comparatively sensitive to heat, and if the pasteurising temperature rises above 145° F. the physical condition of the fat globules is altered. At 150° F. a partial coalescence of the fat globules occurs, with the result that the cream rises rapidly in the finished product, but is diminished in volume. At 145° F. the cream line, *i.e.*, the percentage of cream, is unaltered. This fact is of the highest importance commercially, because a diminished cream line tends to reduce the value of the finished product.

TASTE

The flavour of milk is not changed by heating to 145° F. for thirty minutes. At a few degrees above 150° F. a slight " skin " is formed on the surface, oxidation occurs, albumin is precipitated, and the flavour is altered to that characteristic of heated milk.

ENZYMES

Numerous enzymes have been detected in milk, the chief ones being amylase, catalase, lipase, galactase, oxidase, peroxidase, and reductase. The nature and character of these bodies at once suggest that their origin is in the blood, and the epithelial and other cells derived from the cow. Some unpublished results of the writer indicate that the amount of reductase in milk is proportional to the butter fat content. Enzymes usually increase with the cell content, and it is possible that the cell content in normal milk is partially determined by the fat content. Inflammation in the milk cistern, secretory ducts, and teats increases the number of leucocytes in the milk and also the quantity of enzymes.

The presence of enzymes in milk may be considered as adventitious, and their effect upon it and the role that they play during digestion as hypothetical. Their activity is so small compared with that of the normal secretions of the alimentary tract as to be a negligible quantity. In view of the possibility that this may be incorrect, whatever data are available as to the effect of heat upon enzymes have been collected in Table I. :—

TABLE 1

Effect of Heat on Enzymes in milk

Enzyme	Authority	Weakened At temp. C.	Weakened in mins.	Destroyed At temp. C.	Destroyed in mins.
Galactase ..	Babcock and Russell	65–70	10	76–80	
	Von Freudenreich	65–70	30	75–80	
	Hippius	65	30		
Amylase ..	Koning			68	30
	Hippius			75–80	
	Race	68	30		
Lipase ..	Gillet			65	
Lactokinase	Hougardy ..			75	30
Oxidase ..	Marfan			79	
	Hippius			76	
Peroxidase	Wender			83	
	Schardinger ..			80	
	Ostertag			80	
	Lythgoe	70	30	75	30
	Race	68	30	73	30
Catalase ..	Von Italic ..			over 70	
	Lythgoe	65	30	70	30
	Race	68	30	71	30

When the difference between the samples experimented with is taken into consideration, together with probable variations in the acidity, the above results are very concordant and show that there is no reduction in the enzyme content when milk is heated below 150° F. for thirty minutes.

BACTERIOLOGICAL

Bacteriology, as a science, is much less exact than chemistry, and the results obtained by its application are less definite and more open to controversy. The more or less empirical methods employed by bacteriologists make it difficult, if not impossible, to compare the results obtained by different workers; and the problem is complicated further by the interpretation placed upon pasteurisation in the past. For the present purpose it will suffice to consider only those results obtained in recent years in which the heat treatment is definitely stated.

One of the most serious criticisms of pasteurisation has been the allegation that it interferes with the normal process of souring. Russell and Hastings state :—" The lactic bacteria do not form spores and hence are easily killed if milk is heated. If milk is pasteurised and subsequently kept free from lactic bacteria it will not sour but will putrify, due to the development of the spores not killed by heating."

This phase of the problem was the subject of a very considerable amount of experimental work in the Dairy Division of the U.S. Department of Agriculture, and the results, briefly stated, are that pasteurisation of milk at 145° F. for thirty minutes reduces the total number of bacteria of all kinds, but increases the relative proportion of acid-forming organisms. These results were confirmed in the writer's laboratory in Ottawa, in 1914, when a series of commercial samples gave the following proportion of acid and proteolytic (protein splitting) groups.

	Percentage of Groups Proteolytic	Percentage of Groups Acid forming
Raw milk	12	35
Pasteurised milk ..	2	49

The difference between these results and those of earlier workers is explained by the variation in the heat treatment. When milk is heated to 100° C., the vegetative forms of organisms are destroyed and only the spores remain. As spore formers are usually putrefactive and non-acid forming such milk would putrefy and not sour in the normal way. The treatment at 145° F. does not destroy the whole of the non-sporing forms, but merely reduces the number to a relatively low figure. These develop later and produce normal souring. The results obtained by Ayers and Rupp, and the writer, indicate that the acid-producing organisms are more resistant to heat than are, in general, the protein-splitting ones. A few typical examples from the writer's results are given in Table II. :—

TABLE II

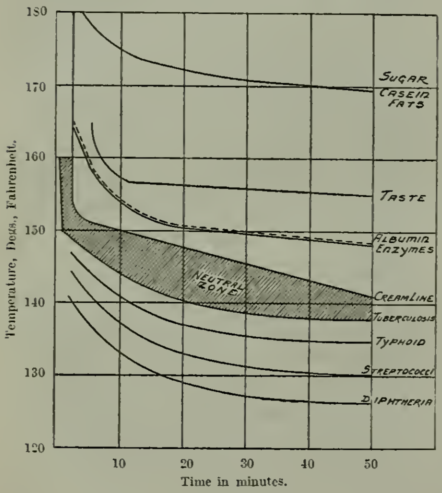
Effect of Treatment at 145° F. on Milk Organisms

Duration of treatment in minutes	Acid producing organisms 1	2	3	Proteolytic organisms 4	5
0 ..	6,100,000	80.000.000	71,000,000	15,000,000	40,000,000
10 ..	2500	100,000	150.000	110	700
20 ..	127	400	1400	10	40
30 ..	96	380	720	4	16
Percentage undestroyed	16×10^{-4}	$4{\cdot}7 \times 10^{-4}$	10×10^{-4}	$0{\cdot}3 \times 10^{-4}$	$0{\cdot}4 \times 10^{-4}$

It is important to note that the bacterial count was not reduced to zero per c.cm. with any of the organisms used.

Further corroborative evidence was obtained during the examination of 98 samples of pasteurised milk by the fermentation test. Of these, 55 to 60 per cent. gave a smooth gelatinous curd due to acid-forming organisms, whilst in 35 per cent. of the samples the number of organisms was too small to produce a curd within the period of incubation. Not a single sample produced a peptonised curd and the proportion of rennet curds was exactly equal to that in certified milk (grade " A ") during the same period.

The infectious diseases that are generally considered to be transmitted by milk are tuberculosis, typhoid fever, diphtheria, scarlet fever, and septic sore throat. It is generally conceded that the organisms causing these diseases are, with the possible exception of B. tuberculosis, quite destroyed or so reduced in number as to render the milk no longer infective. The great majority of sanitarians consider that B. tuberculosis is also either destroyed or so attenuated that it can no longer produce lesions, but in view of the fact that Delépine was able to demonstrate the presence of B. tuberculosis in dried milk the matter cannot be regarded as finally settled. A consideration of the results shown in Table II is of assistance in this connexion. These show that, when there is a massive infection with any organism a small proportion escapes destruction and can be found in the heated product. Normally, the number of disease-producing organisms found in milk from a mixed herd would be comparatively small, and treatment at 145° F. for thirty minutes would insure their practical destruction. It is conceivable, however, that a massive infection may occur and sufficient organisms may survive the treatment to produce typical lesions in guinea pigs. Whether it is possible that a sample that will produce lesions in guinea pigs may not produce a similar effect in children cannot be answered. In the former case the intra-peritoneal or the subcutaneous method of injection is used, and there can be no doubt that the introduction of the needle must tend to lower the natural resistance of the tissues involved. With children the introduction as food is much less severe and there is no artificial impairment of the natural resistance.



All are agreed that pasteurisation reduces the infectiveness of milk, and even if in, perhaps, one case in a thousand, the protection is not absolute, the method must still be considered satisfactory.

VITAMINS

The discovery of accessory food substances or vitamins is of comparatively recent date, and although a large amount of work has been done on this branch of biochemistry and a number of very important results have been obtained, there is still much to be accomplished before they can be classified into a rational scheme. Like the enzymes, the pure substances have not been isolated and it is only by their nutritional properties that they can be detected.

For the present purpose it is proposed to classify the vitamins in accordance with the modified scheme of Drummond adopted by Bywaters in the Report of the Progress of Applied Chemistry, Vol. V, and designate the " fat soluble vitamin " involved as a causative factor in rickets as vitamin " A " ; the " antineuritic " or " water soluble vitamin " as vitamin " B " ; and the " antiscorbutic vitamin " as vitamin " C."

Practically nothing has been published as to the effect of low temperature pasteurisation on the vitamins in milk, and until the investigations on this phase, which the writer understands are now being made at the instigation of the Ministry of Health, are published, the subject must be regarded as *sub judice*.

The available data indicate that heating to 145° F. for thirty minutes will have little or no effect upon the vitamins. Daniels and Loughlin found that heated milk was deficient in vitamin " A," but if the precipitate of phosphates and albumin were added as a colloidal suspension, the results were equal to those with raw milk. At 145° F. there is no precipitation, and it can be inferred that there is no loss of vitamin " A " at this temperature.

Vitamin " B " appears to be more resistant to heat than vitamin " A," and should not be diminished by pasteurisation. With vitamin " C " the results are somewhat conflicting. Dried milk made by the spray process was found by Jephcott and Bacharach to contain less vitamin " C " than that produced on steam rollers, while Hume found that full cream sweetened milk, which is evaporated at a low temperature under reduced pressure, was equal to raw milk in antiscorbutic properties.

The possible partial destruction of vitamins during pasteurisation should be considered in conjunction with a partial deficiency in raw milk. If, as some feeding experiments indicate, raw milk may be deficient in vitamins, the addition of fruit juice is always desirable whether raw or pasteurised milk is used, and the possible partial destruction of vitamins during heating becomes of no practical importance.

The general effect of pasteurisation upon milk has been diagrammatically expressed by Dr. North of New York, and his diagram, slightly modified in accordance with more recent data, is reproduced. This indicates that the neutral zone is so small as to call for extreme care during the pasteurisation of milk. Temperature has to be carefully controlled and in the best plants recording thermometers are in use.

Novel Method of Communicating the Results of Research

The British Non-Ferrous Metals Research Association has evolved a rather ingenious way of communicating the results of its research investigations to its members. Lectures are arranged at one or more centres to which as a rule only Members of the Association are admitted. Two objects are thus served, firstly, early confidential communication of the results of the research is assured to those who have given it financial support, and secondly, the investigator gets into close and immediate contact with that section of the industry chiefly interested in his work. In this manner the future direction of work and its relative practical importance are subjected to the consideration of the investigator and the industry.

The Non-Ferrous Metals Research Association is at present engaged on some ten investigations. Dr. W. Rosenhain, F.R.S., has already reported on the investigation on copper, carried out for the Association by Dr. D. Hanson and others at the National Physical Laboratory. Another large attendance of Members was occasioned by the lecture on "The Cause and Prevention of Red Stains on Brass," by Mr. E. A. Bolton, M.Sc., describing work on this troublesome difficulty which he is carrying out at Birmingham University. The Association has now arranged a third lecture to be given, both in Birmingham and Sheffield, by Mr. Dartrey Lewis, M.Met., on his work on "Materials used for the Abrasion and Polishing of Metals." In view of the wide interests covered, a limited number of tickets is being issued to non-members. The Birmingham lecture will be held on February 26, at 7.30 p.m., and the Sheffield lecture on February 23, at 2.30 p.m., and tickets, so far as space permits, can be obtained from the Association's offices, 71, Temple Row, Birmingham.

CALCIUM CARBIDE INQUIRY III

By SIR WILLIAM J. POPE

The Synthesis of Organic Compounds

The modern student of organic chemistry does not comprehend without effort the attitude of his great predecessors towards the larger aspects of the subject. Charles Gerhardt, speaking of his new classification of organic substances, said: "I show therein that the chemist does the opposite of what is done by living nature: that he burns, destroys and proceeds analytically: that vital force alone acts synthetically and rebuilds the edifices shattered by chemical forces. A satisfactory classification can therefore only be founded upon the decomposition products of chemical compounds" (Comptes rendus, 1842, **15**, 498). A little later Berzelius observed that "in living nature the elements seem to obey laws quite different from those which hold in inorganic nature. If we could discover the cause of this difference we should hold the keys to the theory of organic chemistry; but the theory is so well hid that we have no hope of discovering it, at least, at present" (Lehrbuch der Chemie, 1849, **5**, p. 1).

The development of synthetic methods in organic chemistry removed the obstacle to progress indicated in the foregoing quotations; the importance of such methods was, however, but slowly realised. The term "synthesis" was not applied chemically by German workers prior to 1850; Kopp speaks of Wöhler's synthesis of urea as the "artificial preparation" of that compound (Geschichte der Chemie, 1847, **4**, 381) and Gmelin notes that "it appears not impossible that we shall some day be able to form artificially many, if not all, of the organic compounds which occur in nature" (Handbook of Chemistry, 1852, **7**, 42). John Dalton has a chapter "On chemical synthesis" (A new system of chemical philosophy, 1808, **1**, 211); see also P. Shaw, Chemical Lectures, 1755, 179. Stas, however, figures the apparatus by aid of which he determined the atomic weight of carbon by the "synthesis of carbonic acid" (Bull. Acad. Belg., 1849, **16**, 9) and, a little later, Berthelot, the most distinguished of the early workers in the new field, clearly defined the purpose of synthetic organic chemistry.* He stated that "the word synthesis refers to the formation of an organic substance from the elements: carbon, hydrogen, oxygen, nitrogen, etc.; it is also applied to the preparation of an organic compound from other compound substances less complex than the product to which they give birth" (Leçons de Chimie, 1861, p. 167).

Berthelot thus conceived (1) a broad definition of a synthetic organic compound and (2) one more limited, designed to meet the needs of synthetic organic chemistry as a rapidly developing science. These two definitions may be thus stated :—

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* I spoke inadvertently of oxalic anhydride as being well known (this J., 5, line 46); of course, this compound has not yet been prepared.—W. J. P.

(1) A synthetic organic compound is one which is produced by the direct combination of carbon with another element or with other elements.

(2) A synthetic organic compound is a carbon compound which is produced from other compounds of more simple molecular composition.

The distinction between the definitions involved in the two sections of Berthelot's statement was elaborated by Lieben (Annalen, 1868, **146**, 205), who explained very lucidly his reasons for restricting the term synthesis to those operations in which carbon atoms become actually joined together. Eminent modern workers in general organic chemistry still use the word in the two senses, as is evident from the following definitions.

(3) "The term 'synthesis' as used in organic chemistry is generally assumed, if not explicitly stated, to mean the building up of a carbon compound from compounds of lesser complexity. If the simpler molecule is capable of being produced directly from its elements the synthesis is said to be complete" (Meldola, The Chemical Synthesis of Vital Products, 1904, **1**, p. 9).

(4) "By the synthesis of a carbon compound is understood its building up from the elements or from such carbon compounds as can be produced from the elements" (Richter, Chemie der Kohlenstoffverbindungen oder organische Chemie, 1909, **1**, p. 85).

Organic chemists who deal more specifically with the synthetic methods of organic chemistry generally adopt the second Berthelot conception as the basis of their definition, thus :—

(5) "The idea of 'synthesis' in chemistry has a very variable range. In its widest sense it is applied to the preparation of any specific complex substance from simpler ones ; otherwise by synthesis is meant the production of naturally occurring chemical compounds by artificial means—a very narrow conception of the term. In the following pages by synthesis will be understood those methods of producing carbon compounds in which carbon atoms, which are either free or are not directly combined with each other, become joined together" (K. Elbs, Die synthetischen Darstellungsmethoden der Kohlenstoffverbindungen, 1889, **1**, p. 3).

(6) "The idea of 'synthesis' in organic chemistry is very differently understood. By synthesis is understood, on the one hand, only the direct building up of organic compounds from their elements, and on the other, all those methods for producing organic compounds in which carbon atoms, which were previously not combined or were not combined together, become linked up one with the other" (Posner, Lehrbuch der synthetischen Methoden der organischen Chemie, 1903, p. 2).

The distinct significations thus attaching to the term synthesis as applied in organic chemistry may be referred to as (1) that of a complete synthesis, in which a carbon compound is produced by the combination of elementary carbon with other elements, in one or several stages, and (2) that of a structural synthesis, in which carbon atoms previously not joined become so combined together. It would probably be best to adopt the nomenclature described by J. B. Cohen (Organic Chemistry, 1920, **1**., p. 175) and speak of the synthesis of a complex hydrocarbon radicle as a condensation. If Lieben's view is rigidly applied, the production of methane from carbon and hydrogen and of formic acid from sodium hydroxide and carbon monoxide have to be excluded from the category of synthetic processes. It will be seen, however, that the preparation of calcium carbide from lime and coke is a synthetic process according to all the definitions referred to above.

PROOF THAT CALCIUM CARBIDE IS A SYNTHETIC PRODUCT

The production of calcium carbide in the electric furnace from lime and coke is generally represented by the equation :—

(*a*) $CaO + 3C = CaC_2 + CO$.

The study of this reaction, in which three components are present in four phases, has shown that two balanced reactions are involved ; these are represented by the equations :—

(*b*) $CaO + C = Ca + CO$

(*c*) $Ca + 2C = CaC_2$.

Reactions (*b*) and (*c*) have been investigated quantitatively (Rothmund, Zeits. f. anorg. Chem., 1902, **31**, 136 ; Rudolphi, ibid, 1907, **54**, 170 ; Briner & Kuhne, Journ. chim. phys., 1914, **12**, 432) ; it will be seen that equation (*a*), expressing the overall production of calcium carbide from lime and coke, is the algebraic sum of equations (*b*) and (*c*). The production of calcium carbide from calcium and carbon, which occurs readily when the metal is heated before the blowpipe on a carbon block (Knecht, Ber., 1908, **41**, 498), in accordance with equation (*c*), is reversible. Calcium carbide decomposes slowly into calcium and carbon even at 1050° C. and more rapidly at higher temperatures (Botolfsen, Ann, chim., 1922, **18**, 39). Reaction (*c*) and its reversal are thus essential steps in the formation of calcium carbide from lime and coke ; the manufacture of calcium carbide thus conforms as a synthesis to the wider definition (1).

Further, the elementary carbon which yields calcium carbide with the metal, in whole or in part passes through the stage of carbonic oxide, the molecule of which contains but one carbon atom. It follows that, in the formation of calcium carbide, carbon atoms not previously joined together combine to produce the acetylenic hydrocarbon radicle which has been already shown to be present in the carbide ;

the whole process is, therefore, a structural synthesis in the sense of definition (2).

The work of Guntz (Comptes rendus, 1896, **123**, 1273; Bull. Soc. Chim., 1896, [3], **15**, 756) is of interest as bearing upon the fact that two previously unjoined carbon atoms become linked together during the formation of calcium carbide. He shows that lithium, heated at about 700° in acetylene or ethylene, reacts as follows:—

$$C_2H_2 + 4Li = Li_2C_2 + 2LiH \text{ and}$$
$$C_2H_4 + 6Li = Li_2C_2 + 4LiH,$$

whilst, in methane at a low red heat no trace of lithium carbide is produced. At these low temperatures of reaction the carbide is produced only from a hydrocarbon which already contains a chain of two carbon atoms; it is not formed from a hydrocarbon which does not contain this linkage.

PROOF THAT CALCIUM CARBIDE IS A SYNTHETIC ORGANIC COMPOUND

It is now submitted that calcium carbide has been proved to be an organic compound on the following grounds:—

(*a*) It is a compound of carbon, further,

(*b*) It is the calcium derivative of acetylene and contains the acetylenic hydrocarbon radicle, $-C{\vdots}C-$.

Also, this organic compound is proved to be a synthetic substance, because

(*c*) It is produced from its component elements in its ordinary process of manufacture, and, further, that,

(*d*) In its manufacture a condensation occurs in which two atoms of carbon become joined together.

It is of interest to note that the Referee's recent decision (J., 1922, **41**, 556 R), to the effect that oxalic acid manufactured by the formate process is a synthetic organic chemical, is paraphrased in the above conclusions. He stated that "there is no doubt that oxalic acid is an organic body which can be built up from its elements. The process begins with the use of carbon, the number of carbon atoms in the molecule is increased and the molecule becomes heavier. The molecular construction contains two atoms of carbon linked together. Although in practice the first step in building up is the combining of carbon monoxide and caustic soda, both these substances can be obtained from their elements." The same reasons are given for two diametrically opposed decisions.

GENERAL CONSIDERATIONS

In his decision on the calcium carbide case the learned Referee noted the complainants' contention that the words "synthetical organic chemical" have a technical meaning and stated that, if this were the case, it was his duty to give the words that meaning; this is a point of law which can excite no criticism.

The obvious method for eliciting an answer to the question here indicated is that which has been used in this and the previous articles. A collection has to be made of definitions of the terms "organic" and "synthetic," as presented by those important contributors to organic and synthetic chemistry who have had to think the matter carefully out, and a judgment passed upon the balance of opinion. As I have shown, no organic chemist of repute gives a definition which does not include calcium carbide as an organic compound, whilst the term synthetic, according to all our classical writers, is entirely applicable to the manufacture of calcium carbide. The evidence is, in fact, all on the one side.

During the hearing, however, this method was not used. A number of gentlemen were examined and cross-examined concerning their personal impressions. Obviously, no attempt was made to establish a documentary case and a decision was given on what was practically a desultory conversation, a large part being taken by an entirely erroneous translation of a very authoritative definition. Sir Arthur Colefax, one of the leading counsel engaged in the hearing, and an authority worthy of the utmost respect, says that I am in error in making this last statement (this J., 75); but the point may well be left to the judgment of members of the Society of Chemical Industry after they have read the text of the decision (J., 1922, **41**, 46 R).

Those responsible for the presentation and the contest of the case presented the Referee with no adequate statement on the question of definitions, nor did they place before him the large amount of experimental evidence which demonstrates calcium carbide to be the calcium derivative of acetylene.

In the present controversy, Sir Arthur Colefax and I start from different premisses and with different objects. I inquire whether the evidence contained in the vast stores of knowledge which constitute modern organic chemistry proves calcium carbide to be a synthetic organic compound; the learned counsel asks whether the sketchy outline of the subject placed before the Referee justified this gentleman in his decision. Both questions must be answered in the affirmative. Calcium carbide is a synthetic organic chemical but the complainants did not produce the available evidence in proof thereof. Sir Arthur is needlessly disturbed by the thought that I have been lacking "in fairness to the learned Referee" by my observations that "the proceedings degenerated into an orgy of misrepresentation and misinterpretation" and that "these Board inquiries have become ridiculous farces played to the shame of British methods of legal procedure." I am well aware that the trivialities which he describes sententiously as "the evidence" were received with great decorum, although they would have excited hilarity if produced before an assembly of chemists.

The difference in standpoint between Sir Arthur Colefax and myself is emphasised by the question which he puts to me (this J., 76) as to whether I think that the learned Referee would have been helped by the appointment of an assessor who was "one of the eminent gentlemen who gave it as their opinion that calcium carbide was not a synthetic organic compound." The significance of this question becomes apparent when it is noted that the learned Referee in the calcium carbide inquiry was selected from amongst the advocates—from the distinguished society of King's Counsel formed by Sir Arthur Colefax and his colleagues—and that no one would ever dream of suggesting that any of these gentlemen, when transferred from an advocative to a judicial function, would act otherwise than with strict impartiality. The question suggests that virtue resides only in the practitioners of the law; it implies that all will be well provided that "the evidence," no matter how insufficient it may be, is presented and received with due ceremony, and gravely adjudicated upon. I see no reason for anticipating that either of the distinguished organic chemists who gave evidence for or against the complainants would have shown any partiality had he been appointed to aid the Referee as assessor; I am quite sure that such an assessor would have warned the Referee that "the evidence" placed before him was so fragmentary as to be fictitious, that he was being misled, and that he would do well to call for facts upon which to base a decision.

In these articles I claim to have proved that the evidence to the effect that calcium carbide is a synthetic organic compound is overwhelming. The case is a very simple one, and if my contention is correct it follows that the legal profession has failed in its duty by dealing so perfunctorily with the question submitted to it that an indefensible decision has had, perforce, to be pronounced.

The Schedule to the Safeguarding of Industries Act

The Safeguarding of Industries Act, 1921, was designed with the laudable purpose of fostering many new expansions of British industry and of shielding these from destruction by "dumping" from the Continent. So far as the layman can judge the text of the Act is straightforward and free from ambiguity. The frequent protests which have been made in the Courts and in the Press have mostly been directed, not against the text of the Act, but against the interpretative schedule, and the list of articles chargeable with duty under the Act; these latter are presumably the contribution of the Board of Trade.

The last paragraph of the schedule to the Act may be here more particularly criticised; this specifies as "Goods chargeable with duty" the following:—

"All synthetic organic chemicals (other than synthetic organic dyestuffs, colours, and colouring matters imported for use as such, and organic intermediate products imported for their manufacture), analytical reagents, all other fine chemicals (except sulphate of quinine of vegetable origin) and chemicals manufactured by fermentation processes."

If the declared function of the Board of Trade were the instigation of litigation in the chemical industry it could hardly have acted more efficiently than by such an insertion into the Act. The paragraph intercalates chemical scientific terms of precise meaning and commercial terms of a qualitative nature in such a manner that the whole carries no collective meaning. It can be proved that certain substances are "synthetic organic chemicals," although the use of the unsystematic word "chemical" promotes obscurity, but the expression "fine chemical" is meaningless in a legal document; one witness, indeed, observed that he recognised a "fine chemical" by instinct (this J., 1922, **41**, 555 R).

This concluding paragraph of the explanatory schedule could easily have been drafted in a form entirely free from ambiguity; in such a way, in fact, that counsel's opinion could state very definitely whether an application for inclusion or exclusion of a specific material would or would not succeed. It would not have been passed in its present form had it been submitted to a body of competent scientific and technological chemists for criticism and suggestions. The Association of British Chemical Manufacturers will no doubt agree with this statement; it is to be hoped that this organisation will urge the awful example of the Safeguarding of Industries Act in Government circles and will succeed in making impossible a repetition of this bungle.

ASSOCIATION OF TAR DISTILLERS

Mr. S. A. Sadler, of Middlesbrough, presided at the dinner of the above Association at the Hotel Russell, London, on the 20th inst. About a hundred were present, including Dr. C. C. Carpenter, Dr. H. Butler, Messrs. Bower, Waugh, Robinson and Woolcock. Dr. Carpenter, in a graceful speech, explained how tar had enabled dustless and waterproof roads to be made, and he considered the manufacturers and distillers of tar would always be able to adapt their methods to changing conditions. Mr. E. Shrapnell-Smith contrasted modern roads with those existing in the early days of motoring. He considered the roads in this country were now as good as those in any other.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

THE VISIT OF THE KING to the British Industries Fair on Monday last, coincided with the opening of the Fair. I thought this a marked improvement on the arrangements made in previous years. It not only gave the Fair a good send-off but compelled each exhibitor to have his exhibit ready before the Fair opened. The Chemical Section was, as last year, in the first hall, as one entered at the Uxbridge Road entrance. There were not quite as many firms exhibiting as last year, but those who were exhibiting occupied a larger space. The management of this section was again in the hands of the Association of British Chemical Manufacturers, and both in the individual stalls and in the general layout I thought there was a marked improvement. But how stereotyped and ugly exhibition stands are. They are only there for a fortnight, it is true, and this may be urged as an excuse, but I hope something much more distinctive will be done at Wembley in 1924. A new feature of the Fair was the presence of the British Chemical Plant Manufacturers' Association in close proximity to the Chemical Section, as befitted a body which is an offshoot of the Association of British Chemical Manufacturers. His Majesty spent some time in the Chemical Section and seemed very interested in everything which was shown to him.

THE DEVELOPMENT COMMITTEE under the Dyestuffs Act appears to be very active just now. I hear that visits are being paid to each of the dyeworks in this country and that, already, a vast amount of information has been collected. Very little is heard as a rule about this Committee. It could not get to work as early as the Licensing Committee because it has, in a sense, to derive its information from the Licensing Committee's reports and work on them. For some time the Licensing Committee acted also as an informal development committee, but now, I believe, each Committee does its own work, and there are a sufficient number of persons who are members of both Committees to secure there shall be no clashing. The present position of the British Dyestuff Industry is very different from what it was in 1913. In those days we used to import about 80 per cent. of the dyestuffs used over here and make only 20 per cent. Indeed, of this 20 per cent. a fair proportion consisted of mixtures made with foreign dyes. Now the position is exactly reversed, and we make 80 per cent. and import only the 20 per cent. Not a bad record after only two years' working of the Act. The record with regard to price is almost as good. I am told that the Development Committee have found that the average price per pound of British dyestuffs which was nearly four shillings and sixpence eighteen months ago has been brought down to something a little over half-a-crown.

THE HABIT OF SELF-DEPRECIATION is not easily abandoned by your true Briton, but we may yet not only be proud of this new industry, but may even say so. Hearing about the progress of the dyestuff industry put me on inquiry as to what developments had been made in the manufacture of British fine chemicals, and I was told equally reassuring news. There are twice as many persons engaged in this branch of chemical industry as there were in 1913. For every ton of fine chemicals we made in 1913 we are making two and a half tons to-day, and it is estimated that we are making fourteen times as many as we were in 1913. The range is certainly very much larger than it was, and I believe the purity of the British products leaves nothing to be desired. Prices of fine chemicals have also fallen considerably, and I was given some instances where they were now below the pre-war price.

IF THE MANUFACTURE OF FINE CHEMICALS is to be established in this country it seems to me that it will have to be undertaken in a very different spirit from that of ordinary commerce. It is a peculiar business. The variety of the products is legion ; the quantity of some of them required in a year is, perhaps, a few ounces. Yet they must be of great purity and always in stock. Not a very profitable business I should imagine. Nevertheless, for the credit of Great Britain, it has to be done. If it is possible to get the help of professors and teachers of chemistry it can be done, but, unfortunately, in some quarters this is not forthcoming. I heard an interesting story the other day of a certain school which, having obtained quotations for some fine chemicals from British firms, forthwith placed the order in Germany. A little later the head of the chemical department wanted some assistance and applied to a British chemical manufacturer for it. He got what he wanted, but not until the manufacturer had asked the teacher where he was going to find places for his students if he assisted the Germans to shut up the works of the British manufacturers. This appeared to open up a new line of thought to the teacher of chemistry. The effect of the trouble in the Rhur is now beginning to be felt in British chemical industry, particularly with regard to dyestuffs and fine chemicals. I can confirm the news in your Market Reports of last week. Business is better.

GIFT OF £100,000 FOR SCIENTIFIC RESEARCH

It is announced that the offer by Sir Alfred Yarrow of £100,000 to the Royal Society, to be used at the discretion of the Council of the Society in promoting scientific research, has been gratefully accepted by the President and Council. In his letter to the President of the Royal Society offering the gift, Sir Alfred Yarrow states that he desires to mark his sense of the value of research to the community, by offering the gift to be used as capital or income for the purposes of the Society as the Council may think fit. Sir Alfred Yarrow further suggests that the rules framed for guidance of the committee to be appointed to administer the fund should be reconsidered by the Council every tenth year so as to meet modern needs. Further, he prefers that the money should be used to aid scientific workers by adequate payment and by the supply of apparatus and other facilities rather than to erect costly buildings. Sir A. Yarrow's success as a pioneer in the design and construction of high-speed vessels, has not been attained without much research, and his gift to the Royal Society is one of several made for the public benefit.

INTERNATIONAL TABLE OF ISOTOPES, ETC. (1923)

The following tables and other matter are extracted from the first report of the International Commission on Chemical Elements appointed by the International Union of Pure and Applied Chemistry.

Atomic number.—A *chemical element* is defined by its *atomic number*, which represents the excess of positive over negative charges in the constitution of the atomic nucleus; theoretically, the *atomic number* represents also the number of electrons which rotate round the central positive nucleus of the atom. Each *atomic number* also represents the place occupied by the element in the Mendeleef Table. Of the various methods suggested to determine the *atomic numbers*, the most important consists in deducing them from the wave-lengths of the high frequency spectra by applying Moseley's law.

Elements (simple and complex). Isotopes.—If the above definition is accepted, each chemical element may be *simple* or *complex*, according as its atoms are all of equal mass or not. In the latter case, the element consists of as many *isotopes* as its *atoms* have different *masses*. A *complex* element is a *mixture of isotopes*. Three methods (J. J. Thomson, Aston, Dempster) have been devised to determine isotopes, the most important being that of Aston.

Notation.—The elements, simple or complex, are represented by the ordinary symbols. To indicate any particular isotope its atomic mass is written as an index to the right of the symbol representing the mixture. The expression "atomic mass" is reserved for isotopes or simple elements considered from the isotopic point of view. The expression *atomic weight* retains its usual meaning, and is applied to elements without consideration of their isotopic constitution. Thus, Cl^{35} indicates the isotope of chlorine having an atomic mass 35. This number represents the relative mass of its atom, the atom of oxygen (a simple element) being taken as 16.

Elements included in the Table.—The isotopes of lead which are the ultimate result of disintegration of radioactive elements, and the radioactive isotopes will only appear in the International Table of the radioactive elements. Only those elements appear in the Table of Isotopes which are recognised as simple, or are complex elements whose isotopes have been determined with sufficient certainty.

Provisional values.—Numbers in brackets are to be taken as provisional only.

Table of Isotopes

Element	Atomic no.	Atomic weight (1)	Masses of isotopes (2)	Accuracy %
H	1	1·008	1·008	·02
He	2	4·00	4	0·2
Li	3	6·94	7 ; 6	
Gl	4	9·1	9	
B	5	10·9	11 ; 10	0·1
C	6	12·005	12	
N	7	14·008	14	0·2
O	8	16·000	16	
F	9	19·0	19	0·1
Ne	10	20·2	20 ; 22	0·1
Na	11	23·00	23	
Mg	12	24·32	24 ; 25 ; 26	
Al	13	27·0	27	
Si	14	28·1	28 ; 29 ; (30)	0·1
P	15	31·04	31	0·2
S	16	32·06	32	0·2
Cl	17	35·46	35 ; 37	0·1
A	18	39·9	40 ; 36	0·1
K	19	39·10	39 ; 41	
Ca	20	40·07	40 ; (44)	
Fe	26	55·84	56 ; (54) ?	
Ni	28	58·68	58 ; 60	0·1
Zn	30	65·37	64 ; 66 ; 68 ; 70	
As	33	74·96	75	0·1
Se	34	79·2	80 ; 78 ; 76 ; 82 ; 77 ; 74	0·1
Br	35	79·92	79 ; 81	0·1
Kr	36	82·92	84 ; 86 ; 82 ; 83 ; 80 ; 78	0·1
Rb	37	85·45	85 ; 87	
Sn	50	118·7	120 ; 118 ; 116 ; 124 ; 119 ; 117 ; 122 ; (121)	
I	53	126·92	127	0·2
Xe	54	130·2	129 ; 132 ; 131 ; 134 ; 136 ; 128 ; 130 ; (126) ; (124)	0·1
Cs	55	132·81	133	
Hg	80	200·6	(197-200) ; 202 ; 204	0·1

(1) International values for 1922. (2) In order of intensity of spectral bands. (3) Of the observations Aston is responsible for all save those of glucinium, magnesium, calcium and zinc, Dempster for those of lithium, magnesium, calcium, and zinc, and Thomson for those of lithium and glucinium.

INTERNATIONAL TABLE OF THE RADIOACTIVE ELEMENTS AND THEIR CONSTANTS (1923)

T	Name	Symbol	Atomic		Isotope	Radiation	a_0
			WT.	NO.			
			URANIUM AND RADIUM SERIES				
4·67 × 10^9 years	*Uranium I*	UI	238	92	U	α	2·37
24·6 days	*Uranium X_1*	UX_1	234	90	Th	β	....
1·15 minutes	*Uranium X_2*	UX_2	234	91	Pa	β (γ)	....
2 × 10^6 years	*Uronium II*	UII	234	92	U	α	2·75
6·9 × 10^4 years	*Ionium*	Io	230	90	Th	α	2·85
1690 years	*Radium*	Ra	226	88	Ra	α ($\beta + \gamma$)	3·13
3·85 days	*Radon*	Rn	222	86	Rn	α	3·94
3·0 minutes	*Radium A*	RaA	218	84	Po	α	4·50
26·8 minutes	*Radium B*	RaB	214	82	Pb	β (γ)	....
19·5 minutes	*Radium C*	RaC	214	83	Bi	99 97% β & γ	....
10^{-6} second	*Radium C'*	RaC'	214	84	Po	α	6·57
16·5 years	*Radium D*	RaD	210	82	Pb	(β and γ)	....
5·0 days	*Radium E*	RaE	210	83	Bi	β	....
136 days	*Radium F* (Polonium)	RaF (Po)	210	84	Po	α (γ)	3·58
....	*Radium Ω'* (Lead)	RaΩ' Pb^{206}	206	82	Pb	....	....
....	*Radium C*	RaC	214	83	Bi	0·03% α	?
1·4 minutes	*Radium C''*	RaC''	210	81	Tl	β	....
....	*Radium Ω''* (hypothetical)	RaΩ''	210	82	Pb	....	....
			ACTINIUM SERIES				
....	*Uronium ?*	....	?	92	U	α	....
1·04 days	*Uranium Y*	UY	?	90	Th	β	....
1·2 × 10^4 years	*Protoactinium*	Pa	?	91	Pa	α	3·314
20 years	*Actinium*	Ac	?	89	Ac	—	....
19·5 days	*Radioactinium*	RdAc	?	90	Th	α (β)	4·36
11·4 days	*Actinium X*	AcX	?	88	Ra	α	4·17
3·9 seconds	*Actinon*	An	?	86	Rn	α	5·40
2·0 × 10^{-3} second	*Actinium A*	AcA	?	84	Po	α	6·16
36·1 minutes	*Actinium B*	AcB	?	82	Pb	(β and γ)	....
2·15 minutes	*Actinium C*	AcC	?	83	Bi	α	5·12
4·71 minutes	*Actinium C''*	AcC''	?	81	Tl	β and γ	....
....	*Actinium Ω''* (hypothetical)	AcΩ''	?	82	Pb	....	....
			THORIUM SERIES				
1·31 × 10^{10} years	*Thorium*	Th	232	90	Th	α	2·58
6·7 years	*Mesothorium 1*	MsTh1	228	88	Ra	—	....
6·2 hours	*Mesothorium 2*	MsTh2	228	89	Ac	β and γ	....
2·02 years	*Radiothorium*	RdTh	228	90	Th	α (β)	3·67
3·64 days	*Thorium X*	ThX	224	88	Ra	α	4·08
54 seconds	*Thoron*	Tn	220	86	Rn	α	4·74
0·14 second	*Thorium A*	ThA	216	84	Po	α	5·40
10·6 hours	*Thorium B*	ThB	212	82	Pb	β and γ	....
60 minutes	*Thorium C*	ThC	212	83	Bi	65% β	....
10^{-11} second	*Thorium C'*	ThC'	212	84	Po	α	8·16
....	*Thorium Ω'* (Lead)	Th Ω' Pb^{208}	208	82	Pb	....	....
....	*Thorium C*	ThC	212	83	Bi	35% α	{ 4·55 ? 4·69
3·1 minutes	*Thorium C''*	ThC''	208	81	Tl	β and γ	....
....	*Thorium Ω''* (Lead)	ThΩ'' Pb^{208}	208	82	Pb	....	....
....	*Potassium*	K	39·1	19	K	β	....
....	*Rubidium*	Rb	85·5	37	Rb	β	....

In the above table T is the time in which the quantity of radio-element is diminished to one-half, a_0 is the range in cm. of the α-rays in the air at 0° C. and a pressure of 760 mm. of mercury and, under the heading "Radiation," the brackets ( ) indicate that the radiation is relatively feeble.

FORTHCOMING EVENTS

Feb. 24. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Atomic Projectiles," by Sir E. Rutherford.

Feb. 26. Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W. 1, at 7 p.m. "Photo-Elastimetric Researches on Mechanical Engineering Problems," by Prof. E. G. Coker.

Feb. 27. British Science Guild, Mansion House, E.C., at 3.30 p.m. "Science and Education," by Sir J. J. Thomson.

Feb. 28. Royal Society of Arts (Ordinary Meeting), 18, John Street, W.C. 2, at 8 p.m. "Heat Resisting Glasses," by Prof. W. E. S. Turner.

Mar. 1. The Chemical Society, Burlington House, Piccadilly, W. 1, at 8 p.m. "Co-ordination Compounds and the Bohr Atom," by N. V. Sidgwick. "Silver Salvarsan," by W. H. Gray. "The Propagation of the Explosion-wave Through Gaseous Mixtures," by H. B. Dixon.

Mar. 1. The Institution of Electrical Engineers, Lecture Theatre, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. Report on "Permissible Loading of British Standard Paper-Insulated Electric Cables," by S. W. Melsom and E. Fawssett.

Mar. 2. Society of Chemical Industry, *South Wales Section*, The Technical College, Cardiff, at 7.30 p.m. Annual Meeting.

Mar. 2. Society of Chemical Industry, the Textile Institute, 16, St. Mary's Parsonage, Manchester, at 7 p.m. Joint Meeting of the Manchester and Liverpool Sections. "The Progress of the Chemical Industry in Great Britain since 1914," by Dr. H. Levinstein. A luncheon has been arranged at the Queen's Hotel, Portland Street, Piccadilly, at 1 p.m. After the luncheon, a visit will be paid to the Bradford Road Gas Works, at 3 p.m.

Mar. 3. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Atomic Projectiles," by Sir E. Rutherford.

Mar. 5. Institution of Rubber Industry, Engineers' Club, Coventry Street, Piccadilly, W. 1. "Telegraph Cable Manufacture, Rubber and Gutta Percha," by H. Savage.

Mar. 6. Society of Chemical Industry. *Edinburgh and East of Scotland Section*, Hall of the Pharmaceutical Society, 36, York Place, Edinburgh, at 7.30 p.m. Annual Meeting.

Mar. 6. Society of Chemical Industry, *Birmingham and Midland Section*, the University Buildings, Edmund Street, Birmingham, at 7 p.m. "The Influence of Protective Colloids upon the Velocities of Chemical Reactions," by J. Newton Friend.

Mar. 6. Royal Photographic Society of Great Britain, 35, Russell Square, W.C. 1, at 7 p.m. "An Electric Indicator for Washing-troughs," by K. C. D. Hickman.

SOCIETY OF CHEMICAL INDUSTRY

ANNUAL GENERAL MEETING, 1923

In accordance with the provisions of Byelaw 68, Notice is hereby given that the annual general meeting of the Society will be held in Cambridge on Friday, June 21, 1923, at 11 a.m.

The programme of the proceedings will be issued later; meanwhile it may be stated that the following are among the provisional arrangements that have been made:—

Members attending the meetings unaccompanied by ladies will be accommodated with rooms in the colleges. Those with ladies will obtain quarters at the local hotels.

In addition to the address of the president, Dr. E. F. Armstrong, F.R.S., there will be a popular lecture by Sir Wm. Pope, K.B.E., F.R.S., an address by Dr. F. W. Aston, F.R.S., on Isotopes, and a lecture on Cambridge and its Colleges by Dr. Cranage.

The Society's Medal for 1923 will be presented.

The annual dinner of the Society (which ladies may attend) will be held, and a large number of Cambridge guests will be invited to it. Members and ladies may lunch in various college halls, and there will be no official lunch on this occasion.

Arrangements will be made for parties to visit the various colleges and laboratories. There will be a visit to Ely, and it is believed there will be a reception and a dance.

The meetings will last from Thursday to Saturday inclusive, and they will be preceded by those of the International Union of Pure and Applied Chemistry, which holds its annual meeting on Monday, June 18, and the following Tuesday and Wednesday.

Any of the Society's members desiring to attend the meeting of the International Union will be welcome.

All communications regarding the meeting should be addressed to the General Secretary, at the offices of the Society in London, until further notice.

J. P. Longstaff,
General Secretary

MEETING OF COUNCIL

The monthly meeting of Council was held on Friday, February 9, 1923, the President (Dr. E. F. Armstrong, F.R.S.) in the chair.

The President announced steps that were being taken to arrange for the Annual General Meeting, at Cambridge, on June 20, 21 and 22 next; and progress was reported in the preparation of a scheme for organising propaganda relating to chemical industries in connexion with the British Empire Exhibition, 1924.

The reports of the Hon. Treasurer, and of various committees of the Council, were discussed, and 31 new members (home 23, and oversea 8) were elected.

The Council renewed its grant of £100 to the Chemical Society towards the upkeep of its library during 1923. It may be useful to remind members that, as the result of an arrangement between the Chemical Society and the Society of Chemical Industry, members of the latter Society are entitled to use the library and borrow books from it on precisely the same footing as Fellows of the Chemical Society. The Council is gratified to know that its members who are not members of the Chemical Society are taking advantage of this privilege to an increasing extent year by year.

It was unanimously agreed to award the Society's Medal for 1923 to Dr. C. C. Carpenter, of the South Metropolitan Gas Co., a former President of the Society. It was also decided to ask Dr. Carpenter to give an address at the Annual General Meeting.

Dr. S. Miall was appointed the Society's representative to the Annual Congress of the Royal Institute of Public Health, which will be held in Scarborough in May.

Latham Research Fellowship

Mr. James Craik, M.A., B.Sc., whose appointment to this Fellowship was intimated in the *Journal* for October 31, 1921, page 384 R, resigned in August last, and a paper embodying the results of his work will be published in the *Journal* in due course. The Council has now approved the selection of Mr. Leslie Hall, B.Sc., A.I.C., to work in association with Dr. Dorée in the Research Laboratory of the Borough Polytechnic Institute on "The Constitution of Lignone and the Ligno-Celluloses." The research will be in continuation of the scheme of "Researches on Cellulose," IV (Cross and Dorée), and under the immediate supervision of Dr. Dorée.

NEWS FROM THE SECTIONS

LIVERPOOL SECTION

A meeting of the section was held in the Muspratt Lecture Theatre, Liverpool University, on February 16, Dr. J. T. Conroy in the chair. At the outset the chairman referred in feeling terms to the great loss the section had sustained by the death of Mr. Arthur Carey, a member of the section for many years and a past-chairman. A vote of sympathy was passed to Mrs. Carey and family. A paper was then read by Mr. R. B. Croad, F.I.C., A.R.T.C., on "Synthetic Tannins," in which he suggested that the name "synthetic tannins" should be replaced by "syntans" to avoid confusion with the synthetic products prepared by Emil Fischer and his school, as the term was not applied to any particular product.

A short history of syntans since the production of Schiff's esterified phenol sulphonic anhydride in 1873 up to 1920 was given. Analytical figures were given refuting Moellers' statements in the *Collegium* of 1913 with regard to the hydrolytic action of syntans on pelt. The small quantities of hide substance found in the liquors after tanning was due to soluble amino-acids produced in the lime-sulphide treatment of the hide. This was supported by experimental evidence. Various methods of producing syntans were summarised as follows:—(1) Aldehyde on hydroxysulphonic acid; (2) aldehyde on sulphonated hydrocarbon; (3) aldehyde on hydroxyaromatic compound using an acid condensing agent and the subsequent sulphonation of the dry resin; (4) formaldehyde and sodium bisulphite on an aromatic hydroxy compound; (5) formation of sulphones by the action of heat on sulphonated hydrocarbons; (6) sulphonation of coumarone resins and heavy tar oils.

The commercial method of production was discussed, and also the types of leather yielded by the products and points to be taken into consideration when carrying out the official method of tannin analysis. These points were exemplified by a piece of leather produced by a syntan said to be of British manufacture which gave a good tannin analysis, but on pelt gave a hard, cracky leather, more like dried pelt than anything else. The action of syntans on the pelt was discussed, and a chemical theory of their tanning action advanced based on experimental results. Experiments leading up to the taking out of B.P. 182,823 and 182,824 by Messrs. Harold M. McArthur and Co., Ltd., of Aintree, were described. Samples of leather produced under these patents, together with samples of leather produced by British, American and German syntan manufacturers were shown. All the samples shown were two years old and had been tanned at the same time and under identical conditions. Save for slight alteration in colour, those produced under the alkaline condensations described in B.P. 182,823 and 182,824 had kept their fullness and suppleness, whereas the other samples had gone off badly in colour, becoming thin and tinny and the grain cracky. A method of analysis of Glaubers salts in syntans was put forward, which was quick and, on the syntans tried, accurate.

A discussion followed in which Messrs. A. Morton, H. B. Stocks, R. W. Riding and E. Gabriel Jones took part.

GLASGOW SECTION

The Committee of the Glasgow Section has decided to offer an annual prize in the form of books (which may be selected by the successful candidates) to the value of £5, for original work carried out by Student Associates of the Section. The conditions of the award are laid down as follows:—

The candidate must be a Student Associate of the Glasgow Section of the Society, and must have paid his annual subscription. He must submit, before October 31, a thesis embodying the results of either (*a*) an original experimental investigation; (*b*) original theoretical work; or (*c*) an original application of theoretical work to some chemical process. He must state explicitly whether his thesis is wholly original, or has been guided by others. The results of his work must not have been published prior to being read before the Section. Joint papers by two or more Student Associates will be eligible for award, in which case if the same is approved by the Committee, the prize will be divided equally between the authors. The successful candidate will be required to read his thesis either in full or in abstract at one of the ordinary meetings of the Section, when it will be discussed by members.

EDINBURGH AND EAST OF SCOTLAND SECTION

The fifth ordinary meeting of the session was held in the Hall of the Pharmaceutical Society, Edinburgh, on February 13, Dr. H. E. Watt presiding. A paper on "Vitamins" was read by Dr. G. M. Findlay, Royal College of Physicians' Laboratory, Edinburgh.

After a historical review of the development of the subject, an outline was given of the properties of the various vitamins and their distribution in foodstuffs. The existence of the three vitamins, A, B and C, has now been fairly well established, and another growth factor known as "Bios" has been termed by Funk "vitamin D." This factor is found in liver and muscle and promotes the growth of yeast and bacteria. At the same time McCollum and his co-workers have applied the term "vitamin D" to the anti-rachitic factor which they have described as existing in cod-liver oil. Deficiency of vitamin B in a diet produces the disease known as "Beri-beri," certain symptoms of which in pigeons are similar to those of anoxæmia, however produced, and possibly point to some interference with the respiratory mechanism of the cell. In cases of experimental beri-beri, however, the amount of oxygen in the blood stream is above the normal, and administration of oxygen will not cure the disease. The addition of carbohydrates to the diet increases the rapidity with which the symptoms appear. This connexion between carbohydrate metabolism and vitamin B deficiency is further borne out by the fact that in avian beri-beri the glyoxalase content of the liver is below normal, and administration of vitamin B in such beri-beric cases is followed by an increase in the glyoxalase content of the liver. Animals fed on a diet deficient in vitamin A fail to grow and become highly susceptible to keratomalacia. Vitamin A deficiency also predisposes to bronchitis and broncho-pneumonia. There is evidently some parallelism between the content in butter and maize of vitamin A and that of lipochrome pigment. Green plants also contain more vitamin A than etiolated ones. Vitamin A is stored in the liver and sub-cutaneous fats, so that animals usually have a considerable reserve dependent on the amount of vitamin A in the food. Vitamins B and C are not stored to any extent. Vitamin C, a deficiency of which causes the development of scurvy, is more sensitive to the effects of heating in presence of air, and, in particular, is destroyed by heating in copper vessels. Many seeds like those of the pea and wheat, which contain only inappreciable amounts of this vitamin show a large increase in the amount on germination.

Recent work has shown that there is no relationship between deficiency of vitamin A and the development of rickets, but McCollum and his co-workers have demonstrated that cod-liver oil which has been deprived of its supply of vitamin A is yet able to prevent the onset of this disease, so that they have suggested that there is an anti-rachitic in cod-liver oil. Animals fed on a diet deficient in calcium and phosphates and containing as its source of fat some substance like cottonseed oil will develop rickets, but if to this diet is added a supply of cod-liver oil the animals will remain normal. An interesting fact is that a diet sufficiently low in phosphates to produce rickets under normal conditions will not do so if the animal is provided with only starvation quantities of the food, or if the animal is exposed to ultra-violet rays. Both starvation and exposure to ultra-violet rays produce an increase in the amount of inorganic phosphates in the blood stream. This is confirmed by the fact that there is a seasonal variation in the amount of phosphate in the blood of children examined in towns where rickets are prevalent. In the summer the amount of phosphate in the blood is higher than at any other season and fresh cases of rickets are rare. The amount of phosphate falls off in the autumn and winter and the number of cases of rickets increases.

MEETINGS OF OTHER SOCIETIES

THE OIL AND COLOUR CHEMISTS' ASSOCIATION

At a meeting held at Birkbeck College, London, on February 8, Mr. A. de Waele delivered a paper on "Viscometry and Plastometry."

In introducing the subject of the measurement of the factors governing the consistency of plastic bodies the author dealt with the elementary conceptions of viscous flow in liquids, including the mathematics of Poiseuille's law and the corrections to it. A form of plastometer adapted to the exigencies of routine work in technical laboratories for the study of either viscous liquids or plastic solids was next described and illustrated with lantern slides. In referring to the work of Bingham and his collaborators on the subject of the measurement of plasticity, the author pointed out that Bingham's fundamental equation purporting to illustrate the law of plastic flow, viz. :—

$$\frac{\pi R^3(F-f)}{4V} = \frac{\pi R^4(P-p)}{8Vl} = \eta$$

was *a priori* wrong since it implied a linear relationship between P and V at all shearing stresses above $P=p$, an assumption that could not be realised. Bingham's interpretation of the law of plastic flow had been examined by critical experiments and found to be invalid, no linear relationship having been found in any part of the line. The erroneous conclusions of Bingham and his co-workers, were due to the restriction of their investigations to materials possessing low degrees of plasticity in the first place, and secondly to the confinement of their observations to relatively low rates of shear. As a result, true curvature of the pressure-volume relationship had been mistaken for slippage, a phenomenon which Bingham, furthermore, in his mathematical treatment had incorrectly visualised. A slide illustrating the phenomenon of slippage showed that this takes place *inwards* from the capillary walls, and not outwards from the centre as Bingham had assumed.

In concluding, it was shown that beyond a small shearing stress in which some slippage might occur, the mechanism of plastic flow was continuous up to the point at which possible influences of turbulent flow or kinetic energy corrections might enter, the plastic flow equation being representable by the relationship :—

$$K\frac{P}{Q^{\phi}} = \xi$$

where P corresponded to shearing pressure, Q the volume exuded in unit time, K the capillary constant as deduced from Poiseuille's law, the exponent ϕ differing from that obtaining in viscous flow in being fractional and *less* than unity, and ξ being constant for the material sheared and possibly identical with viscosity. The confirmation of this identity was to be the subject of a subsequent communication. The value $(1-\phi)$ appeared thus in direct numerical proportion to the degree of plasticity.

THE FARADAY SOCIETY

The following papers were submitted to the Faraday Society at the meeting held in Burlington House on February 19 :—

Prof. A. W. Porter and Mr. J. J. Hedges, B.Sc., in Part II. of their paper, "The Law of Distribution of Particles in Colloidal Suspension with Special Reference to Perrin's Investigation," gave some results obtained by Constantin in his work on this subject, and then described their work on the suspension of paraffin in water, which has special interest since the particles are specifically lighter than the medium. It was found that the change in concentration occurred, as expected, at the bottom of the vessel and that there was an increase in concentration with height, reckoned from the bottom of the containing vessel. By plotting the numerical concentration against the relative depth, the following equation connecting these quantities was derived :—

$$\log_e \frac{n}{1-bn} + \frac{1}{1-bn} = Ky + A,$$

the constants being $b = 9{\cdot}7 \times 10^7$; $A = 83{\cdot}23$; and $K = -235$.

Three papers were contributed by Dr. D. B. Macleod, the first being entitled "The Relation between Surface Tension and Density. Dr. Macleod gave the following empirical relation connecting γ the surface tension at any temperature and the densities of liquid and vapour P_e and P_v at this temperature, C being a constant depending on the liquid :—

$$\frac{\gamma}{(P_e-P_v)^4} = C$$

and then proceeded to calculate by this formula the surface tension of such substances as ethyl acetate, ethyl ether, etc. The tables given in the paper show a close agreement between the calculated and observed values for temperatures taken between the melting point and the critical temperature of the substance. Agreement, however, in the case of associated substances is less satisfactory. The author pointed out that from this formula the surface tension should increase proportionally to the fourth power of the density, although no experimental data were available concerning the effect of pressure on the surface tension of a liquid. The next paper by this author was entitled "A Relation between the Viscosity of a Liquid and its Coefficient of Expansion," in which it was assumed that (*a*) the viscosity is dependent on the molecule itself, and in the case of normal unassociated liquids, independent of the temperature, (*b*) the viscosity is dependent upon the free space within the liquid. Assuming x_0 the free space in unit vol. at 0° C., and $\alpha\beta\gamma$ the coefficients of expansion, and that the volumes of the molecules remain constant over the temperature range under consideration, the value of the viscosity of the liquid at temperature t relatively to its value at 0° C. is given by $\frac{\eta_0}{\eta_t} = \frac{(x_0+\alpha t+\beta t^2+\gamma t^3)^A}{x_0}$ where A is a number which varies from 1 to about 3·4 depending upon the liquid. This formula has been applied to a number of liquids, and it is found that in every case the calculated result of the viscosity agrees very closely with the value found experimentally. The author also applies the same expression to the values for the viscosity of carbon dioxide and provides a table giving the constants (A) for a considerable number of liquids. Liquids having a value for A much greater than unity are known to belong to a class of substances whose molecules are associated at ordinary temperatures, and it is assumed that such an associated molecule encloses within the system a certain amount of free space, and, consequently, on cooling the viscosity increases more rapidly than with normal substances. This theory would lead one to expect a rise in viscosity with rise in pressure which agrees with the experimental results available. The third paper, "On the Viscosity of Liquid Mixtures showing Maxima," is really a development of the theory advanced in the previous paper. If two liquids, one mobile or limpid, *i.e.*, having a large amount of free space, and the other viscous, *i.e.*, having a small amount of free space, are mixed, the author considers that it is highly probable that the mobile liquid will share some of its free space with the molecules of the viscous liquid, thus leaving less free space for its own molecules, and so contributing a greater viscosity to the mixture than is proportional to its volume, since its free space has suffered a partial contraction, whilst the viscous portion would contribute less because of an equivalent expansion. This is expressed mathematically by

$$\eta=\eta_1 v_1\left(\frac{x_1}{x_1-\Delta x}\right)^{A_1}+\eta_2 v_2\left(\frac{x_2}{x_2-\Delta x}\right)^{A_2}$$

where η, η_1, η_2 are viscosities of mixture, mobile and viscous liquids, respectively; x_1, x_2 the free spaces in mobile and viscous liquid respectively; A_1, A_2 the constants for the pure substances. This formula is then applied to determine the viscosity of mixtures of such substances as pyridine and water, in various proportions, and tables and curves are given showing how the calculated value of η varies from that obtained by other workers.

In a paper on "The Crystal Growth in Cadmium," Mr. M. Cook, M.Sc., gives the results of experiments undertaken to determine whether recrystallisation or crystal growth can take place in metals not previously subjected to plastic deformation. The paper describes methods by which several unworked specimens of the same shape, size, etc., were prepared and etched so that they could be considered structurally alike, and the heat treatment to which each specimen was subjected. The results obtained indicate that in annealing considerable crystal growth takes place in the unworked specimens, but that no allotropic change is produced in the metal when heated to 100° C. The essential difference between worked and unworked specimens is that in the former new centres of recrystallisation are formed which are absent in the latter.

Mr. Jeffery, who has given in previous papers the reactions in electrolysis with anodes of silver, copper and lead, gave a paper on the results when using an aluminium anode, the anolyte being (1) solutions of sodium nitrate and (2) solutions of potassium oxalate. In the second case the experiments were designed to investigate a case in which an aluminium anode might form complex anions during electrolysis. The conclusions drawn were that, with solutions of sodium nitrite, the probability is that nitrogen peroxide ions react with the aluminium anode to give aluminium nitrite, which is hydrolysed rapidly to hydrated aluminium oxide and nitrous acid, the latter giving rise to nitric acid and nitric oxide. No evidence is given by these experiments of the formation of a complex ion of aluminium with solutions of sodium nitrite, but with potassium oxalate the product of reaction at the anode is a complex ion derived from aluminium.

A paper on "Electric Potential of Antimony Lead Alloys" was read by Mr. S. D. Muzaffar, who described how these measurements are made by a quadrant electrometer against a calomel electrode in N KOH, N $Pb(NO_3)_2$, and tartar emetic with tartaric acid solutions. By this means the possibility of electrolysis by the flow of current through the cell is avoided. The results, which are in agreement with those of Charpy and other workers, prove that no chemical compound is formed between the metals, that no solid solution is formed and that up to 98 per cent. of antimony the potential is identical with that of lead.

THE CHEMICAL SOCIETY

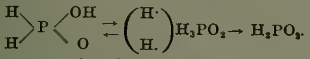
The following papers were selected for reading at the meeting held on February 15:—(1) "Spinacene: its oxidation and decomposition": A. Chaston Chapman. (2) "Investigations on the dependence of rotary power on chemical constitution. Part XIX. The rotary and refractive dispersion of d-γ-nonyl nitrite": R. H. Pickard and H. Hunter. (3) "Investigations on the dependence of rotary power on chemical constitution. Part XX. The rotary dispersive powers of oxygen compounds containing the secondary octyl radicle": H. Hunter. (4) "Studies on hypophosphorus acid. Part V. Its reaction with silver nitrate": A. D. Mitchell. (5) "The form of the vapour pressure curve at high temperatures. Part II. The curve for sodium cyanide": C. K. Ingold. (6) "The properties of ammonium nitrate. Part V. The reciprocal salt-pair ammonium nitrate and potassium chloride": E. P. Perman and H. L. Saunders. (7) "The morphine group. Parts I. and II.": J. M. Gulland and R. Robinson. (8) "A synthesis of pyrylium salts of anthocyanidin type. Part II.": D. D. Pratt and R. Robinson.

Owing to the number of papers on the list the authors merely summarised their communications, and none of the papers gave rise to any discussion. The meeting was presided over by Prof. Lowry and later by Prof. J. F. Thorpe. The following names were given as proposed for election as honorary Fellows: Bohnslow Brauner, Ernst Cohen, Gilbert Newton Lewis, Charles Moureu, Amé Pictet, and Theodor Svedberg. Prof. Pickard dealt with both papers on the investigation on the dependence of rotary power on chemical constitution and Prof. Robinson briefly summarised the last three papers on the list.

Mr. Chaston Chapman's paper on "Spinacene" amended, and added to, work which he had published in 1918. This substance, derived from shark-liver oil, he now considers to be a hydrocarbon, $C_{29}H_{48}$, with six ethenoid linkings; experimental data were adduced in support of the formula. On hydrogenation a colourless liquid, completely devoid of odour, was obtained, evidently the saturated hydrocarbon $C_{29}H_{60}$, for which the author proposes the name *spinacane* to indicate its relationship with *spinacene*. A dodecabromide, $C_{29}H_{48}Br_{12}$, was obtained, and treatment with hydrogen peroxide, the substance being resistant to ordinary oxidation, yielded a product $C_{27}H_{48}O_8$ and also a further one with acidic properties $C_{25}H_{44}O_7$. The decomposition of spinacene by heat alone produced an olefine hydrocarbon heparene, $C_{10}H_{18}$, whereas distillation with sodium under reduced pressure yielded as main product cyclo-dihydroterpene.

Prof. Pickard dealt with relationships between optical activity, refractive index, dispersion and absorption spectra. Coloured liquids were investigated, the effect of which appeared in a measurable part of the spectrum. The suggestion was made that geometrical isomerides might perhaps account for complex dispersion.

The case for tautomerism of hypophosphorous acid was stated by Dr. Mitchell, who suggested that the change from an inactive to an active form which affected reduction took place as follows:—



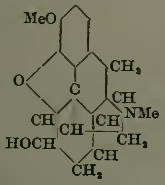
$$\begin{matrix}H\\H\end{matrix}\!\!>P\!<\!\!\begin{matrix}OH\\O\end{matrix}\ \rightleftarrows\ \left(\begin{matrix}H\cdot\\H.\end{matrix}\right)H_3PO_2 \rightarrow H_3PO_3.$$

inactive active

The active form is given as an empirical formula without assigning to it any particular constitution. The change is catalysed by hydrogen ions in both directions.

Dr. Ingold pointed out the four unwarranted assumptions made in calculating thermodynamically the connexion between latent heat of vaporisation and vapour pressure. Using the Nernst equation he applied an extrapolation test in the case of sodium cyanide. Dr. Perman drew diagrams of ammonium nitrate potassium chloride mixtures.

Prof. Robinson discussed formulæ for morphine. He suggested and gave evidence for a bridge formula:—



During the meeting Dr. A. Scott announced that he had received a letter from Messrs. Coster and Hevesy acknowledging the samples he had sent. Prof. Bohr had continued the examination and had found lines corresponding to no known element. The assumption is, therefore, that Dr. Scott's element is not hafnium. Dr. Scott stated that he was continuing work with the material he had at his disposal. He pointed out that the original sand from which he had isolated his oxide contained 25 per cent. titanium, whereas the sand which had been described as occupying a belt 70 miles in extent contained only 10 per cent. titanium. Hence the question of the correct kind of sand might be all important.

INSTITUTION OF PETROLEUM TECHNOLOGISTS

At the meeting held on February 13, Prof. J. S. S. Brame in the chair, Mr. G. W. E. Gibson presented a paper entitled "Some Practical Notes on Oil Pumping."

The author discussed various types of pumps and the methods by which they are driven, drawing attention to the Twells patent valve motion, which aims at the prevention of short stroking. Emphasis was laid on the necessity for suction mains of large diameter and for fitting large suction and delivery valves to pumps that were intended to handle very viscous liquids. The practice of listing the capacities of oil pumps in gallons of water was justified on the ground that, since the viscosity of oils is such a variable quantity, this method gave a reliable figure, from which the practical oil man could determine the pump's performance when handling a particular oil. A view of a pump, used for transporting oil at 400° C., was shown. In this pump the moving parts were protected from the hot oil by a column of cold liquid. During the discussion, in which Messrs. Anfilogoff, Barringer, Challenger, Evans, Professor Hinchley and Dr. Ormandy took part, the opinion was expressed that piston pumps were quite as suitable as plunger pumps for high pressure work. Some speakers objected to belt-driven pumps on the ground that sparks caused by electrical discharges from the belts were dangerous, especially if the pump was used with low flash-point oils. Similar arguments were advanced against the use of high-speed centrifugal pumps. The absorption of oxygen by oil was advanced as one of the contributory causes to the necessity for frequent renewal of air in the air vessels of oil pumps. Other views were expressed that greater attention should be given to the design of suction orifices, and that pumps should be designed with a view to efficiency rather than cheapness.

SAFEGUARDING OF INDUSTRIES ACT

The Board of Trade has received complaints that Rochelle salts and formaldehyde have been improperly included in the lists of articles dutiable under Part I. of the Act. Those interested should communicate at once with the Board.

CORRESPONDENCE

PROFESSOR ARMSTRONG AND THE SMOKE ABATEMENT COMMITTEE

Sir,—I do not wish to prolong a discussion on the above subject, but I would like to offer a word in reply to Professor Bone, because I think that neither he nor Professor Armstrong quite grasp the main object of the Committee. It was not to advise about the best method of stoking a boiler or of firing any other form of furnace or of economising fuel, or even about the kind of fuel to use, but to suggest legislation which should afford the strongest possible inducement to the community to reduce the amount of smoke discharged into the air. When the Committee was told by men intimately acquainted with boiler practice that a boiler chimney need not emit smoke, it does not require the technical knowledge of a Professor Bone or Armstrong to devise efficient regulations to stop smoke from boiler chimneys. The function of the technical expert is made quite clear in Professor Bone's letter, in which he suggests a sort of advisory committee such as was established long ago abroad. Let the manufacturer who gets into difficulties with the authorities go to this committee for advice.

Any common-sense person with a judicial mind and a *trustworthy knowledge of the facts* can draft a good smoke abatement Bill. The great difficulty in a matter of this sort is in obtaining trustworthy information, and for that reason some technical member on such a committee is, of course, desirable. So far I quite agree with the critics.—I am, Sir, etc.,

J. B. Cohen

The University, Leeds.
February 16, 1923.

SMOKE ABATEMENT

Sir,—I hope this correspondence of our gifted experts may not end in smoke! It seems to me as an outsider—seeing a good deal of the smoke—that industry is likely to take much more care of its fuel in the near future owing to higher prices, and there will be sufficient driving force towards reform.

And our humble homes are quite commonly reduced to one smoky fire instead of the three or four of past times. We have been driven to save labour and smoke.

The only practical way of eliminating domestic smoke—for one fire we must have—is for gas works to supply us with smokeless solid fuel.

Gas works alone have the right to distribute gas, the valuable by-product of smokeless fuel. A special company proposing to make smokeless fuel cannot market its gas to any advantage; it may indeed, I have seen it so done, have to dispose of gas to be burnt under steam boilers!

Gas works having a monopoly are our only hope, and so far they have declined to act; they are satisfied, perhaps justly, with the progress of their efforts to eliminate smoke by greater use of gas and do not wish to enter what is to them an untried field.

But we consumers can help them. I am sure that if a gas company or municipality would erect a special plant to produce a free-burning smokeless fuel with a guaranteed low ash content, it would be perfectly easy to secure a guaranteed consumption of the fuel at the market price of coal, by a few thousand well-wishers of the smokeless movement. Many of us would gladly put up with a not quite perfect product in the experimental stage if we felt that clearer skies were in sight!

S. F. Dufton

Wallington, Surrey.
February 19, 1923.

PERSONALIA

Mr. G. S. Pawle has been appointed chairman of Walkers, Parker & Co., Ltd., in place of Mr. David Thomson, who has resigned, but retains his seat on the board.

Mr. D. C. Henry, M.A., has been appointed Lecturer in Colloid Physics in the University of Manchester, and will take charge of the newly-established colloids research laboratory.

The Greenwell Medal of the North of England Institution of Mining and Mechanical Engineers was presented in Newcastle on February 10 to Professor R. V. Wheeler, D.Sc., of Sheffield University, for researches into the chemical and physical properties of coal.

Mr. A. E. Levey, who has for the past five years been the chief technologist to the margarine and lard compound departments of the British Oil and Cake Mills, Ltd., Hull, has resigned his appointment and is leaving for the United States of America early in April.

Lieut.-Col. G. R. Lane-Fox, H.M. Secretary for Mines, has appointed Sir R. A. S. Redmayne chairman, and Messrs. J. Kane, A. M. Lamb, J. Till, and the Rt. Hon. T. Richards members of a committee to prepare, under the direction of the Safety in Mines Research Board, a scheme for investigating methods of reducing the number of accidents from falls of ground in coal mines.

* * *

Mr. P. C. A. Stewart, the well-known petroleum geologist, has been drowned while bathing in Balandra Bay, Trinidad.

The death is announced of Mr. D. Y. Cassels, senior partner of the firm of Pott, Cassels and Williamson, engineers and founders, Motherwell, near Glasgow.

With much regret we announce the death of Mr. Arthur Carey, at one time chairman of the Liverpool Section of the Society of Chemical Industry. An account of Mr. Carey's career was given in our last issue.

NEWS AND NOTES

BRITISH INDIA

The Coal Industry

A report on the production and consumption of coal in India in 1921 has been issued as a supplement to the *Indian Trade Journal* of January 25, 1923. The output of coal during 1921 amounted to 19,303,000 tons, an increase of 7·5 per cent. over the output in 1920, but about 3 per cent. less than the record production in 1919. By far the largest proportion of the output is produced in the Bengal, Bihar and Orissa coalfields, that of Jherria alone producing over 52 per cent. of the total. The average value of the coal at the pit's mouth per ton was 6 Rs. 12 A., compared with an average value in the United Kingdom for the five years ending 1920 of 15 Rs. 9 A. Altogether 205,879 persons were employed, the average output per person employed being 94 tons, compared with 743 in the United States, 184 in the United Kingdom, and 155 in Germany. This small output is due to the fluctuating supply of labour, but production will probably increase within the next few years as coal-cutting by machinery is extending.

Exports of coal during 1921 totalled 275,571 tons, and imports 1,090,749 tons. Of the coal consumed 30·8 per cent. is utilised on the railways, 7·1 per cent. is utilised in iron, steel and brass foundries, and 2·2 per cent. in brick and tile factories, potteries and cement works. Owing to the fact that the coal now being won in India is comparatively near the surface it costs less at the pit's mouth than coal in any other country, and with the discovery of new and valuable fields, coal-mining in India offers prospects of important development.

JAPAN.

Paper Combine in Japan

Japanese manufacturers of wood pulp have been forced to form a combine with a capital of 3 million yen under the name of Kyoto Pulp Kaisha to meet foreign competition both at home and abroad. The difficult situation caused by strong Canadian competition is to be met by the reduction of the total annual productive capacity from 120,000 to 100,000 tons. —(*U.S. Com. Rep., Jan.* 1, 1923.)

GENERAL

Ramsay Memorial Fellowship Trust

This Trust, which has just issued a report and accounts for the year ending August 31, 1922, was constituted for the purpose of administering the Ramsay Fellowships for chemical science. The report is a very striking document, disclosing, as it does, the wonderfully international character of the Ramsay Memorial. Records are given of three general Fellowships, all of which have been awarded and are held by students actively engaged upon research, one at Oxford and two at University College, London. The Fellowships associated especially with Glasgow, Japan, Canada, Sweden, Norway, Switzerland, Denmark and Holland have all been awarded, whilst those of Greece, Italy, Spain and France have not yet been filled. A considerable number of the Fellows will work under Professor Donnan in London, but a fair number of Fellows go to other chemical centres in the country. The annual value of the Fellowship is usually about £300, and in one or two cases considerably higher. Japan gives £460. It is certainly a matter of great gratification to see this change of attitude in chemistry, provision now being made for the access of foreign students to higher chemical studies in this country. It is something like a reversal of the conditions which prevailed a generation ago. Certainly no chemist could wish for a nobler memorial to Ramsay than that now associated with his name.

The New Botanical Laboratory of the Imperial College.

On February 16 the Duke of Devonshire opened the new Botanical Laboratory of the Imperial College of Science and Technology in the presence of a distinguished gathering. The new laboratory, which is devoted to plant technology, forms part of a scheme of development of the Imperial College, which aims at providing men qualified to investigate and advise on problems relating to plant growth, such as parasitic diseases, manuring and plant breeding, as well as the manufacture of plant products. Space and equipment is provided in the laboratory for the study of all these problems and an interesting series of exhibits, ranging from diseases of the rubber tree, methods of preserving latex, and apparatus for investigating the vital functions of plants, to specimens illustrating the manufacture of tiles from castor-seed residues, indicated the wide scope and industrial bearing of the new department. In declaring the laboratory open the Duke of Devonshire instanced the enormous importance of the application of science to the many problems inherent to agricultural development by stating that in tropical Africa alone the British Dependencies covered an area of a million square miles and contained some thirty million inhabitants who were almost solely dependent on agriculture for their prosperity.

New British Chemical Standard: Basic Slag "A."

The organisers of the British Chemical Standards' Movement announce the issue of a basic-slag standard. The special uses of the slag are :—(1) Primarily as an analytical standard for total phosphoric acid and phosphates ; (2) in addition, as a standard mainly for basic-steel makers, but also for acid-steel makers, iron and steel founders and others, to enable them to check their methods for silica, iron, lime and magnesia, etc., in slag.

The analysis is as follows, per cent. :—Phosphoric anhydride (P_2O_5), 12·93 ; equal to phosphates [$Ca_3(PO_4)_2$], 28·24 ; iron, 8·97 ; silica, 16·15 ; lime and magnesia to follow.

During the standardisation of this slag the need for such a standard has been made abundantly evident, for it has been found that even in the determination of such elements as iron, silica, lime and magnesium, which, it may be thought, presents little or no difficulty, improvements in methods have been essential in order to get agreement between experienced chemists. The standard has been tested by a selection of sixteen prominent chemists representing :—Independent analysts : (1) metallurgical, (2) agricultural ; U.S. Bureau of Standards ; English and French iron and steel works chemists (manufacturers) ; English basic-slag grinders and merchants.

The standard sample may be obtained in 100 or 50 gramme bottles at a price just sufficient to cover the cost, either direct from Organising Headquarters, 3, Wilson Street, Middlesbrough, or through any of the leading laboratory furnishers. A certificate giving the names of the analysts co-operating, the types of methods used, and a detailed list of the results will be supplied with each bottle. A special feature of this certificate is the very full notes on the methods used by the different chemists (3 quarto pages in small type). It is hoped that chemists will take full advantage of this standard which has been prepared with the object of promoting unification of analysis.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for February* 15)

TARIFF CUSTOMS EXCISE

Antigua.—Revisions in the export duties affect sugar, syrup, molasses, and cotton.

Australia.—" Dumping exchange " duties have been applied to goods from Czechoslovakia. The prohibition on the importation of calcium carbide has been removed. The application of import duties on citric acid, gunpowder, etc., and certain wares of iron and steel has been deferred.

Austria.—Export licences are required for crude potash salts, supephosphates, manures and fertilisers, and gas-purifying material.

Germany.—The text of the customs regulations of the territory occupied by France and Belgium is given in the issue for February 15.

Italy-Switzerland.—The text of the commercial treaty signed on January 27 is given in the issue for February 15.

Morocco (French).—A decree has been issued regulating the importation and sale of opium, morphine, heroin, cocaine and hashish.

Norway.—All the rates of the customs tariff have been increased by 20 per cent., except those affecting sugar and goods on which the duties are fixed by Treaty.

Rumania.—The export of hides of all kinds is prohibited.

San Salvador.—The import duties on a wide range of pharmaceutical specialities have been reduced from 1 dollar to 40 centavos (gold) per kg.

Switzerland.—The special tax on imported coal has been reduced from 40 to 25 centimes per 100 kg.

Tunis.—The import duties on coal-tar dyes have been further modified.

Uganda.—Regulations controlling the purchase, sale, production, etc. of cotton have been issued.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Tiles	198
,, ..	Ammonium chloride, Leclanché cells and jars (tenders for) ..	10542/E.D./1/C.C. and 2/M.C.
British Guiana	Portland cement, galvanised sheets ..	201
Canada ..	High-speed steel ..	202
,, ..	Drugs	204
,, ..	Wire	10459/E.D./E.C.2.
Egypt ..	Soft soap (tender for)	*
Haiti	Cement	7476/F.L./M.C./2.
Japan ..	Glass, glassware ..	225/14/F.G./M.C./A.
South Africa..	Oxygen gas (tender for)	10549/E.D./C.C.
Spain	Iron ore, coal ..	216
,, ...	Fertilisers, agricultural chemicals	217
Switzerland ..	Paper	218
United States	Shellac..	18088/F.W./C.C.
Uruguay ..	Fuel oil (tender for) ..	7541/F.L./C.C.2.

* Ref. Muh. 1923/26/4. Inspecting Engineer, Egyptian and Sudan Governments, Queen Anne's Chambers, London, S.W. 1.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Ammonium Sulphate

Sir R. Sanders, replying to Sir B. Sheffield, said that the present price of neutral ammonium sulphate containing 25·37 per cent. of ammonia was £16 18s. per ton. As the increase of price compared with that in February, 1922, was only 1·5 per cent., no profiteering existed.—(Feb. 15.)

Dangerous Drugs and Poisons (Amendment) Bill

Mr. Bridgeman presented the above Bill to amend the Dangerous Drugs Act, 1920, and Section 17 of the Pharmacy Act, 1868, and to prescribe a method of calculating percentages in liquid preparations for the purpose of the Poisons and Pharmacy Act, 1908, and the Dangerous Drugs Act, 1920.—(Feb. 15.)

Chemical Trade Regulations

In reply to Mr. Wignall, Mr. Bridgeman said that the Draft Welfare Regulations for the chemical trade were made in July last, and many of them came into force on October 1. Strong objection, however, was taken to the enforcement of certain of the regulations which would have involved structural alterations, and it was agreed that these requirements should not be enforced until a date to be fixed by the Home Secretary.—(Feb. 15.)

Merchandise Marks Bill

Sir W. Joynson-Hicks informed Sir J. Hood that he was considering questions relating to this Bill and could not say when it would be ready.—(Feb. 15.)

REVIEWS

The Official Directory of Members of the Association of British Chemical Manufacturers, with Classified List of their Manufactures. *Pp.* 319. *Published by the Association*, 166, *Piccadilly, London. Price* 10*s*. 6*d*.

This volume, published by the Association of British Chemical Manufacturers, constitutes a valuable guide for the purchase of chemical products of all kinds. Printed in English and in five other languages, it will be found of great value to intending purchasers, as the list of chemical products covers a very wide range, and in addition a supplementary list of proprietary and trade names, comprising the scientific name of the products and the name of the manufacturer, is also given. An interesting feature is that in ordering any of the products contained in the list, purchasers can be certain that the goods they order are actually produced in this country, as all members of the Association are *bonâ-fide* manufacturers. The enterprise of the Association in issuing this handy and conveniently arranged volume is to be commended, and it is to be hoped that it will be used extensively by all those who purchase or use chemicals.

Modern Gasworks Chemistry. *By* Dr. G. Weyman. *Pp. ix*+184. *London: Benn Brothers, Ltd.*, 1922. *Price* 25*s. net.*

Dr. Weyman is to be congratulated on his excellent book, which so admirably fulfils its object, viz., to describe the methods of controlling plants and processes in everyday use in the gas industry. The book is divided into chapters dealing with Coal—Carbonisation—Coke; Maintenance of Heats; Refractory and Insulating Materials, Tar; Ammonia; Oxide Purification; Town Gas; Water Gas; Steam Raising and Water Supply; Lubricants. Each chapter consists of a brief discussion of the subject to which it is devoted, methods of control and analysis being given, followed by a list of references to books or original papers bearing on the text. The book practically covers the whole field of chemical methods, without being overburdened with detail.

The value of the book lies in the fact that it is not merely a compilation of tests and methods culled at second hand, but has been written after much careful thought, and sifting of methods by trial from the author's own personal experience. As instances of the scope and utility of the book to the gas engineer and chemist engaged in the industry, Chapter III deals with the chemical control of the carbonisation process; the choice and blending of coals; and the conditions conducing to the efficient working of the retorts; time and yield factors; gas sampling and analysis. Chapter V deals with the maintenance of heats; causes of fluctuation; the various methods of pyrometric control, and analysis of producer gas. Chapter VII, on Tar, describes the recovery of tar from crude gas; the importance of temperature control in the cooling and condensing system; the methods of analysis of tar and its primary distillation products. Chapter VIII covers the production of ammonia from the retort house until finally sent away as sulphate. The book is well got up and well illustrated. It contains a list of useful tables, as well as a subject index and name index.

One important subject has been omitted altogether, viz., the removal and recovery of cyanide compounds, a subject vastly more important to the manufacturer of gas than the question of lubrication.

Dr. Weyman has produced an exceedingly useful and practical book, which fills a long-felt need, and one feels sure that the book will find a ready welcome from all interested in gas manufacture.

W. A. Walmsley

(1) Calculations of Quantitative Chemical Analysis. *By* L. F. Hamilton *and* S. G. Simpson. *International Chemical Series. Pp.* x+196. *New York and London. McGraw-Hill Book Co.*, 1922. *Price* 10*s*.

(2) A Systematic Qualitative Chemical Analysis. *By* Prof. G. W. Sears, Ph.D. *Pp.* vi+119. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.*, 1922. *Price* 8*s*. 6*d*.

(1) This volume keeps strictly to its title subject—the calculations of quantitative analysis, avoiding the calculations of pure and physical chemistry, and hence meets a decided want. The author rightly states that the knowledge of the chemical principles of analysis and the acquirement of manipulative skill are of little practical value unless they are accompanied by the ability to compute and interpret results from analytical data quickly and correctly. Certainly the student who works systematically through this volume cannot fail to achieve this desired ability. The general arrangement of the volume is to take typical chemical problems arising out of gravimetric and volumetric analysis, subdividing them into problems relating to atomic-weight determinations, electrolysis, oxidation and reduction processes, gas analysis, etc., and after a very brief description of the chemical reactions involved, to treat the problems on simple arithmetical or algebraical lines, first giving a fully worked-out example and then numerous cognate problems with answers attached. The examples given are extremely apt and well chosen and of a most practical nature. It is particularly interesting to note that the authors introduce at every possible opportunity moisture, impurity, burette and volumetric factor corrections, such as are invariably found in practical analysis, thereby impressing their importance and reality on the student. The volume can be strongly recommended as a companion volume to any text book of quantitative analysis. The type is excellent and remarkably free from printers' errors. Some useful tables are appended, but it would have been advisable to have also included a comprehensive table of factors for volumetric and gravimetric analysis, particularly as some care is taken in the text to explain how they are obtained and used.

Nearly three hundred questions without answers are appended. The reviewer cannot resist the temptation to quote one as indicative of the ingenuity displayed in their selection:—"A sample of soda ash is given to a student for analysis. He uses a 0·9000 gram sample and titrates with 0·3/N HCl, passing the end point and running back with exactly 8 c.c. of 0·3/N NaOH. His NaOH burette is accurately graduated, but the bore of the other burette, although uniform throughout its entire length, is not of correct size to agree with the graduations. Not knowing this, the student calculates the analysis and reports 64·50 per cent. Na_2CO_3 If he had used the accurate burette for the HCl and the other burette for NaOH, he would have reported 66·33 per cent. What was the true per cent. Na_2CO_3 in the sample?" As quite a number of similar questions are given it is obviously advisable for a student who knows his future examiner to be in possession of this volume to arm himself similarly.

(2) It is difficult to see what justification there is for a book such as the one under review, the subject matter of which is largely to be found in any one of the innumerable existing text books on qualitative analysis.

For the detection of metallic radicles the usual group precipitation methods are given, interposed with a brief discussion of the reactions involved and precautions to be taken, but the text is of that irritating description necessitating the constant turning of pages to follow out a given procedure. The following extract gives a good idea of the author's style:—"Acidify the filtrate with HNO_3 noting if a gas is evolved (see discussion 60), and treat by (110), treat the residue by (101)." When the number happens to be wrongly quoted as on p. 43, line 19, the reader finds himself instructed to carry out the tests for the members of the copper group on the solution obtained after addition of stannous chloride to the mercuric sulphide precipitate after dissolving in aqua regia. A judicious use of schematic diagrams would probably have resulted in cutting down the text by half with a more than corresponding increase in lucidity.

For the identification of acid radicles a new scheme is given following the method of procedure generally adopted for metallic radicles *i.e.*, a single sample is taken and the acid radicles separated and detected by a series of group reactions. The scheme, however, is only applicable to a very limited number of inorganic and organic acids and no provision is made for the identification of acids, *e.g.*, formates, chlorates, iodates, etc., which do not fit into the scheme.

For the elementary student working with carefully selected simple mixtures the volume might be of some value, but a mixture of quite moderate complexity would speedily force him to refer to a more comprehensive, although not necessarily larger volume. The absence of alternative and confirmatory tests for acids and bases other than those given in the group reactions as well as the absence of any index greatly reduces what value the book might have. The volume is well bound and printed, but contains an inexcusably large number of typographical errors, particularly in chemical formulæ.

T. Callan

Starch and Starch Products. By H. A. Aunden, M.Sc., D.Sc. *Pitman's Common Commodities and Industries Series. Pp.* xiii—121. *London : Sir Isaac Pitman and Sons, Ltd.*, 1922. *Price* 3*s*.

Events of recent years have served to remind us rather forcibly of the importance of starch-producing plants and of their scientifically-controlled cultivation. Apart from the food requirements of the human race there are numerous industrial demands upon starch and its products, and lastly, its potentialities as a source of power alcohol render its increased production in the future a matter of great importance.

In this little book there is a brief but comprehensive sketch of the world's chief natural resources in this respect. There is a chapter devoted to each of the more important sources of starch, dealing with the methods of cultivation, and the primitive and modern processes of preparation and purification of the final product.

Like the rest of the series, this book deals mainly with the industrial and technical aspects of the subject. It contains comparatively little pure chemistry. One chapter deals with general properties, another with the production of glucose, dextrin, etc. ; whilst another is devoted to the fermentation products. Although the book is not necessarily written for chemists, there are one or two mentionable instances of lack of precision in dealing with chemical matters. Perhaps the most pronounced is where the author, discussing the products of acid hydrolysis of starch, says : "This sugar has been proved to be identical with that found in sweet fruits and honey, and for this reason has received the name of grape sugar, fruit sugar, or glucose." Fruit sugar is a name for fructose or lævulose, which occurs together with glucose or grape sugar in many sweet fruits, and in honey.

A number of illustrations (mostly technical) and a large quantity of interesting information of a general and diverse character, are given, but, as already inferred, the scope of the book is industrial rather than chemical.

R. H. Hopkins

REPORT

Report on the Finance, Industry and Trade of Peru, Dated September, 1922. *By* A. J. Hill, *Acting H.M. Consul, Callao. Pp.* 23. *Department of Overseas Trade. H.M. Stationery Office.* 1923. *Price* 9*d*.

There are three distinct natural divisions in Peru. The Pacific coastal region, containing most of the cities and of the white population, produces principally sugar, cotton, petroleum, wool, hides and skins. The mountain region, though exceedingly rich in minerals, cannot be thoroughly developed owing to the lack of railways. The tropical lowlands of the Amazon region have hitherto depended for their prosperity on the collection of wild rubber, though the forests would provide an almost unlimited quantity of pulp wood and timber.

The sugar production for 1921 is estimated at under 300,000 tons, an improvement being anticipated for 1922. Although Peruvian rubber is available in enormous quantities, the cost of transport renders it unable to compete with that from the other markets. The most important copper-producing concerns are the Cerro de Pasco Copper Corporation and its subsidiary company, the Backus and Johnston Mining Co. The total output of copper in 1921 was 33,284 tons, the output in 1922 being estimated at about 35,000 tons. Development of the petroleum industry in Peru has been delayed, but in January, 1922, a new law came into force governing the granting of "exploration concessions," and 1923 is likely to see extensive prospecting. In 1921 the output of petroleum was 488,669 tons against 373,280 tons in 1920. The Backus and Johnston Mining Co., at Casapalca, and the Anglo-French Ticapampa Mining Co., at Ticapampa, produced 9,855,000 oz. troy of silver in 1921. Coal was produced in 1921 to the extent of 357,315 tons, but was insufficient for the needs of the producers, the Copper Corporation (Cerro de Pasco). Gold was mined in 1921 to the extent of 77,400 oz. troy. Only 1776 tons of vanadium grade ore (20 per cent. grade) was produced, owing to the closing of the Mina Ragra mine early in 1921. Exploration for mercury is being carried on at Huancavelica, so far without success. The chief industries carried on in the country include copper-smelting, sugar-refining, cotton-seed oil refining, soap-making and tanning. Trade depression has continued throughout the period covered by the report, but with little buying from abroad, and reduction of existing stocks, and with a favourable trade balance, a better time appears likely.

The latest complete trade figures are for 1920 (for 1919 see J., 1922, 162 R), when exports amounted to £p.35,304,155 (£p.1 = £1 at par), the United States taking 46·1 per cent. and the United Kingdom 35·9 per cent. The chief items were :—Sugar, £15,584,889 ; hides, £358,426 ; rubber, £200,738 ; cocaine, £35,932 ; alcohol, £33,868 ; metals, £4,978,699 ; salts (borates), £3166 ; petroleum, £1,430,953. Imports were valued at £18,358,223, of which the United States supplied 55·4 per cent. and the United Kingdom 14·7 per cent. In the analysis appear :—Colouring materials, £805,761 ; liquors, £584,418 ; medicinal products, £984,856. More recent figures show that in 1921 exports amounted to £15,700,616 and imports to £15,521,706 ; for the first half of 1922 the corresponding figures are £7,937,052 and £4,780,889. Competition of British goods, particularly with American, continues keen ; German and Japanese goods are also on the market.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

There is little or no change to record in the Chemical Market.

Acid Acetic, 40% tech. ..	£22 per ton. Firmness of position continues, with tendency for price to rise.
Acid Hydrochloric ..	4s. to 5s. carboy d/d.
Acid Nitric, 80° Tw. ..	£25 10s. per ton.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works with slight variations up and down due to local considerations
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d.-£8 per ton. Rather quieter tone.
Arsenic (Alkali) ..	£75 per ton. Shortage continues, but inquiry not quite so brisk.
Bisulphite of Lime ..	£7 per ton, packages extra and returnable.
Bleaching Powder ..	£10 10s. per ton. Not much change.
Calcium Chloride ..	£6 per ton d/d. Considerable quantities reported imported from the Continent.
Copper Sulphate ..	£26 10s. per ton f.o.b.
Potash Caustic, 88/90%	£29-£30 per ton. No change.
Potass. Bichromate ..	6¼d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.-£5 10s. per ton. Considerable American inquiry, but not much business passing up to the present.
Soda Caustic, 76% ..	£20-£21 per ton. In slightly better request.
Soda Crystals	£5 10s. per ton carr. paid. No change.
Sod. Acetate, 97/98% ..	£23 10s. per ton. In fair demand. Price firm.
Sod. Bicarbonate ..	£10 10s. per ton. Still in fair demand.
Sod. Bisulphite Powder, 60/62%	£19-£20 10s. per ton f.o.b. or f.o.r. London.
Sod. Chlorate	Market very dull and prices not at all firm.
Sod. Nitrite	£30 per ton 100% basis d/d.
Sod. Sulphide, solid ..	£16 per ton carr. paid. Price unsteady and demand still very poor.
Sod. Sulphite, Pea Cryst.	£17-£17 10s., 1-cwt. wooden kegs included.

WOOD DISTILLATION PRODUCTS

There is a brisk inquiry for products generally, and prices remain firm or show a slight upward tendency.

Acetate of Lime—	
Brown	£9 per ton d/d.
Grey	£18 10s. per ton d/d.
Liquor	9d. per gall. 32° Tw. d/d.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. ,, , 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	7s. ,, ,, 80% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead ..	£38 per ton d/d.

TAR PRODUCTS

Acid Carbolic, Crude 60's	2s. 11d. to 3s. per gall. Good demand.
Acid Cresylic—97/99 ..	2s.-2s. 3d. per gall.
Pale 95%	1s. 10d.-2s. 2d. per gall.
Dark ..	1s. 8d.-2s. per gall.
Anthracene Paste, 40%	4d. per unit per cwt. No business, price nominal.
Anthracene Oil—	
Strained	9d.-11d. per gall. Fair inquiry.
Unstrained	8½d. per gall.
Benzole—	
Crude 65's	1s. 1½d.-1s. 2d. per gall.
Standard Motor ..	1s. 8d.-2s. per gall.
Pure	2s.-2s. 2d. per gall.
Toluole—90%	1s. 9d.-2s. per gall.
Pure	1s. 11d.-2s. 3d. per gall.
Xylol	2s. 9d.-3s. 3d. per gall.
Creosote—	
Cresylic, 20/24% ..	10½d.-1s. 1d. per gall. Fair inquiry.
Middle Oil	7¼d.-9¼d., according to district. Plenty of enquiries.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d.-9½d. per gall.
Solvent, 90/160 ..	1s. 7d.-1s. 10d. per gall. Market dull
Solvent, 90/190 ..	1s. 7d. per gall. Little or no business doing.
Naphthalene, Crude—	
Drained Creosote Salts	£6-£9 10s. per ton Market short.
Whizzed or hot pressed	£10-£12 per ton. Fair enquiry.
Naphthalene—Crystals ..	£17 per ton.
Flaked ..	£15 per ton.
Pitch, medium soft ..	155s.-160s. f.a.s. Manchester. Many buyers.
Pyridine—90/140 ..	10s. 6d.-12s. 6d. per gall. Not much business doing.
Heavy ..	8s.-9s. per gall. Price nominal. No business.

INTERMEDIATES AND DYES

Business in Aniline Dyestuffs still remains good. A fair amount of business has passed, and there is every indication that there will be a still further increase in the volume of trade. Prices remain very firm.

Acetic Anhydride ..	1s. 5d. 100% basis.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic ..	2s. 7½d. lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic ..	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhydrous	1s. per lb. d/d.
Aniline Oil and Salts ..	10d. per lb. naked at works.
Antimony Pentachloride	1s. 1d. per lb.

Benzidine Base ..	.. 6s. 6d. per lb. 100% basis.
Benzyl Chloride ..	.. 1s. 4½d. per lb. 100% basis.
Dinitrobenzene ..	.. 11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	.. £95 per ton.
Dinitrophenol ..	.. £140 per ton.
Dinitrotoluene—48/50 ..	8d.-9d. naked at works.
66/68 ..	1s. 2d.-1s. 3d. naked at works
Diphenylamine ..	.. 4s. per lb. d/d.
Dichloraniline ..	.. 2s. 2d. per lb. 100% basis.
Dichloraniline S Acid ..	2s. 4d. per lb. 100% basis.
Diethylaniline ..	.. 4s. 6d. per lb. d/d, packages extra.
Metanitraniline ..	.. 5s. 6d. per lb. d/d.
Meta Phenylene Diamine	5s. 6d. per lb. d/d.
Meta Toluylene Diamine	5s. per lb. d/d.
Monochlorbenzol	.. £70 per ton.
α-Naphthol ..	.. 2s. 9d. per lb.
β-Naphthol ..	.. 1s. 1d. per lb. d/d.
α-Naphthylamine	.. 1s. 6½d. per lb. d/d.
β-Naphthylamine	.. 4s. per lb. d/d.
p-Nitraniline ..	.. 2s. 8d. per lb. d/d.
Nitrobenzene ..	.. 7½d. per lb., drums extra.
Nitronaphthalene	.. 1s. per lb. d/d.
Naphthionate Soda	.. 2s. 8½d. lb. 100% basis d/d.
Orthonitrochlorbenzol ..	2s. per lb.
Paradichlorbenzol	.. £55 per ton.
Paranitrophenol	.. 1s. 9d. per lb. 100% basis.
Parachloraniline	.. 3s. per lb. 100% basis.
p-Nitro-*o*-amido-phenol ..	4s. 6d. per lb. 100% basis.
Para Phenylene Diamine	12s. per lb. 100% basis d/d.
Para Toluidine ..	.. 5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid Acetic, 80% B.P. ..	£45-£47 per ton. Good inquiry. Prices have upward tendency.
Acid Acetyl Salicylic	.. 3s. per lb. Market exceedingly firm owing to continued increase in cost of raw materials.
Acid Benzoic ..	.. 2s.-2s. 2d. per lb. Not much on offer for spot delivery.
Acid Boric, B.P.	.. £61 per ton Crystals, £65 per ton Powder, packages in 2-cwt. bags, carr. paid U.K. Market steady.
Acid Citric ..	.. 1s. 7d.-1s. 9d. per lb. Market quiet.
Acid Gallic ..	.. 3s. per lb.
Acid Pyrogallic, cryst. ..	5s. 6d. per lb.
Acid Salicylic ..	.. 1s. 7d. per lb. Market stiffening up owing to carbolic position.
Acid Tannic ..	.. 3s. 3d. per lb. Unchanged.
Acid Tartaric ..	.. 1s. 2½d., less 5% demand still good. In spite of the depreciated exchanges the Raw Material Market remains difficult and prices continue to advance. For this reason alone the price of the finished article is likely to rise still further in the near future.
Acetanilide ..	.. 1s. 6d. per lb. neglected.
Amidol	.. 9s. per lb.
Amidopyrin ..	.. 13s. per lb. weaker.
Ammon. Benzoate	.. Still 3s. lb. for good makes.
Ammon. Sulphocyanide	2s. 6d. lb. for recrystallised.
Barbitone ..	.. 12s. 6d. per lb.
Benzonaphthol ..	.. 5s. per lb.
Bismuth Salts ..	.. Prices per lb. for cwt. lots are as follows:—Carbonate 13s., Citrate 11s. 7d., Nitrate cryst. 6s. 11d., Oxide 14s. 5d., Salicylic 10s. 5d., Subchlor 12s. 8d., Subgallate 9s. 6d., Sub. nitrate 11s. Fairly good market.
Bromides ..	.. Still in plentiful supply. Market unsettled.
Chloral Hydrate	.. 4s. lb. weaker.
Formaldehyde 40%	.. £90-£92 10s. per ton.
Guaiacol Carbonate	.. 8s. 6d. per lb. for small quantities. 8s. per lb. would be accepted for 1-cwt. lots.
Hexamine ..	.. 4s. per lb. now asked for spot parcels.
Homatropine Hydrobromide	.. 30s. per oz.
Iron Ammon. Citrate ..	B.P. 2s. 5d. lb. } Fair demand. Green 3s. 1d. lb. }
Magnesium Carbonate—	
Light Commercial	.. £40 per ton.
Magnesium Oxide—	
Light Commercial	.. £89 per ton.
Heavy Commercial	.. £29 per ton.
Menthol ..	.. 37s. per lb. less 2½% for original cases. Small quantities 37s. 6d. nett.
Methyl Salicylate	.. 2s. 3d. per lb. Slightly higher
Methyl Sulphonal	.. 13s. per lb.
Mercurials ..	.. Weak market.
Paraldehyde ..	.. 1s. 6d. per lb.
Phenacetin ..	.. 5s. per lb. Unchanged owing to lack of demand.
Phenazone ..	.. 7s. per lb.
Phenolphthalein	.. 5s. per lb. weaker, but lower prices would be acceptable for definite orders.
Potass. Bitartrate 99/100% (Cream of Tartar)	97s. 6d.-100s. per cwt. for ton lots less 2½%. Market firm.
Potass. Iodide ..	.. 15s. 8d. per lb. for cwt. lots. Cases free. Demand still good.
Potass. Metabisulphite ..	8d. per lb.
Potass. Permanganate ..	8½d. per lb.
Quinine Sulphate	.. 2s. 3d.-2s. 4d. per oz. Bulk packages. Steady market.
Resorcin	.. 5s. per lb. now quoted for good "White."
Salol	.. 2s. per lb. Unchanged.
Sod. Benzoate ..	.. 2s. 2d. per lb. Still in short supply.
Sod. Citrate ..	.. U.S.P. quality 2 mols. water quoted at 2s. 2d. per lb. for cwt. lots. B.P.C. quality 5 mols. water, 2s. per lb.
Sod. Hyposulphite—	
Photographic	.. £15-£17 per ton, according to quantity.

Sod. Salicylate	2s. 3d. for Powder, 2s. 4d. for Crystals. These prices show little profit to the manufacturers, and higher rates are expected in the near future.
Sod. Sulphite—	
Anhydrous	£27 10s.-£28 10s., according to quantity, f.o.r. London drums included.
Pea Crystals	£17-£17 10s. per ton, according to quantity.
Thymol	17s. to 19s. per lb., according to quantity. Much firmer.

PERFUMERY CHEMICALS

Amyl Acetate	2s. 3d.
Amyl Butyrate	8s.
Amyl Salicylate	3s. 3d.
Anethol (melting point 21°/22° C.)	4s. 6d.
Benzyl Acetate (from chlorine-free Benzyl Alcohol)	3s.
Benzyl Alcohol free from chlorine	3s.
Benzaldehyde, free from Chlorine	3s.
Benzyl Benzoate, 19.5°C.	3s.
Cinnamic Aldehyde—	
98/100% Natural	14s. 9d.
Coumarin	12s. 6d.
Citronellol	22s. 6d.
Citral, 100%	10s. 6d.
Ethyl Phthalate	4s. 3d.
Eugenol, 100%	11s.
Geraniol (Palmarosa)	30s.
Geraniol	5s. 6d.-12s. 6d.
Heliotropine	5s. 9d.
Iso Eugenol	18s. 6d.
Linalol ex Bois de Rose	21s.
Linanlyl Acetate	22s. 6d.
Methyl Benzoate	8s. 6d.
Musk Xylol	8s. 9d.
Phenyl Ethyl Acetate	10s.
Phenyl Ethyl Alcohol	17s. 6d.
Rhodinol	45s.

ESSENTIAL OILS

Anise Oil, Red Ship Brand	2s. 1d.
Bourbon Geranium Oil	26s. 6d. for shipment.
Cananga Oil, Java	9s. Firm.
Cinnamon Oil, Leaf	4d. per oz.
Cassia Oil, 80/85%	8s. 6d.
Citronella Oil—	
Java, 85/90%	3s. 6d.
Ceylon	3s. 3d.
Clove Oil	7s.
Eucalyptus Oil, 70/75%	1s. 8d.
Lavender Oil, Mont Blanc, 38/40%	12s. 6d.
Lemon Oil, Spot	2s. 11d. New crop for shipment 2s. 9d.
Orange Oil, Sweet, Spot	9s. 6d. New crop for shipment 8s. 6d.
Otto of Rose Oil—	
Anatolian	24s.
Bulgarian	26s.
Palma Rosa Oil	17s. 6d.
Peppermint Oil—	
English, Mitcham	80s.
Wayne County	13s.
Japanese	7s.

TRADE NOTES

Ceylon in 1921

The year was marked by serious depression in the Colony's chief industries—tea, rubber and plumbago. The rubber situation improved slightly, however, in the second half of the year and, by exercising great economy, estates were able to continue production. Greater attention was paid to preparation owing to the low prices of rubber, especially for mildewed or rusty sheet, and the manufacture of rubber goods has been initiated. Most estates continue to tap on alternate days, but the use of the 3-day tapping system is increasing. The coconut crop was good and exports of cardamoms, cinnamon, citronella oil and kapok increased. Plumbago mining continued to be in an unsatisfactory state and the production of mica was small. About 61 tons of monazite sand was produced at Bentola and trials of dressing plant show that at present prices it should be economically possible to treat the extensiv low-grade deposits of "black sand" on the west coast of the island. Imports were valued at Rs. 260,897,161 and exports at Rs. 256,600,413, the share of the United Kingdom being 25·32 and 46·22 per cent. respectively.—(*Col. Rep. Ann., No.* 1137, 1922.)

Dyestuffs (Import Regulation) Act, 1920

The Board of Trade has received the following statement relating to applications made during the month of January, 1923, for licences under the Dyestuffs (Import Regulation) Act, 1920, from the Dyestuffs Advisory Licensing Committee. Similar monthly statements will be issued regularly in future.

The total number of applications received was 562, of which 473 were from merchants and agents. These were dealt with as follows:—

Granted, 359 (of which 340 were dealt with within one week).

Refused, applicants being referred to British makers (British equivalents being available), 94 (of which 93 were dealt with within one week).

Referred to Reparation Supplies, 53 (of which 53 were dealt with within one week).

Outstanding on January 31, 56 (most of these were applications received on January 31, and 38 were dealt with on February 1).

Of the total number, 562, of applications received, 412, or 73 per cent., were dealt with within two days.

PUBLICATIONS RECEIVED

Plastics and Molded Electrical Insulation. *By* Emile Hemming. *Pp. vii*+313. *New York: The Chemical Catalog Co., Inc.*, 1923. *Price* $5.

The Properties of Some Nickel-Chromium Steels. *Research Department, Woolwich. R.D. Report No.* 55. *Pp.* 51. *H.M. Stationery Office*, 1923. *Price* 7*s.* 6*d.*

Paracelsus, His Personality and Influence as Physician, Chemist and Reformer. *By* Prof. J. M. Stillman. *Pp. viii*+184. *London: The Open Court Publishing Co.*, 149, *Strand, W.C.* 2. *Price* 10*s. net.*

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EDITORIAL

A NUMBER of circumstances have directed our thoughts to the Royal Society: a reference to Dr. Benjamin Franklin in the communication (the latest, not last) from the Rev. B. V. White, the bicentenary of the death of Sir Christopher Wren, and the announcement of the candidates recommended for election by the Council of the Society. There is no doubt that every now and then someone criticises the Royal Society and blames it for having no constructive policy. Such criticism has been indulged in for upwards of two hundred years, and our attention was recently drawn to the *Tatler*, in the year 1710 (No. 236), which stated that the Fellows seemed "to be in a confederacy against men of polite genius, noble thought and diffusive learning." Criticism of this type, and of other types of more recent date, may well continue for another couple of hundred years, for there seems to be no reason why the Royal Society should not flourish, root and branch, for ever. Time was when Science was so elementary that a man of polite genius and diffusive learning might be justly entitled to election to the Society. In the twentieth century diffusive knowledge is readily acquired and not highly valued. It is the intensive culture of the mind in one special domain of learning, which now advances knowledge, and is properly honoured by admission into one of the most aristocratic and exclusive assemblies in the world. To expect constructive policies of a body which comprises the most learned and ingenious mathematicians, geologists, physicists, chemists and biologists of the day is as reasonable as to expect diplomacy from the conclave of the Knights of the Garter, or a scheme of military value from the united wisdom of the Lords Lieutenant of the Counties. The Fellowship of the Royal Society is the highest honour which Science can bestow and those who attain that distinction are chosen by those who are best fitted to judge of the merits of the many candidates who are available. We must be satisfied with such a distinction, and not expect the Fellows to be, in addition, men of the world, pioneers of reform, or contrivers of large schemes which affect the application of science in general to the benefit of mankind.

* * *

Our knowledge of the properties that characterise many of the most widely-used commodities is surprisingly inadequate. Agreement seems hard to find even on subjects such as standards for our food supply, despite their importance to the community and the perfection of modern methods of investigation. Agriculture, formerly an "Art," has long been ranked as a "Science," and technical publications devoted to its furtherance are legion, yet many problems of fundamental importance to it still await resolution. An instance of this is provided in the account, published in this issue, of the "National Milk Conference," from which we gather that problems such as the composition of milk, the effects of sterilisation on its vitamin content, and methods of preventing contamination are subjects of keen controversy. That there is controversy is all to the good, but it is regrettable that there is the need for it, for it implies an absence of precise knowledge. We are glad to support our contributor in urging that these are problems for immediate consideration by the chemist. A problem of the milk industry which still awaits solution is the utilisation of the whey, produced in making cheese, as a source of lactose. Some attempts were made to establish this industry during the war, but they have only partially been successful. The establishment of lactose production on an industrial scale in this country is most desirable, and there are probably many other foods and food products which deserve close attention by chemists in the interests of the community. Some of the problems involved in these require immediate study.

* * *

We recently read some advice to authors of learned books and writings; they were directed to rewrite their articles three or four times, making improvements each time. Such procedure, such leisure, such an oblivion of space and time filled us with envy. The distinguished man who gave such advice wrote, nay writes, for he is with us yet, in a world where weekly journals, dispensing scientific information to what is, in the main, a learned and critical body of readers, are unknown. What standard of style should we aim at? To what level should we never descend? These are the two questions which only our readers can answer for us. We can merely put forward some factors which complicate the situation and make the problem more difficult. How often have we, or some skilled contributors, written some elegant contribution, carefully modulated, nice in expression and having only one fault, that of being ten or a dozen lines too long. We expostulate with the unreasonable printer who refuses—just for this once—to enlarge his column. "We cannot cut this down without spoiling it," we plead. "We can," answers the printer, ominously seizing a large pair of scissors. As for rewriting an article three or four times, this may do for the *Borneo Advertiser* or *Equatorial Herald of Science*, where presumably time is not of the essence of the contract, but here in London, where overtime must be considered and where a few hours' delay may be fatal, some less perfection must be attempted. Simplicity of language, the use of no obscure words where easy ones will do, plain intelligible statements of the case, these are the essentials. Sometimes the author likes to introduce a new phraseology, some fresh terminological excrescences, a new species of shorthand which he and a few others understand. Our science has already enough hard phrases and sesquipedalian words. We shall be more effective as chemists, appeal more to the imagination of our fellow-citizens, make ourselves more felt in the world if we can get into the way of thinking, speaking and writing in words which many of those we address can understand. But do not look for sustained eloquence in our pages; on the other hand, we invite our readers to protest vigorously against bad grammar, involved and ambiguous sentences, or needless obscurity. We feel that we should set a reasonably high standard in the art of bringing scientific information before the notice not only of the expert but also of a large number of readers who prefer comparatively simple words.

* * *

The opening of the new Research Laboratories of the General Electric Co., Ltd., may easily prove to be an event of considerable importance. The buildings themselves are ample and well equipped. The total floor area is about 80,000 square feet, and as the enclosure contains four acres, there is room for additional buildings if occasion arises. So ample a laboratory, run by a company with the experience and resources possessed by the General Electric Company, has potentialities of usefulness which can only vaguely be imagined. The laboratories of the Western Electric Company in New York and of the General Electric Company in Schenectady are probably the two best-equipped Research Laboratories in the United States. At the latter, which is under the direction of Dr. Whitney, Langmuir has done all his work, and his investigations have already attained world-wide fame and are found to be of first rate importance. Research of this quality, likely to prove of great value to the world at large, and in particular to the company responsible for it, is very frequently not very intimately connected with the smaller industrial problems which confront a business organisation. We have confidence that so far-seeing a company as the General Electric Company will not be unduly critical of investigations which do not show some immediate commercial value. First-class research, the kind which produces the telegraph, the wireless developments, the telephone, electric lighting, X-ray industries and such great discoveries, is conducted by men of genius; these are capricious, have ideas of their own, and their work is spoilt or prevented if they are tied down too closely to the investigation of problems set by a board of directors. The speeches made by Mr. Hugo Hirst, the chairman of the company, and by Lord Robert Cecil were interesting and appropriate. That of Sir Joseph Thomson was particularly so. As he said, the capacity for the highest kind of research was not common, and it is only an exceptional man who can make adequate use of such an opportunity as the new laboratories provides. If in the large staff which will no doubt be placed in charge of the work there is one man of outstanding power, this is all that may be expected, and if he is allowed and encouraged to pursue the ideas which his fancy dictates, some highly interesting and commercially valuable discoveries will in time be forthcoming. The nation should be grateful to the General Electric Company for their enterprise, and we shall be much surprised if in ten years the shareholders are not equally grateful.

GASOLINE TEN YEARS HENCE

By **RALPH H. McKEE**

Professor of Chemical Engineering, Columbia University; Chairman, American Section, Society of Chemical Industry

Everyone has a general idea of what present-day motor fuel or gasoline is, and yet there is some difficulty in defining it in a way which is altogether clear. For the present need gasoline may be defined as a hydrocarbon distillate, generally a petroleum distillate, 90 per cent. of which boils below 374° F., and all of which boils below 437° F. It has a density of less than 50° Bé. To be commercial gasoline it must, in addition, have but a light colour and be free from certain types of impurities.

Straight Distillate

Twenty years ago all the gasoline used was obtained as the light low-boiling distillate from crude petroleum. This distillate, which might be called crude gasoline, was then chemically treated to give the refined gasoline. It is quite easy to make a good quality gasoline from such a quality of petroleum as Pennsylvania Petroleum, but when the Pennsylvania fields began to decrease in output and the lower quality oils from Canada, Ohio, the Middle West and the Far West came into the market, it was found that they did not give either as large a percentage of gasoline or a product of as high a quality as had been given by the Pennsylvania oil. On the other hand, the demands for gasoline, due to the growth of the automobile industry, were increasing.

The effect of this change of the commercial situation was that lower grade gasolines began to come into the market. These were lower grade in that they carried some of the higher boiling kerosene fraction, some colour and some of the unsaturated constituents, which give a stronger odoured product. Each phase of this lowering of the standard brought about distinct increases in the amount available, but even in these circumstances the demand has increased faster than the supply, and accordingly there have been attempts to use other products to supply the deficiency. These attempts have given rise to three new petroleum products—casinghead gasoline, natural-gas condensate and cracked gasoline, as well as substitutes quite different from petroleum products.

Cracked Gasoline

When a higher boiling petroleum of the type of low-priced fuel oil or gas oil is heated to a temperature of about 700° F., there is a decomposition of this oil with separation of carbon on the one hand and the formation of light boiling constituents of the type of gasoline and kerosene on the other hand. This process is known as "cracking," and the lighter of the commercial products made is known as cracked gasoline. Cracked gasoline carries up to 40 per cent. of unsaturated compounds. The automobile of a few years ago would not run well on present-day gasoline. Further, it is certain that the gasoline on the market is destined to show an increasing content of unsaturated compounds, and we must look to the engine designer at least to keep up and even with the changes in the type of fuel available.

Casinghead Gasoline

Many an oil well gives at the same time considerable amounts of gas as well as oil. If this gas is examined, it is found to be formed in part by the evaporation of the same volatile constituents as are present in the liquid petroleum. If we condense the low boiling liquids from this gas, we obtain a very volatile gasoline. Gasoline obtained from the gas coming from the top of the casing of an oil well is called in the industry "casinghead gasoline."

Gasoline Substitutes

The requirements for gasoline are increasing year by year by very considerable amounts. In Canada and in the United States gasoline has been cheap and comparatively abundant. This has not been true the world over. We consider 50 cents an imperial gallon high, but most of the world would welcome gasoline at 70 cents a gallon, and call it cheap. Europe is using, and has been using as a motor fuel for some time, large amounts of benzol, obtained as a by-product from its coke and gas plants. Germany has been using a product called tetralin. Tetralin is obtained by the hydrogenation of naphthalene with hydrogen gas in the presence of nickel. It is a colourless fluid boiling at 205° C., freezing about 30° C. Its properties resemble gasoline and kerosene in fluidity, resistance to low temperatures and flash-point (79° C.—174° F.). In the motor it explodes smoothly and shows no tendency to "knock." On account of its low vapour pressure, tetralin must always be mixed with some more volatile fuel—*e.g.*, benzol. In Germany, the mixture most used has been equal volumes of tetralin, benzol and alcohol.

The Scottish shale-oil plants have been furnishing considerable quantities of a motor spirit from oil shale. Cuba has had a surplus of molasses, this molasses on fermentation giving alcohol, and extensive use has been made of this alcohol, not only to furnish visitors from the United States with a beverage, but also locally to replace to a considerable extent gasoline for automobile uses. Natal has also an abundant supply of alcohol from its waste molasses. Imported gasoline is quite expensive, and, accordingly, a product has been devised which goes by the name of Natalite, and has largely taken the place of gasoline in that part of the world. Natalite is a mixture of alcohol with about 45 per cent. of ether. In the United States we have had but one commercial attempt to supply a gasoline substitute. This is the "alcogas," put out by the United States Industrial Chemical Co., of Baltimore, this company being a subsidiary of the United States Industrial Alcohol Co.

Each of these substitutes has its advantages and disadvantages. Benzol and tetralin are decidedly cheaper than gasoline in Europe: but, on the other hand, they make it harder to start the engine, and the tendency towards formation of carbon in the cylinder is greater than with gasoline. Shale motor spirit of Scotland often runs 60 per cent. unsaturated, and, accordingly, it has a strong odour, is somewhat coloured, and cannot be stored for any considerable time without loss of quality. The alcohol products of Cuba and Natal, particularly when mixed with much ether, as in the case of Natalite, give trouble owing to their great tendency to make the engine "knock," and also some trouble due to the difficulty of obtaining them free from acetic acid. If acetic acid is present, there will be corrosion of the storage tanks, tank cars and the container tanks in the automobile. This corrosion and also the "knock" effect can be reduced and even avoided entirely by adding such material as aniline; but aniline is expensive. One does not want to add any considerable amount of a constituent costing $2·00 a gallon, and aniline cannot be had for less.

"Alcogas" is a more complex material than the substitute used in other countries. It consists approximately of one-third benzol distillate, principally benzol and toluol, a second third of alcohol products, alcohol and ether, and the remaining third of petroleum distillate, principally gasoline. The amount of ether required to start the engine easily varies according to the time of year. In winter 10 per cent., and in the summer 5 per cent., is all that is essential. This American gasoline substitute has a big advantage over ordinary gasoline in that the cylinders do not carbonise. This keeping of the cylinders clean means ordinarily a greater mileage per gallon than is obtained from gasoline—about 10 per cent. greater.

Future Demands

The petroleum requirements of the United States and of Canada are steadily increasing, the amount of the increase in the United States being approximately 50 million barrels a year. Part of this increase is due to the increase in fuel-oil requirements, but a large part is also due to an increase in the gasoline requirements. Apparently the gasoline requirement of the country is going to continue to increase and perhaps at an even greater rate than in the past.

The prospects for an increased supply of petroleum from American oil wells are nil. The investigations of the United States Geological Survey and the United States Bureau of Mines show quite definitely that the United States is approximately at its peak of production, and that within a very few years—probably within three years—the production of petroleum in the United States from wells will begin to fall off. Moreover, the Geological Survey calls attention to the fact that we should not expect to find any more large fields of petroleum in the United States. In other words, practically all the possibilities in the way of large petroleum fields in that country have been well prospected, and now we can calculate fairly closely what the production will be in the future. This calculation shows quite definitely that it is soon to decrease in amount. Canada is but little better off. In the past, as at present, the United States furnished approximately two-thirds of the world's production. But we are consuming more than we are producing; for example, in 1919, the United States imported 53 million barrels from Mexico, and, in 1920, 106 million barrels. In 1921 the importation was about 126 million barrels. In each year the United States has imported roughly about 60 per cent. of the total production of Mexico. Mexican and Texas fields are short-life fields; already they are in many places furnishing salt water instead of petroleum.

Shale Oil Industry

Four years ago a careful canvass of the situation showed that there was relatively little known about many of the fundamental factors upon which a successful shale-oil industry must be based. For example, almost nothing was known regarding the heat of reaction by which shale oil is formed from the organic material of the shale. Little was known regarding specific heats and latent heats, and nothing was known regarding the first reactions that control the formation of oil from the organic material. In the thought that this was going to be an industry of great importance to the country and the world, and that the knowledge of the fundamental factors on which the industry is based were essential to a proper development of that industry, the study of these fundamental factors was undertaken at Columbia University. A large part of this work is, of course, yet incomplete, but results have been obtained that are of the utmost importance. It would take a long time to discuss the methods used and the data obtained; now I can only give the results.

One of the most important factors entering into the design of a proper shale retort is that of the knowledge of amount of heat absorbed or evolved in the formation of shale oil from the organic matter of the shale. Dr. Lyder devised the first apparatus capable of directly determining this factor, and found that heat was absorbed in the process, and that the amount of heat absorbed was nearly the same for shales from different sections. This heat absorption amounted, in general, to about 450 calories per gram of oil and gas produced; or, in other terms, 160 B.Th.U. per pound of average shale retorted. This is a surprisingly low figure for such a reaction.

It has been generally thought that the organic matter in shale decomposed on heating to form petroleum products such as gasoline, kerosene, etc., as the primary products of decomposition. It has been shown by these researches that this is not the case, but that the primary product of the decomposition is a heavy solid or semi-solid bitumen, and that petroleum is formed by a secondary cracking process from this semi-solid bitumen. This secondary cracking process, by which petroleum products are formed, is a liquid-phase cracking process similar to the well-known phenomena of the cracking of heavy petroleum to give gasoline. Another surprising thing found was that the decomposition temperature of the shale to give the semi-solid bitumen was a quite definite temperature—about 410° C.

The investigations have also shown the incorrectness of the belief which has been held by many of those working on the developments of shale-oil manufacturing processes—that on heating gasoline is the first product formed; then, on a higher heating, kerosene; and, on still higher heating, lubricating oils, etc. In other words, it was shown that what happens on heating is that all these products are formed *simultaneously* by the cracking of the semi-solid bitumen first formed.

Oil shales vary among themselves not only in yield of oil per ton of shale, but also in type of oil, type and character of minor constituents, and also even in the gangue material which carries the organic portion.

Dr. Ralph T. Goodwin has lately shown that if oil shales are distilled at reduced pressure, there appears an intermediate product between the kerogen of the shale and the shale oil. This intermediate product is highly unsaturated; indeed, by the customary test of solubility in sulphuric acid, some samples show 100 per cent. unsaturation. On heating this product at atmospheric pressure, there is a marked decrease in the so-called unsaturated portion. The unsaturatedness dropped from 100 per cent. to approximately 50 per cent., and on a second distillation at atmospheric pressure the product may become as high as 80 per cent. saturated. This, I believe, is the first case where, on cracking an unsaturated hydrocarbon, saturated hydrocarbons are obtained. Further, it raises the question at once as to whether our ordinary conception of the cracking process is a correct one. In this work of Dr. Goodwin and myself we have further shown that the retorting of each shale is a separate problem, and that the problem of refining the oils begins with retorting the shales.

In Scotland oil shales are worked which furnish but 20 to 22 gallons of oil per ton of shale mined. In Canada and the United States we have large deposits of shales which are able to give a much higher yield of oil. The largest of these deposits are the Green River Shales of Colorado, Utah and Wyoming. There are also large deposits in New Brunswick and Nova Scotia, Nevada, California, Kentucky, Indiana and Ohio, and smaller deposits, though large enough for commercial exploitation, in many other portions of this continent. There are similar deposits in other parts of the world. Of those deposits which are likely to be exploited in the next decade we have variations in yield from 20 gallons to 60 or even 80 gallons per ton. The large deposits of better grade will give about a barrel (42 gallons) of oil per ton of rock. The character of oil produced in some cases is apparently a straight asphalt-type petroleum similar to California well petroleum. Other shales give a large quantity of paraffin wax of even better quality than that given by the best oil wells of Pennsylvania's history. It seems as if probably the average petroleum to be made from American oil shale will resemble most closely the petroleum obtained from the present mid-continent field, such as the Oklahoma oil.

It is not commonly appreciated how large these oil shale deposits are. If we consider only those oil shales which will furnish a barrel or more of petroleum per ton of shale (a barrel is 42 U.S. gallons), we have in the Green River Section alone, in known deposits, sufficient to furnish 64,000 million barrels of petroleum. This is an enormous amount. It is eight times larger than the total of the well petroleum that America has produced since Col. Drake drilled the first oil well in 1859 at Titusville, Pa. It is more than five times the total production of the world since well petroleum became commercial sixty years ago.

SHALE OIL PLANT

A shale oil plant, to be successful, must be able to handle cheaply and efficiently large quantities of oil shale, distilling it to get the crude oil and ammonia, and then crack and refine the crude oil to give a motor spirit useful commercially. The Scottish plants do this, excepting that they devote considerable attention to the recovery of paraffin wax, and it is only the oil left after the wax recovery that is distilled to give lubricating oils, gasoline and burning oils, or is cracked to give shale gasoline.

The Scottish shale retort is a retort of vertical pipe type. When we attempt to handle Canadian or American oil shales in this retort we find that they give trouble, owing to the pieces of shale sticking together and sticking to the sides of the retort. This caking of the shale lumps stops the passage of the shale through the retort. For use on most of these shales, it is quite apparent that we must either modify this Scottish retort or devise retorts on new lines. The Scottish retort is designed with the dual purpose of recovering ammonia from the shale and of obtaining oil. With the American shales we have larger amounts of oil but ordinarily distinctly less ammonia than is produced from the Scottish shale. In other words, the retort to handle the American oil shale *properly* must be one which gives its attention primarily to the production of oil in quantity and of acceptable quality, and only secondarily to the production of ammonia. There are more than a score of retorting schemes which have been proposed by various American inventors. None of these has yet produced shale oil in large quantities. The most completely developed plant and process is that of the Catlin Shale Products Co., at Elko, Nevada, which has a plant which has produced approximately 100,000 gallons of shale oil. A small commercial refinery is just completed, and the first shale oil and shale gasoline to be marketed in quantity in America is coming from this plant. There are probably several other types of retorts which have been proposed for use in distilling oil shale which would, if given proper technical study and trials, develop into commercial processes. At present, few, except the inventor himself, believe that any one of these retorts is certain to be practicable when used on a large scale.

It is only within the last three years that serious attention has been given to the question of the development of a proper type of retorting still, and we have no reasons to think but that, well before the same length of time from now has passed, we will have succeeded in obtaining a retorting scheme which can handle with low labour costs efficiently and economically Canadian and American oil shales.

I have earlier shown you that the American demands for petroleum are increasing at the rate of about 50 million barrels a year. If this continues, it will require each year 75 new plants, each handling 2,000 tons of oil shale a day and representing an investment of a million dollars each, to give sufficient oil to meet simply this yearly increase in demands for petroleum. We have no other prospect which promises to furnish even a minor part of this demand. In other words, we have reason to look forward to a very large chemical manufacturing industry which will give us gasoline in quantity from oil shale and which will rank with our largest manufacturing industries in its labour and capital requirements and in value of output.

SCIENCE

"The desirable treasure of wisdom and science, which all men desire by an instinct of nature, infinitely surpasses all the riches of the world; in respect of which precious stones are worthless; in comparison with which silver is as clay and pure gold is as a little sand; at whose splendour the sun and moon are dark to look upon; compared with whose marvellous sweetness honey and manna are bitter to the taste." *Richard de Bury.*

PREFERENTIAL OXIDATION IN PRESENCE OF CATALYSTS

REX FURNESS

THE substantial reality of the success of applied catalysis during the last two decades is small in relation to its promise for the future. The "triumphs of applied catalysis" is the phraseology of platitude, and it is scarcely necessary to refer to the processes, such as oil-hydrogenation, ammonia synthesis and oxidation, sulphur-dioxide oxidation, acetic-acid production, etc., in order to show the wider outlook rendered possible by the use of suitable catalysts in industry. To a large extent, however, the reactions underlying these processes are simple, and when a suitably efficient catalyst has been discovered, a large step has been taken towards commercial realisation and economic soundness. Broadly speaking, one reaction and one only, is possible in these cases, and the problems associated with its acceleration are essentially more simple than when two or more reactions can take place, and it is a question of accelerating one and retarding the other or others. Preferential catalysis has scarcely yet been touched in successful industrial operation in comparison with simple-reaction catalysis, but presents almost unlimited possibilities.

Preferential catalytic oxidation, too, presents a further complicating feature, in that—with organic compounds—the products of the undesired, but easily attained complete oxidation, are worthless. Thus, the partial or preferential oxidation of benzene will result in the production of maleic acid, but the full oxidation or combustion of the hydrocarbon leads to the formation of carbon dioxide and water. Without minimising the engineering problems, which have had to be solved in, say, ammonia synthesis, it is clear that great difficulties stand in the way of the successful application of catalytic preferential-oxidation processes in practice.

In the study of catalysis in general, no theory of universal applicability can yet be advanced. Even in many specific problems, practical technical operation is well ahead of theory, and in the study of preferential catalysis, practice, though limited, is perhaps still further ahead. It is true, however, that much effort is being made to "blaze a trail," witness the experiments of Rosenmund and Zetzsche. For example, by suitably influencing the catalyst and using benzoyl chloride as a starting material, any member of the following series may be made the chief reaction product, namely, the corresponding ester, hydrocarbon, aldehyde, alcohol or ether. Again, by partial and controlled poisoning of the catalyst, specific and different products may be obtained from one starting material. Alcohol may be made to give aldehyde, ether or ethylene, according to how far the catalyst has been poisoned by the presence of foreign substances.

Much attention has been given to preferential and partial catalytic oxidation in the technical press, and several processes have passed the experimental stage. The production of maleic acid from benzene, by catalytic oxidation under careful control in the presence of oxides of vanadium or molybdenum, and similar problems, such as the oxidation of naphthalene to phthalic anhydride and acid, of anthracene to anthraquinone, etc., have already been reviewed by the writer (*cf.* J., 1921, 307 R).

The preferential oxidation of carbon monoxide contained in hydrogen so that the whole of the former might be converted to the easily soluble carbon dioxide, and the simultaneous combustion of the latter to form water reduced to a minimum, has been the subject of patent claims, but a study of the work of Rideal (*J. Chem. Soc.*, 1919, 993; *J.*, 1921, 307 R), in this connexion shows that little hope of commercial realisation can be entertained, if known catalysts are to be used.

The attempts to oxidise hydrocarbons of the paraffin series—and mineral oils in general—to fatty acids have also been reviewed (*J.*, 1921, 62 R), and little has since appeared to indicate that the project is substantially nearer universal applicability to mineral oils, or to full technical realisation.

There are, however, two processes which merit special consideration to-day. The first, namely, the partial oxidation of sulphuretted hydrogen contained in fuel gases, to sulphur and water, with little or no formation of oxides of sulphur, will provide a process widely applicable for purifying gas, and the scattered results of experimentation are discussed below. The second process, in which partial oxidation of hydrocarbons is effected, and marked preferential catalysis claimed to occur, is said to be under trial on a large scale. This process suggests the possibility of producing a variety of useful industrial products, including resins, soaps, lubricating oils, froth-flotation oils, fuels for internal-combustion engines, etc.

OXIDATION OF SULPHURETTED HYDROGEN TO FREE SULPHUR

Most industrial gases used for fuel purposes contain sulphuretted hydrogen in more or less considerable quantities. Water gas, hydrogen, illuminating gas, etc., must be entirely or substantially freed from this impurity before application in industry, or for heating and lighting in the home. The present old established method, involving the use of hydrated iron oxide in purifier boxes, is slow, cumbersome, and—in comparison with quicker catalytic methods that readily produce free sulphur—expensive, the hydrated iron-oxide process is, of course, catalytic, but very large quantities of the catalyst are required in relation to the amount of gas purified.* Two main endeavours have been made to discover processes which allow of a much greater throughput per unit of space and time. These may, for convenience, be designated the cold process and the hot process.

Cold Purification.—The reaction upon which the removal of sulphuretted hydrogen depends is, in general, the following: $H_2S + O = H_2O + S$. This reaction may be accelerated catalytically, of course, the cycle of reactions occurring in the ordinary iron-oxide purifiers, show that the oxide acts as a catalyst.

Much attention has recently been given to the possibility of using highly active charcoal as catalyst for the above reaction. Thus, the Baeyer Co. claims that the presence of active charcoal greatly increases the reaction velocity, but does not lead to the formation of oxides of sulphur. A gas containing 12 g. hydrogen sulphide per cb. m. may be completely purified by means of charcoal contained in a space of two cubic metres, at a speed much greater than that commonly attained in the old iron-oxide treatment. About 40,000 to 50,000 cb. m. of gas can be treated before the charcoal becomes so saturated with sulphur that this requires extraction so that the reaction may proceed. The density of the various forms of activated charcoal—produced primarily for poison-gas mask fillings during the war—varies considerably, but the charcoal retains approximately an equal weight of sulphur before extraction becomes necessary.

The process has many variants, but in general may be said to follow these lines: Gas containing hydrogen sulphide is freed from tar and naphthalene as far as possible and the bulk of the ammonia is also removed. A slight trace of ammonia acts catalytically, and enables the reaction to take place rapidly at ordinary temperatures. The oxygen concentration is adjusted according to the sulphuretted hydrogen present in the gas, and the mixture is passed over the active charcoal, contained in vessels capable of being heated or cooled. The speed of passage varies with the activity of the charcoal, sulphuretted-hydrogen content, amount of sulphur already formed in the charcoal mass, temperature, and catalysts or catalyst-poisons present. The temperature should be maintained at a low level, although the reaction is exothermic. The charcoal-containers may be arranged in series or parallel, and worked until the sulphur content has reached a pre-determined amount or a definite percentage of hydrogen sulphide has been removed from the gas. The sulphur is then extracted by means of a suitable solvent, carbon disulphide, mono- or dichlorbenzene, tetrahydronaphthalene, etc. After a suitable period of extraction, the solvent is removed and the charcoal, after being washed and dried in a current of hot gas free from hydrogen sulphide, can be used again. The sulphur is easily obtained from solution by crystallisation or evaporation. One of the difficulties of the process is stated to be the extraction of the sulphur, but improved constructional details will remove this trouble. It is, however, interesting to note the process of the Badische Anilin-und Soda Fabrik for the removing of the sulphur deposited. A solution of ammonium sulphide, produced in recovering the sulphur, is distilled in the presence of an inert electrolyte, *e.g.*, sodium chloride, to facilitate the deposition of sulphur and the liberation of ammonia. The aqueous ammonia-solution passes from a condenser to the vessel containing spent charcoal charged with sulphur. The solution draining from the charcoal passes continuously to the still, until the extraction of the sulphur, and deposition from the ammonium sulphide solution produced, is complete. The charcoal is washed, dried, and is then ready for re-use in the catalytic reaction between sulphuretted hydrogen and oxygen.

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* Other processes are also being studied, in which a liquid medium is utilised as absorbent or reagent. Reference need be made only to the use of glycerin under pressure, of dyestuff solutions, alternately reduced by sulphuretted hydrogen and oxidised by air, and of sodium-carbonate solution. The Koppers Co. (U.S.A.) is purifying 25 million cubic feet of gas per day by simple treatment with sodium carbonate solution, followed by passage through iron-oxide boxes to effect the small amount of final purification required. The solution is regenerated continuously by oxidation with air. This process is finding favour in American practice.

The process of purification using charcoal as catalyst is open to several criticisms. The cost of highly active charcoal is high, and although relatively small quantities are required in comparison with the iron hydroxide necessary in purifier boxes, the capital outlay is not small. The objection should be met in the near future since active charcoals should be produced much more cheaply than at present. A second objection, noted in the Alkali Inspector's Report, 1921, is that oxides of sulphur are produced, in addition to free sulphur. The difficulty of removing small amounts of these gaseous oxides, even with alkaline solutions, is well known, and unless complete preferential catalysis can be effected, a serious difficulty will remain. At low temperatures, and with sufficiently active charcoal, however, the reaction is specific in the direction of free sulphur formation, and an excellent case of catalytic preferential or partial combustion is indicated.

Illuminants are absorbed by the catalyst, and ethylene, benzene*, etc., are retained by the charcoal. These are recoverable, and in any case, only diminish the quality and saleability of the gas by the corresponding calorific value. With many industrial gases, no such difficulty exists, for illuminants are entirely absent.

The value of a successful process is obvious. A high-speed reaction, easily controlled and involving little attention in practice, yielding pure sulphur for sale at a profit, is in marked contrast with present processes of gas purification.

Little is yet known of the mechanism of the reaction. The highly adsorptive and absorptive nature of activated charcoal is well known, as is the increased concentration of oxygen and sulphuretted hydrogen upon the surface of the catalyst prior to the reaction. Marshall has recently suggested that oxygen combines with the carbon in the surface layers of the charcoal. Such deductions from a consideration of the phenomena of heat evolution, tend to support an intermediate-compound theory of reaction, but the matter has not been sufficiently studied to allow of explanation being definitely advanced Practice is, as stated above, well ahead of theory, and many companies and individuals have taken out patents covering the process, described in general type above. Thus, the Baeyer Co., Meister Lucius und Bruning, the Badische Co., Naef, Schumacher, and others have described slightly varying methods, all employing activated charcoal as catalyst.

Hot Purification.—Sulphuretted hydrogen is burned selectively or partially in the Chance-Claus kiln, free sulphur being produced. The same catalysts cannot, however, be used in purifying gas from sulphuretted hydrogen. Above 200° C., the reaction $2H_2O + 3S = 2H_2S + SO_2$ may occur, and oxides of sulphur pass into the exit gas. In gases which contain carbon monoxide—coal gas, water gas, and other industrial gases—another reaction is possible, as Evans has recently pointed out : carbon oxysulphide is formed, and is more troublesome than the original hydrogen sulphide.

A hot-purification system requires the discovery of a catalyst which will oxidise sulphuretted hydrogen specifically to sulphur, according to the equation, $H_2S + O = H_2O + S$. Many compounds have been tried, but as yet none appears to act preferentially in full degree, but it is inadvisable to assume that finality in the matter has been reached.

The advantages lying in a successful process are again obvious—a high-speed reaction, the deposition of free sulphur, or its removal from the catalyst by distillation in the gas stream, lower capital and labour charges, etc.

The reaction is exothermic, and with efficient heat-exchange, little, if any, additional heat should be needed, whilst the calorific value of fuel gases, should be but little reduced, if at all.

As typical of efforts being made in the direction of hot purification, the process of Lemon (U.S.P. 1,317,583), may be noted, but, as the catalyst suggested is not sufficiently selective in nature, and some traces of sulphur oxides are formed, it is improbable that a wide application will be possible. The process, involving scrubbing towers for the gas after reaction, would undoubtedly be more costly than the present iron-oxide box treatment. It, however, indicates the potentialities of the hot purification system, in the event of a preferential oxidation being achieved, for in installation and working charges it would easily oust the older systems.

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* Engelhardt has recently described the application of activated charcoal for the stripping of benzene from coal-gas at the Cologne gas-works.

The catalyst suggested for the process is pumice, porous pot, or other porous substance, and the gas mixture containing sulphuretted hydrogen and oxygen in equivalent proportions, is treated at about 300° C. The exit gases, possibly carrying sulphur vapour, pass to a scrubber, wherein the sulphur oxides produced are retained. The calorific value is but little diminished by the treatment. At higher temperatures or in the presence of supported catalytic platinum or nickel catalysts the reaction tends still more towards the formation of sulphur oxide, and a catalyst that induces the rapid formation of sulphur at a low temperature, preferably below 200°C., is urgently needed.

Oxidation of Hydrocarbon Oils

The attempts to produce fatty acids by the oxidation of liquid paraffin wax and hydrocarbon oils have been referred to. A new process, patented in many countries, has recently been described by James (*Chem. Met. Eng.*, 1922, **26**, 209). A reaction in the vapour phase is catalysed at high speed by metallic oxides, etc., and although preferential oxidation in one specific direction is not apparent, it is probable that attempts will be made to find a catalyst which will act in this way. The germ of the preferential-oxidation process is apparent, because in presence of one catalyst, uranium oxide, oxidation is carried to the stage at which aldehydes are formed, whilst molybdenum oxide catalyses the formation of aldehydic acids.

An aliphatic hydrocarbon oil—fuel oil, gas oil, or a sulphur-containing or unsaturated oil—is vaporised, and passed through three catalytic screens, 1 cm. in thickness, the requisite amount of air being added before each screen. The temperature may vary, but is kept as low as possible, the temperature of the catalyst being controlled by immersed cooling pipes.

In a trial on a semi-large scale, 80 per cent. of liquid product was obtained, consisting of 30 per cent. aldehydic acids, 20 per cent. high aldehydes, and 50 per cent. of oxidised oils, alcohols, lower-boiling hydrocarbons produced pyrolytically, etc.

The products offer a distinct possibility of commercial application, for the acids may be converted into calcium soaps, which, mixed with the "congeneric oil" fraction of the product, provide a good lubricating grease. Sodium soaps prepared indirectly from the calcium soaps, are of good colour. If the acids are treated with caustic soda directly, resinification occurs, and the liberated resinous compounds may be used in cheap varnishes. The acids, or the whole liquid product, may be used as a froth-flotation oil, and excellent results are claimed. From the "congeneric oil," an oxidised kerosene may be distilled, and used as a fuel for internal-combustion engines, or as a starting material for "cracking" operations, whilst higher fractions, containing oxygen, can be used to advantage in compounded lubricating oils, much in the same way as free fatty acids are added to mineral oils in the Wells and Southcombe ("germ") process.

It is unnecessary to dwell on the uses of the products, for it will be apparent that they can yield useful commercial materials. It is already known that different products can be obtained by varying the conditions of the reaction and the catalysts. With increasing knowledge of the composition of mineral oils and the development of catalysts that will accelerate specific partial-oxidation reactions, the production of definite substances of commercial use will become possible. The range of products from the many hydrocarbons of mineral oils is extremely wide, and catalytic preferential-oxidation in this field alone is of wide economic importance. The isolation of particular hydrocarbons, the production of definite products from them, and the utilisation of the remaining hydrocarbons as fuel, power spirit, etc., instead of utilising the whole mineral oil as fuel, will be a notable step in the development of a more scientific petroleum industry.

THE GOVERNMENT WOOL-DISINFECTING STATION

THE Departmental Committee on Anthrax in their report to the Home Office pointed out that preventive measures, short of destruction of the organism causing anthrax, could never be successful. The Committee accordingly put forward a scheme for establishing a central disinfecting station under Government control, and recommended the adoption of a method of disinfection, which had been devised by the Committee after prolonged enquiry and experiment and had been reported on favourably by the late Professor Délépine and subsequently by Dr. A. Eastwood, Bacteriologist to the Ministry of Health. The Government adopted the proposals and introduced in 1919 the Anthrax Prevention Act, giving power to make Orders in Council prohibiting the importation of animal products likely to be infected with anthrax, unless they are disinfected on arrival. It also established at Love Lane, Liverpool, the Government Wool-disinfecting Station (Home Office), which has now been operating for about a year. The following account of its work has been prepared by Mr. G. E. Duckering, Director of the Station.

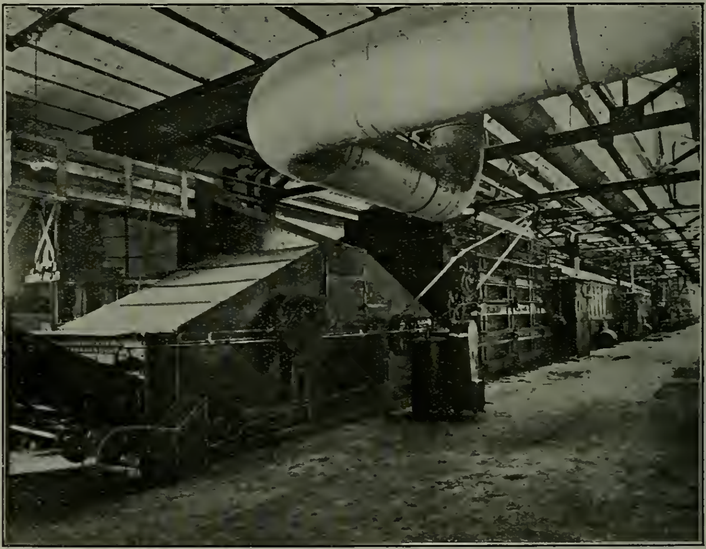
The disinfection process is arranged in seven stages, the machinery for opening the bales of raw material, feeding the material into the machines, disinfection, drying, cooling, and rebaling, being designed to permit all the stages to be carried out in sequence as one operation, without direct handling of the material by the workmen. The stages are as follows :—

Stage 1.—Hydraulically pressed bales as imported are placed on the moving platform of a feeding and opening machine and the steel bands and canvas covers removed. The material itself is not touched, but travels on the platform into the machine, where it is opened and delivered into the first process machine.

Stage 2.—In the first process machine it is submitted for 10 minutes to the action of a dilute alkaline solution at 102°F. in order to remove the albuminous matters by which the anthrax spores are protected. It is then squeezed through rollers and delivered into the second process machine.

Stage 3.—The material is here acted on for 20 minutes by a dilute alkaline soap solution at 102°F. in two successive baths, the purpose being to promote a condition of the spores in which they can be killed with comparative ease. This stage is essential to the process and it possesses the advantage that it also cleanses the material completely. The wool then passes through rollers into No. 4 process machine.

Stage 4.—In this state the actual disinfection is carried out, the material passing through two successive baths (with rollers between) of a 2·3 per cent. solution of formaldehyde at 106° F. It then passes through rollers and is blown by air into a drying machine (*Stage* 5), discharged into a cooling machine (*Stage* 6), blown by air into the charging box of a baling machine, then baled into hard pressed bales of about 320 lb. (*Stage* 7). The material remains 10 minutes in each process bath, and 20 minutes in the drier and cooler, the whole process of disinfection from opening the bale to rebaling occupying, roughly, 90 minutes. Although the material itself is not handled throughout the process, in order further to safeguard the workmen, overalls are worn and sterilised weekly, exceptionally good lavatory accommodation is provided, and the workers take a bath daily.



STERILISATION OF WOOL

General view of Disinfecting Machine from delivery end

Under the Anthrax Prevention Act an Order in Council was made which came into force on June 1, 1921, under which all wool and animal hair imported from or through Egypt, and all East Indian goathair, are required to be disinfected. The imports of these materials, however, fell off very greatly in 1921 and efforts were made to induce voluntary sending of material for disinfection. The disinfection of material voluntarily sent is now a growing branch of the work carried on in the Disinfecting

Station. The following table shows the quantities of different materials disinfected in the period from July 4, 1921 (the date on which the Station began work) to March 31, 1922, and from the latter date to September 30, 1922 :—

Output of Disinfecting Station

MATERIALS	Period July 4, 1921, to March 31, 1922 Lb.	Period April 1, 1922, to Sept. 30, 1922 Lb.
Compulsorily disinfected :—		
Egyptian wool	310,401	182,509
East Indian goathair	190,444	402,049
Voluntarily sent for disinfection :—		
East Indian wool	32,583	25,241
Persian wool	18,194	60,117
Alpaca	1,059	17,228
Mohair	2,924	5,948
Horsehair manes and cow tail hair	8,013	14,375
Goathair	10,034	569
Other materials	8,440	—
Totals ..	582,092	708,036

The introduction of the scheme of compulsory disinfection of a staple raw material like wool is, of course, a great innovation, and it is, perhaps, not surprising that it gave rise to apprehension and much uncertainty in the wool trade partly from the fear of damage to the material and partly because the material is taken out of the ordinary routine and altered in some respects beyond recognition. The result of this, coupled with the great trade depression, was that the volume of imports was much reduced during the first nine months of the operation of the scheme. Gradually, however, confidence in the method of disinfection and in the procedure adopted for handling the numerous lots of materials belonging to different owners has been established, and since the beginning of June the Station has been kept constantly employed, and the imports are returning to pre-war volume.

The conditions which must be rigidly controlled in order to secure disinfection are : (*a*) Strength of solutions ; (*b*) temperature of solutions ; (*c*) time of exposure to solutions ; (*d*) temperature of drying. This control is secured by constant tests. These tests (except as to strength of solutions) and the maintenance of the proper conditions are carried out by the man in charge of the machines, who takes thermometer readings hourly and records them in a report which is made daily showing the identification marks of the lots of material, weight of material fed in per hour, quantity of formaldehyde added per hour, temperature of solutions in each machine and of air in the drier, weight of material delivered from the machines and certain other details. From this daily report the conditions during disinfection of any lot of material can be ascertained at any time subsequent to its disinfection. The conditions of disinfection are independently checked by the works chemist, who also makes analyses of the solutions hourly and records all his results in an independent report, which can be compared with, and used to check, the machine minder's report. In addition bacteriological tests are carried out to ascertain the efficiency of the sterilisation.

A high output is essential, and in order to cover working costs an average output of at least 40,000 lb. per week must be maintained. This average weekly output can now be attained on a working day of eight hours, so that provided the imports of the scheduled materials, together with the quantity sent voluntarily for disinfection, are sufficient to keep the Station fully employed, it should be possible to cover running expenses. For the charge of 1½d. per lb. of disinfected material the services performed at the Disinfecting Station are disinfection, cleansing of the material, and baling. Some prejudice has been shown against disinfection, and this is not yet entirely dissipated. Nevertheless, the condition of the material after disinfection, the freedom of disinfected material from regulations, and the absence of risk of disease, are gradually diminishing such opposition as there was to the scheme, and the time is not far distant when disinfection will be welcomed for its own sake apart from compulsion.

* * *

The following account of a test on a suggested method of disinfecting wool by means of ultraviolet rays has been extracted from a report made by Mr. Duckering, Director of the Wool-Disinfecting Station, to the Home Office.

In December, 1921, reports were published in the Press stating that two Liverpool investigators had discovered that anthrax spores in bales of wool could be destroyed by subjecting the bales to the action of rays from a mercury-vapour lamp, the rays being described as ultraviolet rays. On inquiry it was found that the investigators proposed the use of both X-rays and the rays from mercury-vapour lamps and they claimed that the method, if applied in a warehouse, would sterilise the whole of the material in the warehouse within two minutes.

The Anthrax Committee was strongly pressed to carry out experiments to test the efficiency of the proposed method of disinfection. It was pointed out that if efficient it would be cheap and, what is more important, that the bales of wool could be sterilised in bulk without having to open them or in any way interfere with the material.

It has been long known that ultra-violet rays have some bactericidal effect, but previous experiments have always shown them to lack penetrative power and that, although certain bacilli fully exposed on the surface to the rays could be killed, even the slightest interference or protection is sufficient to prevent any action. The Committee is unaware of any previous experiments on anthrax spores as found in wool. The investigators, however, stated that they had discovered a means of so concentrating the rays as to obtain penetrative power and they were extremely confident that by their method any wool, whatever its bulk, would be completely sterilised on exposure to the action of the concentrated rays.

Accordingly arrangements were made for their apparatus to be fixed up and for bales of wool containing known infected test material to be submitted to the action of the rays. The test was carried out on March 15 in the presence of the two investigators and their assistants, who manipulated the apparatus, Dr. Eastwood, Dr. Eurich, and the members of the Departmental Committee on Anthrax. The apparatus set up by the investigators consisted of two Cooper-Hewett mercury-vapour lamps and an X-ray apparatus and was placed in such a position as to "focus" the rays on the two bales of wool containing the infected test material, which were placed behind another row of bales interposed between the test bales and the source of the rays. They were exposed to the action of the rays for ten minutes. After the experiment the bales were removed to the Government Wool-Disinfecting Station, the infected blood clots removed in the presence of the investigators, Dr. Eurich and the members of the Departmental Committee on Anthrax, and placed in sterile receptacles. One blood clot from each bale was handed to Dr. Eurich, who took it away with him, and one blood clot from each bale was sent to Dr. Eastwood for examination. The reports of Dr. Eurich and Dr. Eastwood are as follows :—

March 20, 1922

Report on infected test material (after test)

Blood clot 2 and blood clot 4. From bales exposed to ultra-violet rays. Anthrax bacilli cultivated after 18 hours' incubation.

Anthrax bacilli were cultivated rapidly and with ease from all these clots. There was also an abundant growth of other bacilli. The vegetative functions of the anthrax spores have, therefore, not been influenced by the exposure to ultra-violet rays and sterilisation has failed. Whether their toxic properties have been affected is a question which I am not in a position to answer.—(Sd.) F. W. Eurich.

March 20, 1922

Report on test material (after test)

In connexion with an investigation at Liverpool on March 15, 1922, as to the action of combined ultra-violet and X-rays upon anthrax spores, I have made bacteriological examination of two samples (Nos. 1 and 5). No. 1 was in the centre of a press-packed bale of wool, and No. 5 was in the centre of a hand-packed "square" of wool. Both bales were exposed to the treatment.

I have found that there is not the slightest indication of disinfection. Cultures from each sample yielded numerous anthrax colonies, together with an extremely abundant crop of other bacteria. The cultures produced fatal and typical anthrax in guinea-pigs in two days. —(Sd.) Arthur Eastwood.

NOTES FROM HEATHFIELD—II

By the Rector, Rev. B. V. WHITE, M.A.

Dear Mr. Editor,—A stagnant pond in the lower part of my parish has furnished me and the members of my household with a number of interesting problems. It is foul and slimy and has an accumulation of dead leaves, sawdust and other vegetable matter in a high state of decomposition. We have derived some pleasure from viewing portions of the green slime under the microscope, but the bubbles of gas which arise from the decaying mass at the bottom of the pond, especially when it is stirred with a stick, will form the subject of a few observations.

These bubbles may easily be collected in a glass jam pot filled with water and held upside down with the open end of the jar just under the surface of the water. Unless my memory is at fault, there is a fresco in Manchester showing the great John Dalton engaged in collecting such bubbles in the manner I have described. The gas is largely composed of marsh gas or methane, a compound of carbon and hydrogen with the formula CH_4. What other compounds are contained in the bubbles I do not know, and I shall be grateful to any of your readers who will point out to me some exact analysis of any such gases. It is by no means easy for me to follow out in my mind exactly how the gas is produced. If I am asked, I explain that it is made by some putrefactive decomposition of decaying vegetable matter, probably assisted by bacterial action. This usually suffices for my children or my parishioners, but it has no merit except its sonorous and imposing verbiage. How did the plant obtain its carbon and its hydrogen, and how is the marsh gas made and permitted to escape ? These are the questions which I put to myself.

It has been known for a century that living plants absorb from the air a certain amount of carbonic acid or CO_2 ; this they absorb through their leaves ; they also absorb through their roots small quantities of water and compounds of nitrogen. Water is a compound of hydrogen and oxygen H_2O, and the plant has the power of assisting the carbonic acid and the water to combine to make formaldehyde. From the formaldehyde the plants make cane sugar, and plants also contain grape and fruit sugar which my chemical books term glucose and fructose ; nobody seems to know which of these sugars is the first to be formed. Professor Baly of Liverpool has in his own rooms made from carbonic acid and water—not by the help of plants, but in glass bottles and flasks kept in bright sunlight—formaldehyde and a syrup which may be a sugar. This syrup may quite possibly be formose, a name used to describe some sugary mixture whose composition is not known. In any case Professor Baly considers his syrup to be akin to formose. This discovery, a quite recent one in practice though old in theory, has given us a greater insight into the ways in which plants perform their chemical operations than perhaps any other. The Rector of the adjoining parish of Burnsall, to whom I recently explained this, sent me a few days ago some Latin hexameters on this matter, of which I will only quote a small portion :—

> " *tu, Baly, lentus in umbra*
> *Formosam resonare doces aldehydamque*
> *silvas* "—

which means, Thou, Baly, in the leafy shade, teachest the woods to resound with " formose " and " aldehyde." This is a pretty conceit, and the whole poem is full of such.

And other experiments made at Liverpool prove the preparation of various alkaloids by somewhat similar methods, using ammonia and carbonic acid. Some of my friends, who are more sceptical than I am myself, tell me that, as the learned Mr. Stas once showed, and as Mr. Ost and another confirmed later, it is very difficult to free ammonia from alkaloids and other organic bases, and that this fact may account for some of the bodies made at Liverpool; but ever since I was a student at Cambridge, now some years ago, I have been accustomed to accept, without criticism, facts announced at the Royal Institution or the Royal Society.

I am never quite clear whether the plant makes the chemicals or whether the chemicals make the plant. Perhaps Sir William Pope, who I am glad to notice is a contributor to your columns, will explain this for our benefit. As a Professor of Chemistry he will be more familiar with these matters than I am; or, could you, Sir, persuade Professor Baly to write a lucid explanation of the point. So far as I can understand the matter the plant is continually absorbing its chemical reagents from the air and the soil, provided the light is there and the weather not too cold; and these will, under suitable conditions of light and heat, act together and make aldehydes and sugars, and from these cellulose and ligno-celluloses, which are the principal constituents of wood and cotton and some other substances. This means a growth of the substance of the plant, which must steadily increase its stature and its bulk so long as the conditions are favourable. So to some extent it is true that chemicals make the plant; yet, on the other hand, the plant has certain qualities which it has inherited from its ancestors and cannot be altered.

The seed of the mignonette has in it some substance which fixes the sort of plant which will be made, the shape of its leaves, the colour of its flower, and the peculiar scent which belongs to it. This quality is well portrayed in the poem, " Progress of Man," written a hundred and twenty years ago by Canning or Frere, and it is as true to-day as it was then. Some plants have the inherited power of making very peculiar chemical compounds, and the nature of these depends only on the plant itself; the quantity of the substance manufactured will very likely depend on the warmth, the light, the richness of the soil and the amount of rain. But the foxglove will make a complicated substance called digitalin, the potato will make starch, and the artichoke will make inulin, and unless it is the nature of the plant to do so, you cannot in any way compel the chemicals to unite and form these compounds, no matter how you alter the temperature and other conditions, which is indeed a curious instance of the mysteries of Nature.

Most plants contain cellulose and derivatives of this substance; it seems to be the decomposition of the cellulose and the ligno-celluloses which liberates the marsh gas, especially the ligno-celluloses. These each contain a CH_3 group, and it is quite possible that when they break up the CH_3 groups unite with the extra atoms of hydrogen and so make the CH_4 which we can collect in our jam jars.

Your pages have been much occupied of late by a controversy concerning the best method of burning fuel so as to secure economy and the prevention of smoke. The late Dr. Benjamin Franklin, an American philosopher, who was elected into the Royal Society so long ago as 1756, paid close attention to this question, and, in the second volume of his collected works, devoted nearly one hundred pages to describing and depicting many elegant and efficient devices for burning pitcoal in such manner as to combine the greatest heating effect with the least smoke production. A comparison of Dr. Franklin's disquisition with the discussion in your columns suggests that matters are much as he left them one hundred and fifty years ago. When your disputants peruse the work of this long-departed philosopher they will note the following injunction :—" And, indeed, all our knowledge is so imperfect, and we are from a thousand causes so perpetually subject to mistake and error, that positiveness can scarce ever become even the most knowing; and modesty in advancing any opinion, however plain and true we may suppose it, is always decent, and generally more likely to secure assent. Pope's rule, ' To speak, though sure, with seeming diffidence,' is therefore a good one."

Festina lente is a good rule, but in this instance the precept has been used to excess.

If you think my letter worthy the notice of your respectable Society you are at liberty to lay it before them; they will consider it, I hope, as it was intended, as an humble attempt to promote a more minute inquiry into these intricate chemical processes.

[Our valued contributor seems to refer to Stas, Œuvres complètes **1**, 375 and Ost and Bannow, Journ. f. prakt. Chemie, 1883 [2], **28**. 271.—Editor.]

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

The Advertisements in this Journal

were the subject of a conversation which was taking place among a number of members of the Society when I joined them the other evening. The manner in which they were displayed was favourably mentioned, but the number of pages which they occupied was the source of much outspoken comment. It has often puzzled me why advertisers advertise, and if they must, and I am told they must, why they advertise in the way they do. I am aware that of recent years a very clever and select body of men have arisen, who call themselves "business builders" or some such name as that, and are prepared to supply any sort of scheme required to advertise a particular business. These must be exceptional people, but there is in every business one person who has the spending of so much money for the purpose of advertising the business.

How are Advertisements Allocated ?

Presumably a certain sum of money is decided upon which is the limit of the amount to be spent in a particular year. On what principle is this money spent ? I wish someone would tell me. The theory of the thing is that the advertiser has something to say about his goods and wants to say it at the cheapest possible rates to the largest number of prospective buyers. So far, so good ; the size of a paper's circulation is something, but it is not all. It is surely the number of prospective buyers into whose hands the paper goes which is the measure of a paper's usefulness as an advertising medium. In other words, the paper must go into the counting-house and the secretary's offices if it is to get to prospective buyers. The paper which has the news and the kind of articles which the occupants of those offices read is the paper which ought to get the advertisements.

It is extraordinary

what a meeting-place the Chemical Section of the British Industries Fair is becoming annually. On the opening day, when the King and Queen were being conducted round the Chemical Hall, I noticed that most of the directors of the firms represented by exhibits were in attendance, and prior to the Royal visit were engaged in friendly conversation. What a change ! Five years ago some of these gentlemen hardly knew each other—to speak to. Later in the week I observed Colonel Jos. I. McMullen of the U.S. Army, who is over here from America on important business, filling in time between two appointments by examining the exhibits, and not missing much. Early this week Mr. Percy Ashley, the Assistant Secretary to the Board of Trade, who is responsible for the Industries and Manufactures Branch, was also there. Perhaps the schoolboys were the most interesting visitors to watch. They seemed instinctively to pick out the exhibits where the most long-suffering attendants were on duty, and they acquired not only a wealth of information verbally, but their acquisition of the printed word was even more voracious. Some science masters are in for a bad time !

Broadcasting

is very much in the public eye at the moment. Critics complain that it is a base use of the fruits of pure science—an argument which seems strangely familiar—and that the transmissions are too short or too high-class or not high-class enough. Some detect a reactionary tendency in a sermon ; others declare that the British Broadcasting Company has been "got at" by ecclesiastics and forced to begin not earlier than 8.30 p.m. on Sundays. Speculation is rife as to the effect which this "new art of broadcasting" will have on those who spend much of their time listening to it. This last query is one which may well be of some interest to scientists. To those who would look into this I suggest a line of inquiry. It is well to remember that quite half the amateur sets in the country are run on the technical, if not on the financial side, by boys—principally those with some interest in things scientific—many of whom will make some branch of science their profession when they grow up. There is some value as a scientific training to be found in the manipulation and repairs (no light task) of wireless apparatus, and this must be balanced against the tale of home-work neglected and interest diverted from ordinary school-work. It is not broadcasting, however, which should cause us the more immediate concern in this field. As has been pointed out over and over again, we are deplorably short of high-power commercial stations : it is a defect which must be remedied with the least possible delay. The developments of wireless will no doubt be enormous, and I was amused to read in the newspaper this morning, in Sir J. J. Thomson's speech at the opening of the General Electric Company's new laboratory, how Lord Kelvin wished to restrict the capital of the first wireless company to £100,000, because that seemed the utmost amount of capital that could find useful employment in wireless telegraphy. If it is true that a process will always take three or four times as long as is expected, it is undoubted that it will always cost five or six times as much as the pioneers estimate. Even while the first plant is being erected, fresh possibilities and improvements become manifest. One should never commit one's prophecies to paper or disclose them to a man who keeps a diary.

FORTHCOMING EVENTS

Mar. 3. UNIVERSITY OF LIVERPOOL, Adelphi Hotel, Liverpool, at 7.30 p.m. Dinner in connexion with the opening of the new Chemical Laboratories.

Mar. 3. THE ROYAL INSTITUTION OF GREAT BRITAIN, 21, Albemarle Street, W. 1, at 3 p.m. "Atomic Projectiles," by Sir E. Rutherford.

Mar. 5. INSTITUTION OF RUBBER INDUSTRY, Engineers' Club, Coventry Street, Piccadilly, W. 1. "Telegraph Cable Manufacture, Rubber and Gutta Percha," by H. Savage.

Mar. 5. SOCIETY OF CHEMICAL INDUSTRY, *London Section*, Engineers' Club, 39, Coventry Street, W. 1, at 8 p.m. "Industrial Poisoning and the Works Chemist," by Dr. T. M. Legge.

Mar. 6. SOCIETY OF CHEMICAL INDUSTRY, *Edinburgh and East of Scotland Section*, Hall of the Pharmaceutical Society, 36, York Place, Edinburgh, at 7.30 p.m. Annual Meeting.

Mar. 6. SOCIETY OF CHEMICAL INDUSTRY, *Birmingham and Midland Section*, the University Buildings, Edmund Street, Birmingham, at 7 p.m. "The Influence of Protective Colloids upon the Velocities of Chemical Reactions," by J. Newton Friend.

Mar. 6. ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, 35, Russell Square, W.C. 1, at 7 p.m. "An Electric Indicator for Washing-troughs," by K. C. D. Hickman.

Mar. 7. THE INSTITUTION OF SANITARY ENGINEERS, Caxton Hall, Westminster, S.W. 1, at 7.30 p.m. "The Mechanics of the Activated Sludge Process," by J. A. Coombs.

Mar. 7. THE INSTITUTE OF METALS, Institution of Mechanical Engineers, Storey's Gate, S.W. 1, at 10 a.m. to 5 p.m. Annual General Meeting. Also on March 8.

Mar. 7. THE INSTITUTE OF CHEMISTRY, *Leeds Area Section*, The Queen's Hotel, Leeds, at 7 p.m. "Chemical Jurisprudence," by Capt. J. A. Foster.

Mar. 8. SOCIETY OF CHEMICAL INDUSTRY, *Ottawa Section*, University Club, Elgin Street, Ottawa, at 8 p.m. "Chemistry in the Canadian Civil Service," by Government Chemists.

Mar. 8. SOCIETY OF DYERS AND COLOURISTS, *London Section*, Dyers' Hall, Dowgate Hill, E.C., at 7 p.m. "The Valuation of Dyestuffs by Titration Methods," by R. B. Brown and H. Jordan.

Mar. 8. INSTITUTE OF CHEMISTRY, *Liverpool and North-Western Counties' Section*, Chemistry Lecture Theatre, Liverpool University, at 7.30 p.m. "Chemical Warfare," by Major V. Lefebure, O.B.E.

Mar. 9. INSTITUTE OF METALS, *Sheffield Local Section*, Mappin Hall, The University, St. George's Square, Sheffield, at 7.30 p.m. "Further Notes on Britannia Metal," by Capt. F. Orme.

NEWS FROM THE SECTIONS

MONTREAL SECTION

The January meeting was held at the Queen's Hotel, and was preceded by dinner. Dr. MacLean, the Chairman, presided, and was supported by Dr. R. F. Ruttan. The lecturer of the evening was Dr. H. E. Howe, editor of the *Journal of Industrial and Engineering Chemistry*, New York.

Chemistry as the maker and breaker of nations was his theme, and Dr. Howe emphasized the need of enlightening the general public, and particularly business men, on the great debt owed to the chemist, and, incidentally, of impressing upon the chemist himself the vital importance of his profession, and the absolute dependence of the world on his knowledge. The duty consequently devolved on the chemist of asserting himself and forcing recognition of his profession as one of paramount value to the world. Dr. Howe showed the power which chemistry has wielded in several notable instances, and its close relation to finance and prosperity. Chemistry developed the purple hue used by the merchants of Tyre and Carthage, from the fluid secreted in the tiny shell of a Mediterranean mollusc, and this lent largely to the riches of the two ancient cities. By the use of the deadly Greek fire, chemistry decreed that the siege of Constantinople should come to naught. Chemistry discovered the art of making weapons from metal, and thus moulded the destinies of early warring mankind. In later times the same science gave birth to margarine at the siege of Paris by the Germans in 1870, and during the Napoleonic Wars, when the continent was blockaded by the British Fleet, the art of deriving sugar from beets was utilised by the French to circumvent the efforts of the British. Since that time both France and Germany have steadily increased the amount of their beet-sugar production, and now, instead of being an importer of sugar, France, only a few years ago, exported about 250,000 tons of beet sugar annually. Without TNT the Germans would have had far more difficulty in blowing up the foundations of the Belgian fortresses, and without chemistry to fight disease, the Panama Canal would never have been built. Dr. Howe referred also to the discovery of gunpowder, which set the nations hunting for nitric acid, and saltpetre from which the acid is obtained. By chemistry the West has been able to break the camphor monopoly, held, not long ago, by the Japanese. With its large deposits of sulphur, used for making sulphuric acid, the United States has been able to obtain its share of international safety. Chemistry is the key to international relations, declared Dr. Howe, for it sometimes seems that the nations are all striving for power and the right to exploit conquered peoples.

In the future the ascendancy will lie not with that nation which has the most natural resources, but with the nation which best knows how to use its resources. The chemistry of the future will form the most fearful, humane and efficient weapon yet wielded on this earth. It will put a premium on intelligence, and it will be a leveller of nations, for a small nation with a superior knowledge of the war-time operations of chemistry will be able to outdistance her larger but slower neighbour. The Germans once built a large part of their hopes for world power on their mastery of the making of dyes. At present Germany is attempting to make liquid fuel from coal, and further, the Germans believe they possess the key to tropical Africa in an antidote which effectively combats sleeping sickness. Germany will not give this secret to other peoples without exacting her price : the restoration of her African colonies. Canada's debt to science is mainly for its development of asbestos, nickel and the manufacture of paper.

Prof. R. F. Ruttan referred to Dr. Howe as the man who had done more than any other to make known to industry the vast importance of research. Prof. J. F. Snell, of Macdonald College, and Messrs. C. F. Bardorf, of the St. Lawrence Sugar Refining Company, and T. H. Wardleworth spoke briefly.

NOTTINGHAM SECTION

At the meeting held on February 21, presided over by Mr. S. F. Burford, F.I.C., a paper by Messrs. A. Brittain, M.Sc., and C. Elliott, B.Sc., on " Plaster of Paris," was read by the former.

In a brief survey of previous work the authors referred to the papers of Davis (this J. **26**, 727) in 1907 and of Keene in 1916, also to one read last November before the Ceramic Society. The order of changes on heating is from the monosymmetric form of the dihydrate (gypsum) to the orthorhombic then to orthorhombic half-hydrate, and to the soluble or one of the insoluble forms of anhydrite. Slides were shown illustrating the aqueous vapour-pressures of different systems at 100° C., and the temperatures of the transitions. According to the authors' experiments the hemihydrate is formed between 109° and 130° C., and anhydrite between 160° and 200° C. It becomes dead burnt at 200° C., but even then will rehydrate if ground sufficiently finely. The design of the closed kettles used in America was then explained. These include settlers in which large quantities of dust carried away with the escaping steam are collected. In the Cummer continuous rotary process, the furnace gases pass through the material, the calcination is completed in three stages and the material is ground after calcination. The two conversion or " boiling " temperatures are at about 120° to 130° and 190° C., with loss of 12 to 16 per cent. and 6 per cent. of water, respectively. In the English open pans stirred by chains, the " boiling " occurs at about 118° C.

The fuel consumption per ton of plaster produced is about 80 lb. of coal in the rotary process, 95 to 200 lb. in the kettle and 400 to 480 lb. in the English open pan. The great inefficiency of the English process is due to excessive surface radiation and poor heat-transmission through the thick iron or tile bottoms. Experiments showed that a thinner plate and the use of producer-gas instead of solid fuel improved the efficiency.

Plaster always contains gypsum even when it also contains much insoluble anhydrite. The presence of the gypsum accelerates the setting, probably by providing nuclei of crystallisation, but decreases the strength, since it does not enter into the crystallisation, but acts like an inert material. A similar effect is produced by overburnt anhydrite. The use of accelerators and the effect of varying the amounts of water were also briefly described.

In the discussion which followed Mr. Pentecost referred to the analogous advantage of fine grinding in the drying of starch, and Mr. J. M. Wilkie expressed satisfaction that the section had at last heard a paper on this typically local industry. Dr. Firth alluded to a German patent in which it was claimed that the theoretical quantity of water gave the hardest set product. Was there a possibility that on long storage the anhydrite might dehydrate gypsum ? Dr. Prideaux wished for information on the chemical changes associated with the first and second setting. In gauging the plaster with water was it usual or advisable to allow for the relative proportions of half-hydrate and anhydrite ? Another speaker asked why commercial plaster sometimes set quickly and then gave again, and the Chairman wished to know whether there were critical temperatures in the setting.

Mr. Brittain, in reply, said that all the other constituents were estimated and the gypsum obtained by difference. When heated above 800° C., anhydrite was again capable of setting, and it gave a basic sulphate above 1000° C. The term "first set" was a misnomer; it merely meant the point at which the plaster became unworkable. Plaster made from the sulphate of lime recovered in the manufacture of phosphoric acid set slowly but gave a hard and dense product.

GLASGOW SECTION

The Ramsay Chemical Dinner was held in the Grosvenor Restaurant on February 23, and was attended by members of the Society of Chemical Industry, the Institute of Chemistry, the Society of Dyers and Colourists, the Glasgow University Alchemists' Club, the Andersonian Chemical Society, and the Ardeer Chemical Club.

Professor G. G. Henderson, F.R.S., presided, and the guests included Sir Thomas Paxton, Bart., Lord Provost of Glasgow, and Lady Paxton; Dr. E. F. Armstrong, F.R.S., President of the Society of Chemical Industry; Mr. C. R. Gibson, President of the Royal Philosophical Society of Glasgow; and Mr. G. A. Mitchell, President of the Glasgow Chamber of Commerce.

Mr. C. R. Gibson, in proposing the toast of "The Joint Chemical Societies," said that the Society of Chemical Industry was the largest chemical society in the country and had local sections throughout the world. They honoured that evening the memory of Sir William Ramsay, a past president of the Society, and they were happy to have in the chair another distinguished past-president and to have with them the ruling president, Dr. E. F. Armstrong.

Of the other societies included in the toast, the Institute of Chemistry was a body which looked after the interests of the profession, and the Society of Dyers and Colourists was devoted to the interests of the dyeing and allied industries. The Students' Societies were represented by the University Alchemists' Club and the Royal Technical College Andersonian Chemical Club. These societies served a very useful purpose and afforded opportunities for the discussion of problems of academic and industrial importance. The Ardeer Chemical Club was composed of members of the research staff of Messrs. Nobel Explosives Works at Ardeer. It was a pleasure to think that this firm realised the importance of chemical research. He welcomed the spirit of co-operation which had brought the societies together, and he suggested that a proposal to form a chemical section of the Royal Philosophical Society of Glasgow would be welcomed by the Council.

The chairman responded to the toast and referred to the formation a few years ago of the Federal Council of Pure and Applied Chemistry, which was intended to be representative of all the chemists in the country. They wished, he said, to impress upon the public that the profession of chemistry was one of the most important, if not the most important, in the country. The future prosperity of the country depended largely on the development of chemistry, and it was very necessary that the people should realise it. The importance of the profession would be realised only by the co-operation of the chemists themselves, and he was glad that a step in this direction had been taken.

Dr. E. F. Armstrong, F.R.S., in proposing the toast of "The City of Glasgow," said that they all had pleasant memories of Glasgow and of the meeting held there last July. The position which Glasgow occupied in the commercial world was second to none. The Lord Provost replied and appealed to chemists to assist the movement for obtaining a purer atmosphere in Glasgow. The air was polluted by burning raw coal and especially by burning it in the domestic fireplace. He thought that chemists could help him and the Corporation to ensure purer air for the citizens. Mr. W. E. Moodie, chairman of the local section, proposed the toast of "The Guests." Mr. G. A. Mitchell, in reply, referred to the appeal made by the Lord Provost for a smokeless fuel and to the fact that chemists had been able to produce a smokeless fuel from raw coal. Attention must now be given to details so that a cheap product might be available.

BIRMINGHAM AND MIDLAND SECTION

Dr. E. B. Maxted presided at the special meeting, held on February 20, in co-operation with the Chemical Society.

Prof. G. T. Morgan and Mr. F. R. Jones read a paper on the "Interaction of Formaldehyde and the Nitro-naphthylamines," in which they pointed out that the seven known nitronaphthylamines have been condensed with formaldehyde under varying conditions:—4-Nitro-α naphthylamine and 2-nitro-α-naphthylamine give dinaphthylmethane bases; 1-nitro-β-naphthylamine furnishes the hydrolysable methylenebis-1-nitro-β-naphthylamine, which exists in two differently coloured modifications; 5-nitro-β-naphthylamine gives rise to two products, a dinaphthylmethane base and a dinaphthacridine; 8-nitro-β-naphthylamine gives methylenebis-8-nitro-β-naphthylamine, which becomes transformed into a dinaphthylmethane base; 5-nitro-α-naphthylamine resembles α-naphthylamine in yielding ill-defined products; whereas 8-nitro-α-naphthylamine furnishes methylenebis-8-nitro-α-naphthylamine and a dinaphthylmethane base which has the noteworthy property of separating in yellowish white tabular crystals containing three molecular proportions of formaldehyde. These results indicate that the nearer the nitro-group is to the amino-radicle in the nitronaphthylamine the more marked is the retarding effect of this nitro-group on the condensation with formaldehyde.

A "Note on the Preparation of β-Naphthol-4-sulphonic Acid," presented by Prof. G. T. Morgan and Eveline Jones, described an attempt to obtain β-naphthol-4-sulphonic acid from the commercially available naphthalene-1-diazo-2-oxide-4-sulphonic acid by boiling this diazo-compound with alcohol, when elimination of the diazo-group occurs, the resulting β-naphthol-sulphonic acid being characterised by means of its azo-derivatives with the diazonium salts of *p*-toluidine, *p*-nitroaniline and β-naphthylamine.

A paper on "Hydrogen Ion Determination," was read by Mr. S. R. Carter. The advantages of reducing all degrees of acidity and alkalinity to one common scale were demonstrated and the basis of Sörensen's hydrogen ion experiment was explained. The constitution of indicators was discussed and their application to the determination of p_H values was illustrated by experiments. The latter portion of the lecture was devoted to the electrometric methods employed for hydrogen ion measurements, and to electrometric titrations; the principles involved were illustrated by potentiometers and electrodes lent by the Cambridge and Paul Instrument Co.

MEETINGS OF OTHER SOCIETIES

BIOCHEMICAL SOCIETY

Dr. Dale presided over the meeting held in the National Institute for Medical Research, Hampstead, on February 12, and the following communications were read:—

(1) "A Comparison of the p_H Determined Electrically with the p_H Calculated from the Carbon Dioxide of Blood in Pathological Conditions": T. R. Parsons and E. P. Poulton. Two methods of calculation were employed:—(1) Warburg's Method (Biochem. J., **16**., 153, 1922); (2) from the carbon dioxide of the plasma, using a relation established by Campbell, Hunt and Poulton (Journ. Path. and Bact., in the press) for the carbon dioxide of the blood and corresponding true plasma, according to the formula $p_H = 6\cdot1 + \log$(combined CO_2)—log (free CO_2). In the latter case the blood must not be anæmic or, with certain reservations, polycythæmic. Neither method should be used if the blood contains excess of fixed acid. Under these circumstances the carbon dioxide in true plasma must be determined directly. Out of 39 observations on various pathological cases (without fixed acid), 82 per cent. (by Warburg) and 79·5 per cent. (Campbell, Hunt and Poulton's method) were not further away than 0·05 p_H from the value actually determined with the hydrogen electrode.

(2) "The Blood in Polycythæmia": J. M. H. Campbell, G. H. Hunt and E. P. Poulton. One case of erythræmia and four cases of congenital heart disease with polycythæmia were investigated. The power of fixing carbon dioxide was much diminished (average, 34 c.c. at 40 mm.); this was not accounted for by the increase of red cells, so that fixed acid must have been present. This was abolished in one case of erythræmia after five days in an oxygen chamber, though the blood picture was not changed. In these cases the arterial carbon-dioxide pressure was normal, so that the arterial p_H was diminished. The percentage oxygen saturation of the blood was diminished in all the cases, but especially in the congenital heart cases (pulmonary stenosis and patent septum), so that there must have been a mixture of the blood from the veins and from the lungs in the arteries. It was also shown that polycythæmia itself leads to faulty æration of the blood in the lungs. Want of oxygen leads to increased ventilation, and in the congenital heart cases the alveolar carbon dioxide is much lower than the arterial carbon-dioxide pressure. Breathing oxygen in these cases does not lead to diminished ventilation, and the explanation is that though the oxygen want is relieved the arterial carbon-dioxide pressure is raised, whilst the fixed acidity remains the same, so that the arterial p_H is diminished. These two factors probably neutralise each other in their effect on the respiratory centre.

(3) "On the Mode of Action of Vitamins": W. Cramer. On withholding the fat-soluble vitamin "A" from the diet of rats an atrophic condition of the intestinal mucous membrane results. This is especially marked in the lower part of the small intestine where the villi are necrosed. The same lesion occurs after exposure to large doses of X-rays and radium. This is, therefore, another instance of the fact that the tissue lesions produced by radiations on the one hand and vitamin deficiencies on the other are essentially similar. The intestinal lesion rapidly disappears under the influence of cod-liver oil. It is specific for vitamin "A" deficiency and does not appear when vitamin "B" is withheld, when a different atrophic intestinal lesion is produced—namely, atrophy of the lymphoid tissue (Peyer's patches). The intestinal lesion produced by vitamin "A" deficiency accounts for most, if not all, the general effects occurring in that condition: cessation of growth, infection, thrombopenia. The intestinal mucous membrane of rats kept since birth on a diet which, though adequate to maintain the animals in apparent good health and enable them to grow and to breed, was restricted in its vitamin content, differs in its appearance from that of rats kept on the same diet supplemented amply with vitamins: in the latter animals the villi are distinctly bigger. The observations confirm the views expressed in previous papers concerning the mode of action of vitamins. These food accessory substances have a drug-like specific stimulating action on certain parts of the digestive tract. These parts are, in fact, dependent for the full development of their functional activity on an abundant supply of these vitamins in the food, and undergo atrophy in the absence of these vitamins. In this respect the vitamins resemble hormones, in the absence of which atrophic changes occur in certain tissues (atrophy of the uterus in the absence of the ovarian hormone, atrophy of the testes in the absence of the pituitary hormone). The generalisation that all cells require vitamins is incorrect and should be abandoned, The same applies to the idea that vitamins contain "growth promoting" factors.

INSTITUTE OF CHEMISTRY

A crowded meeting of the Huddersfield section was held on February 15, in the Technical College, to hear a lecture by Prof. W. L. Bragg on "X-rays and Crystal Structure." The chairman, Dr. H. H. Hodgson, in welcoming the distinguished lecturer, said that no chemist needed an introduction to the work of Prof.

Bragg, but that the chemists of Huddersfield had been looking forward for some time to personal contact with him. Prof. Bragg first described crystal structure and the phenomena of crystallisation, remarking that all true solids were crystals. He then proceeded to the analysis of crystals by X-rays, and compared the results with those obtained by microscopical investigation. Following this came a description of the light which the analysis throws on chemical composition, revealing the beautiful underlying architecture of crystals in its entirety. Particularly does the method afford a means of finding the distances between the atoms in the solid state. A wider aspect of the field was then reviewed, including the nature of chemical combination and the forces of chemical attraction, and an answer was given to the question of why the properties of substances alter so completely when they are combined, *e.g.*, why common salt is so different from its constituents, sodium and chlorine. The cognate problem of the seat of atomic individuality was then considered. In discussing atomic and molecular dimensions, many characteristics were explained from the standpoint of electrostatics, *e.g.*, the problems relating to heats of solution and heats of formation of substances. The final section of the lecture was devoted to the insight which X-ray analysis affords for the study of chemistry. No longer can barriers be erected between chemistry and physics, since recent work by the physicist has broken the existing but always artificial boundary.

ROYAL INSTITUTION

On February 8, Prof. I. M. Heilbron gave a lecture on the "Photo-synthesis of Plant Products," devoted more especially to the synthesis of organic nitrogen compounds. Pictet, he said, believed that alkaloids were formed by the degradation of more complex compounds such as protein or chlorophyll, but Gadamer and Prof. Robinson considered that they were actually primary products of assimilation. In general, it could be assumed that, except in plants living in association with nitrogen-fixing bacteria, nitrogen entered the plant through the roots in the form of some soluble nitrogen compound. The work of Moore and his collaborators, however, seemed to show that in the absence of sources of nitrogen other than atmospheric, unicellular algæ could fix nitrogen and form proteins in presence of an abundance of carbon dioxide.

The key to the formation of alkaloids was to be found in activated formaldehyde. Prof. E. C. C. Baly and himself had found that activated formaldehyde—*i.e.*, formaldehyde produced by photosynthetic action, reacted with nitrogen to form formhydroxamic acid, which at once combined with more activated formaldehyde, producing a variety of complex nitrogenous compounds similar to those found in the living leaf. It was found that if excess of nitrite were used, formhydroxamic acids and nitrogen compounds alone were produced, but in the presence of excess of formaldehyde, sugars were produced in addition to nitrogen compounds. Activated formaldehyde could condense with formhydroxamic acid in three ways, to form either amino-acids, alkaloids or glyoxalines. On replacing the nitrite by ammonia it was found that whether one started from carbon dioxide and ammonia or from activated formaldehyde, on exposure to the light the same compounds were attained. Evidence had been obtained of the production of methylamine, pyridine, piperidine, and other substances.

INSTITUTION OF RUBBER INDUSTRY

A paper on "Technology in the Rubber Industry" was read by Mr. W. A. Williams at the meeting held on February 5.

Mr. Williams said that much that is possible in the modern rubber factory is due to the labour of chemists. But for the work of the chemist and the metallurgist we should have been still struggling along with toy machines such as those used by Hancock and Goodyear, possibly manufacturing nothing better than waterproof coats and pencil erasers. Although the rubber industry has been possible through the agency of the chemist indirectly, it is only within recent years that the chemist has come in direct touch with rubber manufacture. His inclusion in the factory organisation has synchronised with the rapid development of the industry during late years, and the problems that have presented themselves could not have been handled by the strictly-practical man. The success of a technical and scientific department in factory organisation depends solely on the staff. What is wanted is not so much the specialist as a man who has had a broad scientific training, with chemistry as his special subject; the factory and laboratory training that follows after his engagement will make him an efficient works chemist. The organisation I will outline is one to meet the requirements of a large plant, but has the advantage that it can be adapted to smaller factories.

The laboratory sections and the full organisation are as follows: (*a*) chemical research laboratory, (*b*) physical research laboratory, (*c*) chemical routine laboratory, (*d*) physical routine laboratory, (*e*) mixings control laboratory, (*f*) experimental laboratory, (*g*) power, fuel and boilers laboratory, (*h*) contracts and specifications laboratory, (*i*) specifications and supplies link, (*j*) work-planning department.

It is somewhat difficult to foretell the character of the investigations that may be asked from the chemical research laboratory, as the work of a rubber factory is very varied. As examples of the work to be carried out, I would instance investigation to obtain a clearer understanding of the nature of crude rubber to ensure the supply of a uniform raw material;

to evolve suitable analytical methods for use by the laboratory sections which control manufacture. Research work on the production of accelerators has become very important of late, and investigations on reclaiming should not be lost sight of. In the physical research laboratory problems will be handled comprising physical work on new methods and new manufactures, together with the investigation of improvements on existing manufactures. Example of the class of work undertaken by this section are the photo-micrographic examination of pigments correlated with their stress-strain diagrams, and the application of accelerators as distinct from their production on a manufacturing scale. Through the chemical routine laboratory passes all the chemical routine work of the factory, such as the checking of deliveries of supplies against standard specifications, and of samples of the factory products. This section carries out any routine chemical testing required by the other laboratory sections. The physical routine laboratory has duties similar to those of the chemical routine laboratory in that it deals with the check testing of supplies and of the manufacture at various stages of production up to completion and draws the immediate attention of the department concerned when the tests do not show adherence to the manufacturing specification.

The mixings control laboratory is concerned with the adjustment of manufacturing difficulties arising from mixing and vulcanisation; the supply of new mixings to the factory as may be required, and the control of the factory drug departments. In the experimental laboratory work is carried on for the improvement of current manufacture both in quality and build, and the initiation of the manufacture of new articles. The power, fuel and boilers laboratory deals with questions of boiler control, inefficient firing, water softening and lubrication, and keeps a close check on the calorific value of the fuel purchased. The duties of the contracts and specification's laboratory are to assess qualities against specifications which are furnished by prospective customers, the detailed work being carried out either by the chemical or physical routine laboratory. The specifications and supplies link drafts working specifications for all standard manufactures and new productions for the factory, giving necessary details of qualities, weights and measurements, but not interfering with details of the processes. In the work-planning department, consideration is given to all labour and manufacturing operations to economise labour, reduce fatigue and cut down waste.

It should be the duty of the chemist in charge of his respective section to see that the work of the section is properly recorded, and reports on all the work should be filed, and copies sent daily to the works manager, who can then adjust faults which, if not attended to, may later lead to complaint. The reports of the respective departments are in turn circulated through the whole of the laboratory sections, as it is essential that the departments must not work on a water-tight plan. Each section must be conversant with the work of the other section, for the problems are interdependent and valuable suggestions and assistance are obtained by bringing to bear on the subject the different points of views of all the sections concerned.

An outline has thus been given of an organisation for scientific and technical control which, in its complete form, would meet the requirements of a large concern, but which can be started on a small scale and built up as the factory grows. Naturally, large organisations were the first to appreciate the advantages of scientific control and research, and it is due to that appreciation that they have improved their factory processes and costs of production at the expense of their smaller rivals. Such an organisation, however, can only touch the fringe of the subject of research and problems await the detached investigator that are of interest to the whole industry and these can best be carried out by pooling the costs and results of scientific research, such as is done by the Research Association of the British Rubber and Tyre Manufacturers' Association. The success of the industry depends upon its ability to command the application of improvements and reduced costs, which in these days can be achieved by no rule-of-thumb methods. We must, therefore, continue to advance, or be surpassed by other nations which are using science in the struggle for world trade.

THE ROYAL SOCIETY

The Council of the Royal Society, at the meeting held last week, decided to recommend for election into the Society the following from the list of candidates :—

Edgar D. Adrian, M.A., M.D., Lecturer in Physiology, University of Cambridge.

W. L. Balls, M.A., Sc.D. Work on cotton.

Professor Archibald Barr, D.Sc., LL.D. Professor of Civil Engineering at Leeds, 1884–1889, and Glasgow, 1889–1913, well known for his work on range-finders.

Prof. C. H. Desch, D.Sc., Ph.D. Prof. of Metallurgy, Sheffield, who has written on Planimetric Analysis of Alloys, Composition of Eutetics, Solidification of Metals, Hardness of Solid Solutions, Absorption Spectra, Cement and other topics.

Prof. E. Fawcett. Prof. of Anatomy, University of Bristol.

Prof. F. Horton, Sc.D. Prof. of Physics, Royal Holloway College, who has published work on the Discharge of Negative Electricity from Hot Calcium, Ionisation Potentials for Electrons in Helium, etc.

R. T. Leiper, M.D., D.Sc. A distinguished parasitologist.

Prof. J. W. McBain, M.A., D.Sc. Prof. of Physical Chemistry, Bristol, who has investigated the properties of silver-tin alloys, the nature of soap solutions and developed a theory of colloidal electrolytes.

Prof. J. J. Rickard MacLeod. Prof. of Physiology, Toronto University.

G. A. K. Marshall, D.Sc. Director of the Imperial Bureau of Entomology.

Sir Douglas Mawson, D.Sc. Geologist and explorer.

W. H. Mills, M.A., Sc.D. Lecturer in Organic Chemistry, Cambridge, who has worked at optically active oximes, the constitutions of the isocyanines and carbocyanines, etc.

J. S. Plaskett, B.A., D.Sc. Astronomer, Dominion Observatory, Ottawa, 1905–1917.

Prof. H. R. Procter, D.Sc., Emeritus Prof. of Applied Chemistry (Leather) in the University of Leeds, the pioneer in the application of science to the leather industry; has also written on colloid chemistry and other scientific subjects.

Prof. W. Wilson, Ph.D., D.Sc. Prof. of Physics in the University of London; author of papers on the Photo-electric Emission from the Alloy of Sodium and Potassium, and on other topics.

THE NATIONAL MILK CONFERENCE

BY G. CECIL JONES

The report of the proceedings of the National Milk Conference held at the Guildhall, London, in November last, has at last been issued. It is a well-printed volume of 220 pages, and is obtainable from the Conference Secretary, 3, Bedford Square, W.C. 1, price 3s., post free. The papers, twelve in number, are printed in full, and with a few exceptions the contribution to the discussions are reported *verbatim*. This makes a big book, and there is perhaps some danger that its size may scare off some who should read it. They may accept the writer's assurance that the report is extremely easy reading, and that this form of publication was the only safe one, failing a very strong editor or editorial committee. Some editing there has been, but of a kind which makes one glad there was no more.

For the sake of the milk industry it is to be hoped that many chemists will peruse the pages of this report. At every session problems were stated, the solution of which must depend largely on the work of chemists. At the opening session Prof. H. E. Armstrong gave offence to some by saying: "We know nothing of the composition of milk," but it was the right note, and by sounding it and its harmonics at each succeeding session he sent many away convinced that the milk industry has much to learn. The immensity of that service can be realised fully only by those in close touch with the industry and with the officials in Whitehall, who are so satisfied with the present state of our knowledge that they have recently tried to stereotype questionable dairy practice. The papers read at the Conference themselves supported Prof. Armstrong's statement that the industry had everything to learn. The opening paper on "Dairy Breeds of Cattle in Relation to Cost of Production" ended with the statement: "On the cost of milk production according to breed, no reliable data exist." The second paper on "Feeding in Relation to Cost of Production" raised a much more difficult problem but, needless to say, did not solve it. Both papers were valuable for the information they conveyed, but doubly valuable for compelling attention to gaps in our knowledge.

There were papers of a more didactic type, but these were less convincing. For example, there was one on "Pasteurisation," by Dr. Charles North, of New York. It is a good enough statement of one point of view, that which sees the advantages of pasteurisation far outweighing its disadvantages. It was only by accident that the contrary view found exponents at the Conference, and it is surprising that the organisers of the Conference did not seek for someone of this school to open the discussion. The subject has been dealt with recently in these columns by Prof. Armstrong and need not be laboured here, but it may be pointed out: (1) That in addition to its known disadvantages there are reasonable grounds for fearing that it may have disadvantages not yet recognised, and (2) that the Conference was held at a time when the Ministry of Health was known to be framing regulations as to the pasteurisation of milk. Another disappointing paper was that of Dr. Robert Hutchinson. Those of us to whom the first edition of his "Food and Dietetics" was useful expected great things. It is true that book was published in the Dark Ages, when we knew next to nothing of the constitution of proteins, and nothing at all of advitants, but recent work was as accessible to Dr. Hutchinson as to the rest of us, and we expected a masterly survey. We did not get it. Instead we were told that the temperature of pasteurisation was not high enough seriously to affect the anti-scorbutic advitant, and that infantile scurvy after all was a very rare disease. Having no medical qualification, the present writer must leave it at that.

The Editor asked for a short article, not an abstract, so it is unnecessary to give the titles of all the papers. The chief problems of the milk industry are two: (1) to produce milk as economically as possible, and (2) to exclude dirt from it as far as possible from the time of milking until it reaches the consumer. In the solution of these and cognate problems it needs the help of chemists—whole chemists. It is not yet in the mood to pay them, but it must be educated or forced to do so. If trying to carry on without them hurt only the producer and distributor of milk, they might be left to sink, but the economic production of wholesome milk is a problem of national importance.

CORRESPONDENCE

PROFESSOR ARMSTRONG AND WOOL DISINFECTION

Sir,—I am directed by the Secretary of State to say that his attention has been drawn to the article by Professor Armstrong in your issue of February 2, headed "Legislative and Departmental Interference with Industry and the Common Weal," in which Professor Armstrong refers to the proposal for an International Convention for the disinfection of anthrax-infected wool and hair which was submitted to the International Labour Conference at Geneva in 1921. Professor Armstrong's observations on this subject contain several inaccurate and misleading statements, one of which Mr. Bridgeman thinks it important to correct, namely, the statement that "No attempt had been made in advance (*i.e.*, by the British Government) to consult with the representatives of India or the Dominions." This allegation is unfounded. In 1918, after the Home Office Departmental Committee on Anthrax had reported, steps were at once taken officially by the British Government to ascertain the views of the Governments of those parts of the British Empire which appeared to be affected by the proposals, namely, India, South Africa, and Egypt; and in the case of India, which was peculiarly concerned, the various aspects of the question were the subject of full discussion and consultation between the British and Indian Governments.

No similar action was taken in regard to Australia, but this was not because Australia was overlooked, but because the scheme of disinfection recommended by the Departmental Committee and adopted by the British Government, was strictly limited to dangerous materials and excluded wools from countries like Australia, where effective precautions are taken to prevent infection. The British proposals therefore did not affect Australia.—I am, Sir, etc.,

John Anderson

The Home Office, Whitehall
Feb. 20, 1923

Sir,—I can only feel honoured that the Secretary of State deigns to notice my article; but if my "several inaccurate and misleading statements" be of the order of that upon which he comments, they are not serious.

What may or may not have been ascertained in 1918 has little bearing upon what was done in 1921. So much had been done in the interval. The Home Office went into action, at Geneva, either knowing (from inquiries made in 1918) that Indian and other representatives would be opposed to their proposal; or without having ascertained what their attitude *at the Conference* would be. My suggestion is that there should always be consultation between the several units of our Empire before any attempt be made to secure compulsion through the agency of the Geneva machinery; to use Geneva as a lever to make India or any other unit do what the home Government cannot bring about within our own circle by ordinary diplomacy is a very dangerous policy for us to adopt. The occasion was not one for compulsion but for consultation. In the more serious case of White Lead, the English Government knew that Australia, at least, was bitterly opposed to the course taken. To me it seems that the League of Nations is reduced to a farce by such proceeding; if so used, it must increase, not diminish, friction.—I am, Sir, etc.,

Henry E. Armstrong

Lewisham
February 26, 1923

"ROTARY DISPERSION"

Sir,—May I be permitted to correct an error which appears on p. 181 of to-day's issue of Chemistry and Industry? In the papers communicated on February 15 to the Chemical Society, by Dr. R. H. Pickard and myself, the suggestion is made that the complex rotatory dispersion of the organic compounds examined in the course of investigations being carried out in these and other laboratories is due to "dynamic" isomerism—not "geometrical" isomerism. The suggestion is, of course, by no no means new. It was originally put forward, I think, about ten years ago by Prof. Lowry, but it is certainly proving a fruitful working hypothesis.

May I, in conclusion, plead for the general adoption of the term "rotatory," as applied to optical activity, rather than the less euphonious term "rotary," which, in addition, already possesses a well-understood mechanical significance?—I am, Sir, etc.,

Harold Hunter

Chemical Department,
Battersea Polytechnic
February 23, 1923

"ORGANIC" CHEMISTRY

Sir,—It is to be hoped that I am not the only original member of the Society of Chemical Industry equal to a little laughter at times. Sir William Pope is mistaken in supposing that I protest against the "intrusion of such novelties as phase-rules, ions, etc." When there are so many new arrivals with an unfamiliar accent, it surely is not an act of discourtesy for one to step aside and watch. We have seen many come, stay, and prove useful and boon companions when we have got to know them better, but there are others, although exciting our wonder and admiration, who, by persistent intrusion many bring us disquietude, and sometimes hindrance, to our daily work. There is still some work even for empirics, so the suggestion of the lethal chamber is, perhaps, a little premature. What I do protest is, that we have for many years been guilty of using a misleading word—Organic Chemistry. As Sir William says: "Truly, there is but one chemistry"; and it is, undoubtedly, the persistent use of a false term that has caused the present trouble. Chemists are generally agreed that "Organic Chemistry" simply means an extended study of carbon compounds, but the trouble starts when they have to define the exact place where the extension begins, for this certainly can never be done. It is unfortunate that they have not had a word implying this meaning. "Carbology," for instance, although a hybrid, might well have been used; and, again, I see no reason why "Carbonic matter" should not replace the often misused term, "Organic matter," reserving the latter, if used at all, for animal or vegetable organisms or their combustible debris and products of decomposition.—

I am, Sir, etc., JOSEPH BARNES

Arnside, Westmorland
February 19, 1923

SPINACENE

SIR,—May I call your attention to a slight inaccuracy in your account of the paper on "Spinacene," which I communicated last week to the Chemical Society. The work which I published in 1918 was certainly added to, but was not "amended" since—as I pointed out in my earlier paper—all the numbers obtained for Spinacene and its compounds were in much better agreement with the formula $C_{29}H_{48}$ than with the formula $C_{30}H_{50}$. In my recent paper I merely explained that the only compound about which there had been any uncertainty—namely, the dodecabromide—had, as a result of further purification, come into line with the other compounds. To say that I "now consider" Spinacene to be a hydrocarbon, $C_{29}H_{48}$, with six ethenoid linkings is not exactly correct, as I knew and stated that to be its correct description in 1918. What I have since done, among other things, is to work out its probable constitution.—I am, Sir, etc.,

A. CHASTON CHAPMAN

8, Duke Street, London
February 23, 1923

PRICES OF WOOD DISTILLATION PRODUCTS

SIR,—We should like to offer you our thanks for the very excellent Market Report on Wood Distillation Products that you are now publishing.

We may say that we consider the prices quoted are most accurate, with the exception of Wood Creosote at 2s. 6d. (two shillings and sixpence) per gallon. Either we are underrating our product or we are in the wrong market. As we believe we have the largest output of Wood Creosote in this country, we should esteem it a favour if you could give us any indication as to the potential buyers at 2s. 6d. per gallon for this material, or inform us on what basis this quotation is given in the *Journal*.—I am, Sir, etc.,

Per pro SHIRLEY ALDRED AND CO., LTD.
P. E. ALDRED, *Director*

Worksop
February 26, 1923

PRICE OF GERMAN PERIODICALS

SIR,—In case you may deem it worthy of comment I send herewith a circular received last night from a well-known Liepzig firm. Their prices make one breathless! Our German *confrères* not only appear to think that English chemists can afford to pay fancy fees for the privilege of belonging to German societies, but that they are also so overburdened with superfluous wealth that they are likely customers for publications priced at figures "beyond the dreams of avarice."—I am, Sir, etc.,

GEORGE R. TWEEDIE

Southfields, S.W. 18
February 13, 1923

[From the very interesting circular sent by our correspondent we extract a few outstanding examples. The circular is issued by the Buchhandlung Gustav Fock of Leipzig. Further comment is needless :—

(1) Berichte der deutschen Chemischen Gesellschaft. Jahrgang 1-53. 1868-1920. £105.
(2) Liebigs Annalen der Chemie und Pharmazie. Band 1-412 mit 8 Suppl. und Generalregister zu Band 1-380. 1832-1916. Teilweise Neudruck. Gleichmässig gebunden. £210.
(3) Monatshefte fur Chemie. Bd. 1-40 u. Reg. 1880-1920. £125.
(4) Chemisches Centralblatt. Jahrgang 1-67 1830-1896. Gleichmässig gebunden, selten schöne und komplette Serie. £400.

—ED.]

PERSONALIA

The University of Edinburgh has accepted a gift by Mr. J. A. Hood of the sum of £15,000 to endow a chair of Mining.

Prof. E. W. Washburn has been elected vice-president of the chemical section of the American Association for the Advancement of Science.

Mr. J. T. Troestel has resigned his position on the dust-explosion staff of the U.S. Bureau of Chemistry to become chief chemist of the American Refractories Co. at its Jobet, Ill., plant.

* * *

From Germany the deaths are announced of Prof. K. E. Bessel, formerly director of the Physical Technical Reichsanstalt, and of Prof. F. Neesen.

The death is announced of Mr. F. J. Lloyd, a well-known agricultural chemist, who had done valuable work on the feeding of animals for milk production and on cider-making.

NEWS AND NOTES

BRITISH INDIA

Final Forecast of the Sesamum Crop, 1922-23

A memorandum based on reports received from provinces which contained an average of 99·6 per cent. of the total area under sesamum states that the area under the crop is estimated at 4,847,000 acres (4,529,000 acres in 1921-22), and the yield at 428,000 tons (456,000 tons). Excluding Burma, these estimates of area and yield fall short of the corresponding estimates of last year by 12 and 17 per cent. respectively. No very favourable weather was reported, but the general condition of the crop is said to be fair.—(*Ind. Tr. J., Jan.* 25, 1923.)

FRANCE

Cream-of-Tartar Industry in France and Algeria

The wine districts of Southern France and Algeria are the world's largest sources of cream of tartar, the average annual production of argols being 10,000 tons. Of this quantity of argols (crystals which form on the wine casks and contain 75 per cent. of cream of tartar) some 5200 tons are exported to the United States, 2000 to England, 800 to Germany, and 2000 are consumed in France. The 18 cream-of-tartar factories in France had an annual production before the war of 6000 t., but now produce only 2000 t. In addition to the argol production some 15,000 t. of wine lees containing from 18 to 20 per cent. of cream of tartar are also available annually. The principal centre of the cream-of-tartar trade in France is Montpelier.—(*U.S. Com. Rep., Jan.* 15, 1923.)

GERMANY

Aphrogen, a New Saponin

Amongst the various products which Germany has in the past been obliged to obtain largely from abroad are the raw materials from which the naturally occurring class of glucosides, the saponins (*cf.* J. 1920, **39**, **281** A; 1921, **40**, 156 and 825 A), are extracted. Foreign supplies being now too costly, Germany has fallen back upon her own resources, and the firm of Otto Bärlocher, of Munich, has succeeded in obtaining from indigenous plant products a saponin, to which the name *Aphrogen* is given. Since the glucosides of this class possess in a marked degree the power of producing froths they are often added to beverages, and it has therefore been of importance to determine the physiological behaviour of *Aphrogen*. Toxicity and hæmolytic power are found not to run parallel, though in both respects, according to recent experiments by Dr. M. Mandelbaum, *Aphrogen* is much less active than its predecessors. It is therefore better suited than the latter for use in emulsions and beverages. Details of its extraction are not given.—(*Chem.-Z.*, 1923, p. 71.)

GENERAL

New Colloids Research Laboratory in Manchester

The *Manchester Guardian* reports that the Council of Manchester University has approved a scheme for establishing a Colloids Research Laboratory in the University. A sum of £11,842 has been subscribed and given to the University towards the endowment and cost of the equipment of the department. The Research Laboratory will be known as "The Graham Research Laboratory," and Mr. D. C. Henry, M.A., now Lecturer in Chemistry in the University, has been appointed Lecturer in Colloid Physics as from September next, and will take charge of the Laboratory.

Molybdenum Ores

This monograph, which is part of the series on Mineral Resources, with Special Reference to the British Empire, published by the Imperial Institute (John Murray, pp. 86, price 5s.), gives a useful account of the occurrence, characters and uses of molybdenum ores. Until recently the commercial use of molybdenum was practically limited to the manufacture of chemicals such as ammonium molybdate. Of late years molybdenum has, however, been used in steel making, in electrical and other work, and as a constituent of non-ferrous alloys of remarkable properties. Owing to the shortage of tungsten during the early part of the war, exploitation of molybdenum deposits was very active, as the consumption had greatly increased. The world's production of molybdenum in metric tons o metallic contents of concentrates during recent years is as follows :—

	1915	1916	1917	1918	1919	1920	1921
Australia	70·8	74·2	94·4	105·1	95·5	35·5	5
Bolivia	6·5	5·2	—	—	—	—	—
Canada	8·0	42·5	89·9	102·9	30·9	Nil	Nil
Chile	—	0·8	20·1	—	—	—	—
China	—	2·7	2·4	1·1	—	—	—
Korea	—	3·2	59·2	10·7	—	—	—
Japan	—	18·3	12·1	70·3	—	—	—
Mexico	—	—	—	14	1	0·3	2
Norway	72·3	73·1	82·1	84·9	—	—	—
Peru	1·3	3·1	3·8	1·3	2·5	1·0	—
Spain	5·2	26·7	—	—	—	—	—
Sweden	—	0·3	20·3	25·1	—	—	—
United States	82·4	93·8	158·8	390·8	135·2	15·0	Nil

Only two molybdenum minerals are of practical importance, viz., molybdenite and wulfenite. The concentration of wulfenite ores is comparatively simple, whereas molybdenite ores require concentration by water or oil flotation. Processes of extraction of the metal consist either in electric fusion, the aluminothermic method, or leaching (in the case of wulfenite) with an alkaline solution such as sodium sulphide. The ores are found in small quantities in the United Kingdom, but the chief deposits are in India, South Africa, Canada, and especially in Australia, deposits in Queensland and New South Wales having produced about half the world's output of molybdenum ores during recent years. Norway and the United States (Arizona) are also important producers. The monograph concludes with a list of references to the literature on molybdenum.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for February* 22)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Algiers	Lubricating oils	267
Brazil	Paint, oil, varnish, metals, tinplate	271
British India	Sheet glass, glycerin B.P., potassium iodide cryst. B.P. (tender for)	*
Canada	Iron sheet, tinplate, heavy hardware	224
	Brass and copper tubing, sheet and rods	†
Denmark	Scientific instruments, laboratory supplies	2724/F.F./C.C./2
Egypt	Oils, zinc and iron sheets, tinplate, copper, earthenware, copra	264
Italy	Crystal glass	234
,,	Hardware	235
Netherlands	Steel and copper wire	239
,,	Nickel-plated steel plate, nickel-plated tinplate	244
,,	Brass and copper sheet, iron and steel	246
,,	Pottery, china, glass	249
New Zealand	Crockery, hollow-ware	226
Rumania	Iron sheet, tinplate, tin, zinc, copper, lead	251
,,	Heavy chemicals, oils, waxes, vanillin	252
Spain	Pharmaceutical products	256
Straits Settlements, etc.	Druggists' supplies, patent medicines	266
Switzerland	Paper	262

* Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E. 1.

† Canadian Government Trade Commissioner, 37, Basinghall Street, E.C. 2.

TARIFF CUSTOMS EXCISE

Belgium.—The export prohibition has been withdrawn from coke.

Czechoslovakia - Latvia. — The commercial treaty between these two countries is now in force.

Ecuador.—By a recent amendment to the customs tariff, the duties on certain vegetable oils, soap, etc., have been reduced, and those on " luxury " articles have been increased.

Fiji.—The export duty on copra is reduced from 15s. to 10s. per ton. Tinplate of British origin may be imported duty-free.

Finland.—The import and export duties leviable during 1923 are to be the same as in 1922. Increased duties, however, are applied to sugar, and iron and steel bars and reduced duties to certain wares of paper and china.

Germany (*Occupied Territory*).—Further measures of trade control are set out in the current issue.

Greece.—Crude coconut and palm oils are dutiable at double the former rate, and the duty on unspecified goods has been raised from 20 to 40 per cent. *ad valorem.* Alterations in the export duties affect turpentine, resin, oil, soap, and tartar.

Mozambique.—A copy of the new import tariff may be consulted at the Department.

Rumania.—Export prohibitions are applied to brass, zinc, linseed, paper (not printed), crude petroleum, petroleum residues, mineral grease, edible vegetable oils, and raw hides. Authorisation is required for the export of pig and cast iron, copper, caustic soda, paraffin wax, bones, cement, cellulose, scrap iron, ferro-manganese, glue, starch, and certain petroleum products.

South Africa.—A " dumping " duty has been imposed on cement imported from Belgium, Denmark and Holland. A special duty is leviable on imported Dutch superphosphates containing less than 17 per cent. available phosphoric acid.

Tunis.—The consumption duty on alcohol is raised from 850 to 1000 francs per hectolitre of pure alcohol, but denatured alcohols remain subject to a duty of 2 fr. per hl. of pure alcohol.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Exports of Coal

In reply to Mr. Shinwell, Lieut.-Col. Lane-Fox said that the export of coal from this country to France, Belgium, Italy, Germany and Holland for the fortnight ended February 10 exceeded the fortnightly average in the last quarter of 1922 by 52,000 tons.—(Feb. 15.)

Import Licences for Dyestuffs

Viscount Wolmer informed Major Attlee that the Dyestuffs (Import Regulation) Act, 1920, empowered the Board of Trade to charge for each licence a fee not exceeding £5 to cover the cost of administration. Fees actually charged were based on the value of the consignment to which the licence related, and ranged from 2s. 6d. on consignments of a value up to £100, to £5 on consignments exceeding £3000 in value.—(Feb. 19.)

The Shropshire Barytes Industry

Lieut.-Col. Lane-Fox, replying to Viscount Sandon, said he was aware of the precarious condition of the barytes industry in Shropshire.

The Ministry of Transport was inquiring as to the effect of railway rates on the industry. He was not aware how foreign competition could be overcome, but any proposals to that end would be considered.—(Feb. 19.)

Overseas Trade Department

The Prime Minister (Mr. Bonar Law) informed Mr. Darbishire that expenditure on the Department of Overseas Trade and its overseas services had been substantially reduced. In view of the importance of promoting our overseas trade, and having regard to representations received from the commercial community in favour of maintaining the Department, it was not intended to abolish it.—(Feb. 19.)

Home-grown Sugar-Beet

Replying to Mr. Wise, Mr. R. Sanders said in accordance with arrangements for the future amalgamation of the Kelham and Cantley sugar-beet factories, both factories would offer contracts for beet to the limit of their respective capacities, so that 6000 acres would be grown for Kelham and 9000 acres for Cantley. Although this area was nearly double that grown last year, many requests from farmers had had to be refused. The Government had approved a scheme for raising capital to alter and improve the Kelham plant to enable it to deal efficiently with this year's crop and for reorganising the company's finances. For this reason the amalgamation of the two companies was postponed until the end of the present season, when the results of operations at both factories would be available.—(Feb. 19.)

Medical Research Council

In a written answer to Sir H. Nield, Mr. Baldwin stated that, in view of the magnitude of the national expenditure due to disease, and the vital importance of measures calculated to improve the health and efficiency of the industrial population, the Parliamentary Grant-in-Aid of £130,000 per annum to the Medical Research Council was not excessive, and its detailed allocation, whether for publishing Reports or other purposes, might be left to the discretion of the Council. Considerable value was attached to the work of the Industrial Fatigue Research Board in the industrial world.—(Feb. 19.)

National Physical Laboratory

Mr. E. Wood, answering Sir P. Newson, said that in 1913–14 the National Physical Laboratory received Treasury Grants totalling £21,150, and payments from Government Departments for services rendered amounting to £32,546. The staff then numbered 202 and cost £27,323. According to the estimate for 1922–23, the staff of 490 cost £145,500, and sums received for services rendered would total £89,000, the net cost to the Department of Scientific and Industrial Research being £75,000.—(Feb. 21.)

GOVERNMENT ORDERS AND NOTICES

Safeguarding of Industries Act, 1921

The Treasury has issued an Order dated February 15, under Section 10 of the Finance Act, 1922, exempting from duty certain articles which contain ingredients dutiable under the Safeguarding of Industries Act, Part I., on account of the small value of the dutiable ingredients or parts in comparison with the total value of the whole articles. Articles thus exempted from duty include: Ornamental articles, otherwise dutiable only by reason of containing lamp-blown ware as a part; unmedicated toilet oils containing dutiable perfumes, fireworks, sporting cartridges, bath salts, grease paints, and toilet preparations, which contain dutiable chemicals as a part or ingredient; toilet and medicinal preparations, disinfectants, and flavouring mixtures, which contain dutiable chemicals, provided that the value of the dutiable ingredients in any article does not exceed 10 per cent. of the aggregate value of the ingredients of the article.

Permitted Explosives

The Secretary for Mines has made an Order dated February 15, 1923, varying the list of permitted explosives named and defined in the Explosives in Coal Mines Order of September 1, 1913, and in subsequent amending orders.

COMPANY NEWS

THE SOUTH METROPOLITAN GAS CO.

The ordinary general meeting was held on February 14, Dr. Charles Carpenter presiding.

In discussing the questions relating to gas supply which are now before the public, Dr. Carpenter said that the necessity for recovering benzol and toluol from coal gas for high-explosives manufacture during the war led to complaints about the quality of the gas. As a result the Fuel Research Board investigated the matter, and suggested that gas should be sold by its thermal value, leaving the gas undertakings free to adopt the standard of heat quality best suited to the circumstances of manufacture. The consumer was protected by the installation of recording devices, many of which, he hoped, would soon be put to work. With regard to the safety of gas supply, the truth was that, whether gas, electricity or candles were used for lighting, certain risks would attend their use, but never outweigh their advantages. The dangers of carbon monoxide in coal gas were exaggerated as coal gas containing it had a characteristic smell, It was noteworthy that even the large municipal corporations supplied gas containing carbon monoxide. The company still had to pay double the pre-war price for coal, and prices of by-products had fallen heavily. For the first time since 1914 the pre-war dividend of 5½ per cent. had been reached.

REVIEWS

Heat Transmission. Technical Records of Explosives Supply, 1915–1918. *Ministry of Munitions and Department of Scientific and Industrial Research. No. 9. Pp. iv.+48. H.M. Stationery Office,* 1922. *Price* 5s.

The prefatory note states : " This is the 9th and last of a special series of Reports, which have been published in order to make available, for the benefit of the industries concerned, the results of scientific and industrial value contained in the technical records of the Department of Explosives Supply of the Ministry of Munitions." This note sufficiently explains the scope of the work, which has been compiled by Mr. W. McNab and edited by Dr. A. W. Porter.

The book contains three sections, the first being theoretical, the next experimental, and the third being an application of the principle to certain special cases. There are several alignment charts, from which overall co-efficients of heat transmission can be calculated graphically, and there are charts dealing with the co-efficient of transmission for pipes carrying water and gases respectively. The theoretical section is due to Dr. Porter, and is not intended to carry the theory of heat transmission beyond that attained in recent text-books, but is sufficient only to introduce the symbols and formulæ required for the study of the experimental data.

When the Department of Explosives Supply undertook to erect a number of important factories, in which heating and cooling of liquors and gases constituted so large a number of problems to be solved, there was found to be an insufficiency of data upon which to design such plant with certainty. Accordingly, a number of experiments was made, covering the question of cooling acid, the use of lead coolers and superheaters in denitration plants, the effect of stirring on rate of cooling, the heat transfer in surface condensers, the question of surface losses, etc. The data thus obtained have been collected and interpreted in the light of the theory, and a number of valuable co-efficients have been determined, some of which are applicable only to special cases, but others have a much wider significance, which renders the book of all-round value as a work of reference which should be in the hands of every designer who has to deal with heat-transmission problems.

In spite of all the published data regarding heat transmission, there is still a great lack of connected data from which results for any definite set of circumstances can be interpolated, and this work carries the solution of heat transmission problems a stage further than any existing book ; but the theory is still far from complete, and there is still scope for a great deal more work on this subject.

On page 8 the law of heat transmission from fluid to metal or *vice versa* is stated, but the constant involved in the equation is omitted, although the formula has been used in constructing the chart (Fig. 4) for the co-efficient of heat transmission for pipes carrying gases. By working backwards this constant is found to be between 0·21 and 0·22. From the reviewer's experience this constant is probably rather low, and should be nearer 0·24.

The experimental section would have been increased in value if the overall co-efficients obtained had been compared methodically with the theoretical value obtained from the formula, and there are wide discrepancies in the results tabulated in Fig. 7.

One important omission is the performance of concentric tube interchangers—a method of heat transfer which is coming more and more into use and upon which reliable data are badly needed. The theory is touched upon and the statement is made regarding the " equivalent diameter " of an annulus, that " it would seem fair to treat it as equivalent to a pipe of diameter equal to the difference of the diameter of its outside and inside surface." One may ask " Why ? " especially if the annulus is narrow compared with the pipe diameters. Experimental data are not available to support this, and the point still needs elucidation.

It is important to note that the " equivalent diameter," when the formula is based on " heat/foot^2 " is not the same as the " equivalent diameter " when the formula is based on " heat/foot run." Where the sectional area of the inner pipe equals the sectional area of the annulus, then, if the equivalent diameter in the formula based on heat/foot^2 is 2×annular width, the " equivalent diameter " based on heat/foot run is 13·5×annular width.

In dealing with fundamental principles on page 1 the temperatures t_1 and t_2 should surely be the *metal* temperatures not the temperatures " just inside and just outside." From the illustration t_1 and t_2 would appear to refer to the fluid temperatures. Again the co-efficient of transmission is calculated per *square foot*, but it should be noted that in many cases in practice where relatively thick pipes are used, the areas inside and outside are very different. In such cases the *mean* area should be used, and even then the result must be regarded as approximative. Would it not have been better to adopt the method of employing coefficients which give the heat transmission per *foot run* of pipe ? Thus :—

If k_l = C.H.U/hr./ft. run/° C. for inner film
k_o = ,, ,, for outer film
k_m = ,, ,, for metal =

$$\frac{2 \quad K}{\log_e \quad b/a}$$

Then, if k=overall co-efficient,

$$\frac{1}{k} = \frac{1}{k_l} + \frac{1}{k_o} + \frac{1}{k_m} \text{ exactly,}$$

whilst the corresponding equation on the surface basis is only an approximation.

It will need care to avoid being misled or puzzled by some typographical errors which should be removed in any succeeding edition. For example: On page 9, line 14, t_1 should be t; on page 11, in the diagram t Hot t should be t_0 Hot t; on page 12, $(t_0'—t')/(t_0'—t)$ should be $(t_0'—t')/(t_0—t)$; on page 15, the numerator and denominator of the expression within the square brackets should be reversed, and the third line from the bottom should read: (Thermal cond.) ×(press.×dens. at 1 atm) $^{\frac{3}{4}}$/ (Viscosity) $^{\frac{1}{4}}$.

On page 16 the index $\frac{3}{4}$ should be outside the bracket and not applied to velocity only. Further, it is unfortunate that the symbols used on page 3 in relation to Fig. 1 have different meanings from those used on the previous page, and that H has a different meaning. For Fig. 1 k, k_1, k_2 are not defined; they are

k_1=co-efficient of transmission for one film.
k_2= ,, ,, other ,,
$\frac{k}{b—a}$= ,, ,, metal.

Reverting to the chart of Fig. 4, in applying this to an interchanger where the temperature varies along the interchanger, Fig. 4 gives the coefficient of heat transmission for any particular temperature. As stated on the top of page 16, the mean value of the coefficient for the whole interchanger can be approximately obtained by taking the mean value of the temperature. It might be noted that the coefficient of transmission will vary only slightly even for the great temperature changes, because

$$H = CK\left(\frac{v\,\delta\,D}{\mu}\right)^{\frac{3}{4}} \quad \text{where}$$

H=CHU/hr/ft run/°C, and in ordinary cases $v\delta D$ is nearly constant along a given interchanger, so that $H=C'K/\mu^{\frac{3}{4}}$

Now $K/\mu^{\frac{3}{4}}$ varies only slightly with change of temperature; hence a nearly accurate value of H is obtained by employing the *mean* temperature.

In conclusion, the Department of Scientific and Industrial Research have done wisely in publishing for the general benefit this book of valuable data, and it will be of real assistance in all industrial establishments where heat-transmission problems are handled scientifically.

H. A. HUMPHREY

LE CAOUTCHOUC. *By* PAUL BARY. *Les Colloïdes dans l'Industrie. Pp. vi+255. Paris: Dunod,* 1923. *Price* 29 *francs.*

The study of colloids is a branch of science which has made rapid developments in recent years, and in this connexion rubber is one of the substances which have attracted most attention. It does, in fact, appear certain that the colloidal state of rubber forms the key to its remarkable properties and reactions, and must be the true basis for explaining its behaviour in the various technical processes involved in its production and manufacture—from the coagulation of the latex to vulcanisation and regeneration.

The author has undertaken the difficult task of presenting a study of the chemistry and technology of rubber from the point of view of its colloidal nature, and his efforts have been attended with no small measure of success. The work consists of a systematic survey of existing knowledge of the subject, including brief abstracts of most of the recent literature of importance, which make it a useful reference book. Wherever opportunity occurs the author attacks his subject from the colloidal-chemical aspect, and in so doing displays a great deal of originality, thus providing some most interesting additions which open up a vast field of thought.

The first part deals briefly with rubber latex, its constituents, and methods of coagulation, and is followed by chapters on chemical properties and constitution, physical properties, and vulcanisation, with a concluding chapter devoted to synthetic rubber, regenerated rubber, and substitutes. The author is seen particularly to advantage in his treatment of such subjects as the swelling and process of solution of rubber in Chapter III; the theory of vulcanisation, reversibility of the reaction between rubber and sulphur, and the mode of action of accelerators in Chapter IV; and the theory of devulcanisation in Chapter V, which contains lists of patented processes for the synthesis of isoprene and artificial rubber, and for the regeneration of rubber. Judged from the economic standpoint, the importance of these seems hardly sufficient to merit the labour which must have been expended in compiling them, and a much more useful purpose would have been served by a similar much-needed *résumé* of the patent literature concerning a number of other subjects of far greater importance at the present time; such, for example, as accelerators of vulcanisation and vulcanisation processes.

It is unfortunate that so many errors have escaped detection during correction of the proofs. The following are some which have been noted:—In the reference on p. 17 to H. P. Stevens' work, "4, p. 1960, 1922," should read "4, p. 196, 1922"; on p. 128, "H. D. Porritt" should read "B. D. Porritt," and Porritt is not indexed; on p. 135, line 4, "et" should read "est"; on p. 138, the structural formula needs correction; on p. 190, "Casparia" should read "Caspari"; on p. 194, 7th line from the bottom, "puisser" should read "puisse"; on p. 197, "Shart" should read "Short"; and in several instances the abbreviation "Chem. Ind." is incorrectly used for "Jour. Soc. Chem. Ind." Apart, however, from these minor defects, the book is well and clearly written, and should prove a valuable addition to the libraries of all interested in the elucidation of the intricate problems of the chemistry and technique of rubber.

R. N. JOHNSON

OPTICAL METHODS IN CONTROL AND RESEARCH LABORATORIES. VOL. I. *By* J. N. GOLDSMITH, S. JUDD LEWIS AND F. TWYMAN. *Second Edition. Pp. iv+56. London: Adam Hilger, Ltd.*, 1923. *Price* 1*s*. 6*d*.

The optical properties—*e.g.*, refractive index, emission or absorption spectrum, and specific rotatory power of a substance are physical qualities characterising the molecule of the substance. These various characteristics can, in general, be determined with great accuracy; indeed, certain optical measurements of the kind referred to are among the most precise known to physical science. It is not surprising, therefore, that the attention of chemists and physicists was, early in the history of applied optics, turned to the development of instruments for the rapid and easy determination of these characteristics. Refractometers and polarimeters are to-day part of the equipment of most research and technical laboratories. We would say that their very familiarity appears to be responsible for a certain contempt of the conditions of use under which alone they are capable of affording useful and accurate information. In addition to instruments of the above types, spectrometers, spectrographs, and spectrophotometers, both for the visible and invisible regions of the spectrum have long been available and are now finding a limited application in chemical technology. The financial potentialities of the technical application of spectrophotometry may be instanced by a case taken from the work under review, where, on p. 21, we read that during 1914–1919 a saving reckoned in tens of thousands of pounds was effected in the cost of dyes by the use of a spectrophotometer. The main purpose of the book is to afford information concerning the directions in which refractometers, polarimeters, spectrographs and spectrophotometers can be of value to the technical chemist. The authors' and publishers' high qualifications for this task are indisputable, and the reviewer heartily commends the work to the notice of all technical chemists. The work contains a wealth of references to literature dealing with the application of optical methods of investigation in the most unexpected directions. Thus, to take a few illustrative applications at random, we find particulars of the detection of as little as 0·0000001 gm. of mercury in explosives, the quantitative determination of from 0·004 to 0·216 per cent. of lead in copper, the determination of a few hundredths of one per cent. of nitrogen peroxide in gases resulting from the decomposition of gun cotton, etc., the analysis of mixtures of methyl and ethyl alcohols, and of mixtures of benzene and cyclohexane, the detection of naphthalene in benzol, and the discrimination of coal-tar and coke-oven tar creosotes from blast-furnace and water-gas tar creosotes. Other applications are legion.

Certain points of adverse criticism will, it is hoped, be avoided in future editions. No index is provided to the book, a defect limiting very seriously its usefulness. A uniform style has not been maintained throughout the book. In one part references are given as footnotes; in another they are embodied in the text or at the end of the chapter. One part is apparently the work of the reputed authors; another is very clearly the work of the publishing house. Messrs. Adam Hilger, Ltd., have a world reputation second to none as makers of optical instruments. Certain of their publications are of an equally high standing. The growing tendency in English scientific literature of a certain type, issued since the war, to attempt to run pure science and literature of the trade-circular type in joint harness is to be deprecated. Appreciation of the scientific part of the brochure under review is expressed above, but one is sorely tempted to modify this when confronted with such statements as the following (p. 12):—"Anyone purposing to commence serious visual spectrum analysis without one of the modern 'Wavelength' forms (introduced by Adam Hilger, Ltd., in 1904) would be well advised to employ his time more usefully." The authors and Messrs. Hilger are capable of something very much better than that. Some continental firms—mention may be made of the Siemens-Konzern—are responsible for scientific publications worthy of ranking with what is best in scientific literature. Messrs. Hilger, Ltd., are amongst the firms who could do the same for English science. The book could be extended, its obvious defects removed and its usefulness very much increased. One thing is certain, it could not then be issued at the modest price which commends the present edition. Perhaps the reviewer has been misled and the publication is the latest form of post-war trade circular; if so, it is the best with which he is acquainted, and his advice to chemists and physicists is—get it!

J. S. G. THOMAS

"WHERE TO BUY" EVERYTHING CHEMICAL. *Pp.* 200. *London: S. Davis & Co., January*, 1923. *Price* 2*s*. 6*d*.

This Index, the second so far issued, is published in January and July of each year, and provides a useful guide to the principal sources of supply of chemicals, chemical plant and apparatus, each of these sections being treated under a separate heading. Under the name of each chemical will be found the names and addresses of the principal manufacturers or merchants arranged alphabetically to facilitate reference. The wide range of chemicals and chemical plant listed provides an impressive tribute to the importance of the chemical trade in this country. The trade names of various chemical products are given in an appendix. This publication is better than most others of its kind, but as usual some of the principal manufacturers are omitted from the respective lists and their places taken by agents and merchants who do not specialise in the product.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

There is in general little or no change to report in prices during recent weeks. Unfortunately the tone of the market has gone decidedly pessimistic and has not fulfilled the promises of the earlier weeks of the year. The effect of publicity and the bringing together of buyers and manufacturers at the British Industries Fair can only have a beneficial effect, and by displaying the line upon which various firms are developing will stimulate others to make the fullest use of new products which are being put on the market.

Acid Acetic, 40% tech.	£22 per ton. Tone still very firm and supplies none too plentiful.
Acid Hydrochloric	4s. to 5s. d/d.
Acid Nitric, 80° Tw.	£25 per ton d/d. Not in much demand.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Position well maintained but somewhat quieter than at the earlier part of the year.
Arsenic (White)	£65-£70 per ton. Tone slightly less firm.
Bisulphite of Lime	£7 per ton, packages extra and returnable.
Bleaching Powder	£10 10s. per ton d/d. No change in demand, which is still poor.
Calcium Chloride	£6 per ton d/d. In poor request.
Copper Sulphate	£26 10s. per ton f.o.b.
Potash Caustic, 88/90%	£29-£30 per ton. No change.
Potass. Bichromate	6¼d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton. No change in prices, but greater quantities are offered for spot delivery.
Soda Caustic, 76%	£20-£21 per ton. No change.
Soda Crystals	£5 10s. per ton carr. paid. Demand well maintained.
Sod. Acetate, 97/98%	£23 10s. per ton. In fair demand. Price firm.
Sod. Bicarbonate	£10 10s. per ton. Inquiry quite good.
Sod. Bisulphite Powder, 60/62%	£19-£20 10s. per ton f.o.b. or f.o.r. London.
Sod. Chlorate	Prices of foreign supplies vary, and buyers are not keen on placing orders for forward delivery.
Sod. Nitrite	£30 per ton 100% basis d/d.
Sod. Sulphide, solid 60/62	£15 per ton. Market unsteady and demand shows no improvement.
Sod. Sulphite, Pea Cryst.	£17-£17 10s., 1-cwt. wooden kegs included.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£9 per ton d/d.
Grey, 80% basis	£18 10s. to £20 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead	£38 per ton d/d.

TAR PRODUCTS

Acid Carbolic—		
Crystals	1s. 3d.-1s. 4¼d. per lb. Very active demand, especially from Japan. Price has upward tendency.	
Crude 60's	3s. 8d.-3s. 9d. per gall. Good demand.	
Acid Cresylic—97/99	2s.-2s. 2½d. per gall. Not much business moving.	
Pale 95%	1s. 11d.-2s. 2d. per gall.	
Dark	1s. 9d.-2s. per gall.	
Anthracene Paste, 40%	4d. per unit per cwt. Price nominal. No business.	
Anthracene Oil—		
Strained	9d.-11d. Fair inquiry.	
Unstrained	8¼d. per gall.	
Benzole—		
Crude 65's	1s. 1½d.-1s. 2d. per gall.	
Standard Motor	1s. 8d.-2s. per gall.	
Pure	2s.-2s. 2d. per gall.	
Toluole—90%	1s. 9d.-1s. 11d. per gall.	
Pure	2s. 1d.-2s. 3d. per gall.	
Xylol	3s. 3d. per gall.	
Creosote—		
Cresylic 20/24%	10½d.-1s. 1d. per gall. Moderate demand.	
Middle Oil	8½d.-9½d. per gall.	Good demand.
Heavy	8½d.-9½d. ,, ,,	
Standard Specification	8½d.-9½d. ,, ,,	
Naphtha—		
Crude	9d.-9¼d. per gall.	
Solvent 90/160	1s. 7d.-1s. 9d. per gall. Little business doing.	
Solvent 90/190	1s. 7d. per gall. Fair demand.	
Naphthalene Crude—		
Drained Creosote Salts	£6-£9 10s. per ton. Supply short.	
Whizzed or hot pressed	£9 10s.-£12 10s. per ton.	
Pitch, Medium Soft	157s. 6d. to 160s. per ton f.a.s. Manchester. Numerous inquiries. Market still firm.	
Pyridine—90/140	10s. 6d.-12s. 6d. per gall. Not much business.	
Heavy	8s.-9s. per gall. Price nominal.	

INTERMEDIATES AND DYES

Business in Aniline Dyestuffs has been on about the same level as reported last week. Although there has not been that increase in the volume of trade which has been rather noticeable during the last three or four weeks, at the same time there has been no falling off. The outlook is distinctly better.

Prices remain firm, with a slight advance in one or two outstanding colours. It is quite anticipated that owing to the large rise in price of some of the raw materials, that in other cases prices will have to be advanced to cover the rise.

Acetic Anhydride	1s. 5d. 100% basis.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 7½d. lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride—Anhy.	1s. per lb. d/d.
Aniline Oil and Salts	10d. per lb. naked at works.
Antimony Pentachloride	1s. 1d. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene—48/50	8d.-9d. naked at works.
66/68	1s. 2d.-1s. 3d. naked at works
Diphenylamine	4s. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Meta Phenylene Diamine	5s. 6d. per lb. d/d.
Meta Toluylene Diamine	5s. per lb. d/d.
Monochlorbenzol	£70 per ton.
α-Naphthol	2s. 9d. per lb.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 8d. per lb. d/d.
Nitrobenzene	7½d. per lb., drums extra.
Nitronaphthalene	1s. per lb. d/d.
Naphthionate Soda	2s. 8½d. lb. 100% basis d/d.
Orthonitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Chlorphenol	2s. 10d. per lb.
Paradichlorbenzol	£55 per ton.
Paranitrophenol	1s. 9d. per lb. 100% basis.
Parachloraniline	3s. per lb. 100% basis.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
Para Phenylene Diamine	12s. per lb. 100% basis d/d.
Para Toluidine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid Acetic, 80% B.P.	£45-£47 per ton. Tendency for prices to harden further
Acid Acetyl Salicylic	3s. per lb. for good crystal.
Acid Benzoic	2s. 3d. per lb. Will probably advance further in price.
Acid Boric B.P.	£61 per ton Crystals, £65 per ton Powder, packages in 2-cwt. bags.
Acid Citric	1s. 8d. to 1s. 8½d. per lb., less 5%. Fair demand.
Acid Gallic	3s. per lb.
Acid Pyrogallic, cryst.	5s. 6d. per lb.
Acid Salicylic	1s. 7d.-1s. 9d. per lb.
Acid Tannic	3s. 3d. per lb. No change.
Acid Tartaric	1s. 2½d.-1s. 3d. per lb., less 5%. Fair demand still maintained.
Amidol	9s. per lb.
Amidopyrin	12s. 6d. per lb. for quantity.
Ammon. Benzoate	3s. per lb. for good makes.
Ammon. Sulphocyanide, recryst.	2s. 6d. per lb.
Barbitone	13s. per lb. Price advancing.
Benzonaphthol	5s. per lb.
Bismuth Salts	Price per lb. for cwt. lots are as follows:—Carbonate, 13s., Citrate 11s. 7d., Nitrate cryst. 6s. 11d., Oxide 14s. 5d., Salicylate 10s. 5d., Subchlor 12s. 8d., Subgallate 9s. 6d., Subnitrate 11s.
Calcium Lactate	2s. per lb. Steady.
Chloral Hydrate	3s. 9d.-4s. per lb., according to quantity and holder.
Formaldehyde, 40%	£90 to £92 10s. per ton.
Guaiacol Carbonate	8s. per lb.
Hexamine	4s. per lb. Available supplies rapidly absorbed.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate	B.P. 2s. 5d. per lb. (Green, 3s. 1d. per lb. } Fair Demand.
Magnesium Carbonate, light commercial	£37 per ton.
Magnesium Oxide—	
Light, commercial	£85 per ton.
Heavy, commercial	£28 per ton.
Menthol	37s. per lb., less 2½% for original cases. Small quantities 37s. 6d. nett.
Methyl Salicylate	2s. 3d. per lb. for water-white product in glass containers.
Methyl Sulphonal	13s. per lb.
Paraldehyde	1s. 6d. per lb., will probably be considerably advanced in price.
Phenacetin	5s. per lb., quiet and steady.
Phenazone	7s. per lb. No change.
Phenolphthalein	4s. 9d. per lb. Slightly lower.
Potass. Bitartrate, 99/100% (Cream of Tartar)	98s.-100s. per cwt., less 2½% for ton lots. Market very firm.
Potass. Ferricyanide	4s.-4s. 3d. per lb.
Potass. Iodide	15s. 8d. per lb. for cwt. lots. Cases free. Demand still good.
Potass. Metabisulphite	7d. per lb.
Potass. Permanganate	9d. per lb.
Quinine Sulphate	2s. 2d.-2s. 4d. per oz.
Resorcin	5s. per lb. now quoted for good "white."
Salol	2s. 3d.-2s. 6d. per lb., advancing in sympathy with Salicylates.
Sod. Benzoate	2s. 3d. per lb., with continental quotations very much higher.
Sod. Citrate—	
P.B.C.	2s. per lb.
U.S.P.	2s. 3d. per lb.
Sod. Hyposulphite,—Photographic	£15-£17 per ton.
Sod. Salicylate	2s. 3d. fpr powder, 2s. 4d. for crystals. These prices show little profit to the manufacturers and higher rates are expected in the near future.
Sod. Sulphite—Anhydrous	£27 10s.-£28 10s., according to quantity, f.o.r. London, drums included.
Sod. Sulphocarbolate	1s. 5s. per lb., higher.
Thymol	19s. per lb.
Zinc Sulphocarbolate	1s. 6d. per lb., advanced to.

PERFUMERY CHEMICALS

Amyl Acetate	2s. 3d. per lb.
Amyl Butyrate	8s. ,,
Amyl Salicylate ..	3s. 3d. ,,
Anethol (melting point 21°/22° C.)	4s. 6d. ,,
Benzyl Acetate (from chlorine-free Benzyl Alcohol)	3s. ,,
Benzyl Alcohol free from chlorine)	3s. ,,
Benzaldehyde, free from chlorine	3s. ,,
Benzyl Benzoate, 19·5° C.	3s. ,,
Cinnamic Aldehyde, 98/100% Natural ..	14s. 9d. ,,
Coumarin	12s. 6d. ,,
Citronellol	22s. 6d. ,,
Citral, 100%	9s. 6d. ,,
Ethyl Phthalate ..	4s. 3d. ,,
Eugenol 100%	11s. ,,
Geraniol (Palmarosa) ..	30s. ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	5s. 9d. per lb.
Iso Eugenol	18s. 6d. ,,
Linalol ex Bois de Rose ..	21s. ,,
Linalyl Acetate	22s. 6d. ,,
Methyl Benzoate ..	8s. 6d. ,,
Musk Xylol	8s. 9d. ,,
Phenyl Ethyl Acetate ..	10s. ,,
Phenyl Ethyl Alcohol ..	17s. 6d. ,,
Rhodinol	45s. ,,

ESSENTIAL OILS

Anise Oil, Red Ship Brand	2s. 1d.
Bourbon Geranium Oil ..	26s. 6d. for shipment.
Cananga Oil, Java ..	9s., firm.
Cinnamon Oil Leaf ..	4d. per oz.
Cassia Oil, 80/85% ..	8s. 3d.
Citronella Oil—	
Java, 85/90% ..	3s. 9d.
Ceylon	3s. 6d.
Clove Oil	8s. 3d.
Eucalyptus Oil, 70/75%	1s. 8d.
Lavender Oil, Mont Blanc 38/40%	12s. 6d.
Lemon Oil, spot ..	3s. New crop for shipment 2s. 11d.
Orange Oil, sweet, spot ..	10s. New crop for shipment 10s. 6d.
Otto of Rose Oil—	
Anatolian	24s.
Bulgarian	26s.
Palma Rosa Oil ..	17s. 6d.
Peppermint Oil—	
English, Mitcham ..	80s.
Wayne County ..	13s.
Japanese	6s. 9d.

TRADE NOTES

Trade Publications

Electrometric Apparatus for Determining Hydrogen Ion Concentrations.—We have received from Messrs. A. Gallenkamp and Co. a copy of their list No. 80 of Electrometric Apparatus for Determining Hydrogen Ion Concentrations. The list contains useful descriptions of the apparatus and the methods of working, and should be found useful to all those who have to carry out determinations by this process.

Aluminium.—We have received a small booklet (pp. 80, price 5s.) from the British Aluminium Co., Ltd., giving a collection of useful data on the physical, mechanical, and other properties of aluminium. In view of the ever-increasing use of aluminium in the electrical and other industries, this pocket book should prove of great utility, as the tables provided appear to cover most of the data required by those utilising this valuable metal.

PUBLICATIONS RECEIVED

OPTICAL METHODS IN CONTROL AND RESEARCH LABORATORIES. *By* DR. J. N. GOLDSMITH, DR. S. JUDD LEWIS *and* F. TWYMAN, *F. Inst. P. Vol. I. Pp. iv*+56. *Second edition. London: Adam Hilger, Ltd.,* 1923. *Price* 1*s.* 6*d.*

MANUEL PRATIQUE DE LA FABRICATION DES ENCRES. *By* L. DESMAREST *and* S. LEHNER. *Bibliothèque des Actualités Industrielles, No.* 65. *Third edition, revised and enlarged. Pp.* 372. *Paris: Gauthier-Villars et Cie.,* 1923. *Price* 12 *fr.*

THE STRUCTURE OF ATOMS. *By* PROF. ALFRED STOCK. *Translated from the second German edition, revised and enlarged, by* S. SUGDEN, M.Sc. *Pp. viii*+88. *London: Methuen and Co., Ltd.,* 1923. *Price* 6*s.*

DYES AND THEIR APPLICATION TO TEXTILE FABRICS. *By* A. J. HALL. *Pitman's Common Commodities and Industries. Pp. ix*+116. *London: Sir Isaac Pitman and Sons, Ltd.,* 1923. *Price* 3*s.*

METHOD FOR THE IDENTIFICATION OF PURE ORGANIC COMPOUNDS BY A SYSTEMATICAL ANALYTICAL PROCEDURE BASED ON PHYSICAL PROPERTIES AND CHEMICAL REACTIONS. *By* S. P. MULLIKEN, PH.D. *Vol. IV. Pp. vii*+238. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.,* 1922. *Price* 30*s.*

PUBLICATIONS OF THE UNITED STATES BUREAU OF MINES, *Department of the Interior. Washington: Government Printing Office,* 1922:—

COKE-OVEN ACCIDENTS IN THE UNITED STATES DURING 1921. *By* W. W. ADAMS. *Technical Paper* 318. *Pp.* 34. *Price* 5 *cents.*

ANALYSES OF KENTUCKY COALS. *Technical Paper* 308. *Pp.* 92. *Price* 10 *cents.*

COAL-DUST EXPLOSION TESTS IN THE EXPERIMENTAL MINE, 1913 TO 1918 INCLUSIVE. *By* G. S. RICE, L. M. JONES, W. L. EGY, *and* H. P. GREENWALD. *Bulletin* 167. *Pp. xxii*+639. *Price* $1.

ELECTRIC BRASS FURNACE PRACTICE. *By* H. W. GILLETT *and* E. L. MACK. *Bulletin* 202. *Price* 50 *cents.*

NATURAL-GAS MANUAL FOR THE HOME. *By* R. A. CATTELL. *Technical Paper* 325. *Price* 10 *cents.*

PREPARATION OF LIGHT ALUMINIUM-COPPER CASTING ALLOYS. *By* R. J. ANDERSON. *Technical Paper* 287. *Price* 10 *cents.*

STRONTIUM MINERALS (1913—1919). *The Mineral Industry of the British Empire and Foreign Countries. Imperial Mineral Resources Bureau. Pp.* 12. *H.M. Stationery Office,* 1923. *Price* 4*d.*

JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

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EDITORIAL

THE controversy—if one may so describe it—between Sir William Pope and Sir Arthur Colefax has been most interesting to read. Their studies, traditions and points of view differ so entirely that they hardly come to really close quarters. One of the earliest writers on the atomic theory tells us how delightful it is to watch a fight without sharing oneself in the danger. There is a sweetness in seeing the evils from which you are yourself exempt. This particular contest is between two champions, each of whom has made good points in that branch of learning in which he is most skilled and has demolished the arguments which he supposes the other to have put forward in that branch. Sir William has given a proof that calcium carbide is a synthetic organic compound, so closely reasoned, so well supported by evidence and so lucidly explained that it seems incontestable. Probably both agree that the Referee has rightly come to a wrong conclusion. How can such a catastrophe be avoided in the future? Sir Arthur claims that the learned Referee gave a true decision on the evidence before him, and Sir William admits that this is so.

* * *

Few chemists will dispute Sir William's conclusion; few lawyers will dispute Sir Arthur's. Some points remain undecided, and as we occupy a position in which we are not biassed by any profound knowledge on either side, we appointed ourselves a court of appeal, and having written on the back of the last number of our JOURNAL, *Curia advisare vult*, we have given the matter our best attention, and from the lofty and serene position which Lucretius describes in the passage we first mentioned we deliver our considered judgment:

A Referee who is impartial but not deeply versed in chemistry is very much handicapped in weighing chemical evidence. He would come to a sounder judgment on purely chemical controversies if he were assisted by a chemist who would approach the matter in a judicial frame of mind. Such chemists could be found. So, too, a chemist confronted with a number of conflicting legal opinions would be well advised to consult a lawyer who could do more than add up the witnesses on each side and decide with the majority. Quality, as well as quantity, must be considered, and the amateur finds it difficult to appraise the witnesses unless he can find a skilled assessor to help. Even in the highest legal circles these differences may be detected, and it is possible that among chemists some discrimination should be made in nice points of learning. Did not Lord Bowen say of a brother judge?—"To go to the Court of Appeal with a judgment of ——'s in your favour is like going to sea on a Friday. It is not necessarily fatal, but one would rather it had not happened."

Had Sir William and Sir Arthur chosen to argue whether the decision of the Referee was proper in the circumstances, much might have been said. But they agree on this, nor is there any obvious conflict of opinion as to the wording of the schedule to the Act.

We cannot imagine that decisions arrived at in the same manner as the calcium carbide decision will weigh with chemists, and we hope that future inquiries will be conducted with a greater degree of co-operation between the law and chemistry than has hitherto prevailed. We have ignored the debating points which each knight has scored over the other; if they will consult with us in our private room, we think they might probably agree on some joint recommendation to a higher authority which would tend to a more convenient procedure in the future.

Each party is at liberty to bring the matter before us again.

This seems to be a period of centenaries: it is about a hundred years since Pasteur was born, it is about a hundred years since Jenner died and it is about a hundred years since Faraday discovered benzene. The March number of *The Indian and Eastern Druggist* has an interesting short article on Claude Louis Berthollet, who died near Paris in November, 1822. Berthollet following work done by Priestley, showed that ammonia was composed of one part of nitrogen combined with three parts of hydrogen, and he helped to establish the use of chlorine as a bleaching agent. He discovered the chlorates and suggested the use of potassium chlorate as a detonator. A terrific explosion at Essonnes, near Paris, put an end to this investigation. Berthollet escaped the fury of the French Revolution which terminated the life of Lavoisier. When things were a little quieter he became a Professor of Chemistry, but left his work to follow Bonaparte through his campaign in Egypt and Syria. He published in 1781 a book on "Elements of the Art of Dyeing," in 1801 "Researches on the Laws of Affinity," and in 1803 his "Essay on Chemical Statics." In his later years he retired to Arcueil, where he used to meet Chaptal, Gay Lussac and other chemists. After the restoration of the monarchy he was raised to a seat in the Chamber of Peers and died in November, 1822. We read the article in our contemporary with some pleasure and hope more historical notes will be published in it.

* * *

The success that has attended the manifold applications of catalysis in chemical industry is fast becoming a commonplace. Yet all that has been achieved by single-reaction catalysis, as exemplified by the hydrogenation of oil and the synthesis of ammonia, important as it is, is but little compared with the vast possibilities opened up by the utilisation of preferential catalysis. This newer phase of the question has hardly yet reached industrial application, but sufficient experimental evidence is forthcoming to show its importance. Our last issue contained an article on "Preferential Oxidation in Presence of Catalysts," which provides a valuable summary of our knowledge of this fascinating subject. Special attention was devoted to the oxidation of sulphuretted hydrogen in industrial fuel-gases and to the utilisation of hydrocarbons as a source of a variety of useful products. The problems attending the purification of coal-gas are well known and the importance attaching to the partial oxidation of hydrocarbons becomes very plain when it is realised that developments in this direction may help to solve the problem of conserving our dwindling supplies of fuel oils. In publishing this article, we desired once more to direct attention to the subject, in the hope that it may stimulate further inquiry in this new and vast field of research.

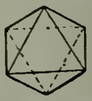
A METHOD OF REPRESENTING CO-ORDINATED COMPOUNDS

By PROF. T. M. LOWRY, F.R.S.

The diagrams used conventionally to illustrate stereoisomerism in co-ordinated compounds are by no means satisfactory. The first essential of such a diagram is that the six co-ordinated groups in compounds such as potassium cobaltinitrite, $K_3[Co.6NO_2]$, or the hexammine of cobaltic chloride, $[Co.6NH_3]Cl_3$, should be represented as occupying identically similar positions. As Werner points out, these six positions might be either the six corners of a hexagon, the six corners of a triangular prism, or the six corners of an octahedron. In the two former cases, three series of di-derivatives should exist, corresponding to the *ortho*, *meta* and *para* di-derivatives of benzene, whereas in the third case only two series of derivatives, corresponding to the *cis* and *trans* derivatives of ethylene should exist. The experimental evidence was conclusive in favour of the last method of representation and Werner's octahedron is now established on a foundation of experimental fact that is but little, if at all, inferior in strength to that on which the tetrahedral carbon atom of Le Bel and van't Hoff reposes so securely.

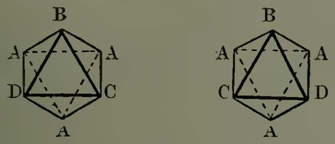
The diagrams used by Werner to represent these octahedra (consisting of a square pierced by an axis of fourfold symmetry) are, however, seriously at fault, since two of the positions appear to be distinguished sharply from the other four. On the other hand, the correct projection of an octahedron, as used in crystallography, is not easy to draw accurately; and even when this has been done, it has the disadvantage that one of the corners is hidden from view at the back of the projection.

The disadvantages of both of these systems can be avoided by making use of the fact that an octahedron resting upon one of its triangular faces has a hexagonal outline when viewed from above, *e.g.*, from a distant point on one of the axes of threefold symmetry. This hexagonal outline is easy to typewrite and easy to print. It is moreover already familiar to many who are handling chemical manuscripts from its use in the formulæ of benzene and other aromatic compounds. All that is necessary in order to convert the hexagon into an octahedron is to unite the 2 : 4 : 6 positions by three straight lines (resembling "meta" linkages) to represent the edges of the upper face of the octahedron; if desired, the outline of the lower face can also be shown by joining the 1 : 3 : 5 positions by dotted lines, thus:



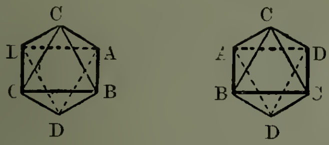
As illustrating the usefulness of this method of representing co-ordinated compounds, diagrams are given below to show the enantiomorphism of the different types of compounds to which Werner attributed molecular asymmetry.

(a) *Complex radicals of the type* $[MeA_3BCD]$



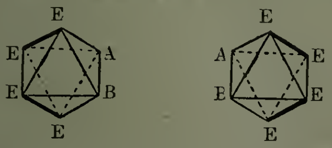
In this case enantiomorphism arises from the clockwise or counterclockwise arrangement of three different substituents, BCD, occupying one face of the octahedron.

(b) *Complex radicals of the type* $[MeABC_2D_2]$



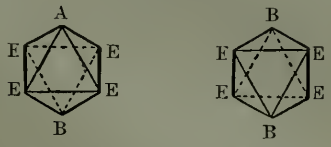
If BCD do not occupy one face of the octahedron, they must necessarily be grouped on one of the square sections which form the principal planes of symmetry. In this case, in order to produce asymmetry, the two apices on either side of this square section must be occupied by two different radicals, *e.g.*, A and B, or C and D. When viewed from one of these similar apices, *e.g.*, C, the four radicals ABCD on the square section then show *either* a clockwise *or* a counterclockwise sequence.

(c) *Complex radicals of the type* [MeAB en$_2$]

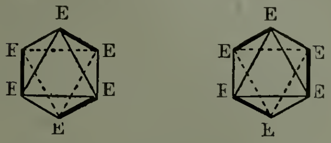


In these diagrams the bivalent radicals " en," which may be identical, are represented by the symbol E——E. Werner points out that the univalent radicals A and B can also be made identical without destroying the asymmetry of the figure; but he distinguishes this as a totally different type of asymmetry, since the octahedron can no longer be separated into two non-superposable tetrahedra. The fact that the asymmetry of co-ordinated compounds of this type persists when A and B are made identical is, however, clearly shown in the diagrams reproduced above.

Werner points out that the univalent radicals A and B or B and B in this type must occupy the *cis* position to one another, since the *trans* isomers possess a plane of symmetry. This is clearly shown in the diagrams set out below, where the removal of the univalent radicals from the " ortho " to the " para " position obviously introduces a vertical plane of symmetry into the diagrams :



(d) *Complex radicals of the type* Me en$_3$



The fact that optical activity can be produced by three identical bivalent radicals, associated with a single atom of metal, may be regarded as the final vindication of Werner's hypothesis; but some of us to whom this phenomenon is by no means new still have to think hard in order to produce a correct diagram of the two enantiomorphous forms even of a simple compound such as the cobaltioxalate, K_3 $[Co.3C_2O_4.]$ When the system of diagrams now suggested is used, this difficulty disappears completely, since the two enantiomorphous forms of the compound can be depicted as easily as the two variants of Kekulé's formula for benzene.

The two diagrams shown above have the further advantage that the existence of a threefold axis of symmetry (with 3 twofold axes of symmetry perpendicular to it) is clearly demonstrated. The thick lines representing the three bivalent radicals are therefore arranged like the blades of a propeller, but of opposite signs in the two cases. Thus, if the figure were rotated in a clockwise direction about the threefold axis, the blades would tend to drive the figure towards the observer in the first case, but away from him in the second case.

NITRE CAKE

Suggestions for its Utilisation and an Improvement in the Manufacture of Nitric Acid

By H. H. GRAY, B.Sc.

More especially during and since the War, when the production of nitre-cake reached a point never touched in the previous history of the British chemical industry, many suggestions and processes have been put forward for the utilisation of this troublesome by-product, but it was only recently that the London correspondent of an American technical journal intimated that the "nitre-cake problem was still with us."

The writer has often been amazed at the way in which chemical manufacturers can utilise materials imperfectly and yet make a profit, but nothing has ever seemed so surprising as the curious state of affairs which during the War compelled the management of one explosives factory to pay twenty-one shillings per ton for the disposal of nitre-cake. Very recently he was credibly informed that it was possible to buy nitre-cake at seven shillings per ton. In the latter case the curious thing was that the firm who sold the material was a large consumer of sulphuric acid and sodium sulphate. No doubt the ultra-commercial attitude of some people in the industry is responsible for this state of affairs, and it will be a good thing for old England when stewardship replaces profit-mongering, and when the patriotism of the battlefield is more widely recognised as being very near akin to that form of public spirit which takes pleasure in the efficient utilisation of the national resources or the securing of a contract for one's native country.

However, that day is rather far distant owing to the complexity of human nature, and it is perhaps time to proceed with the matter indicated by the heading of the article.

Being acquainted in a general way with the ease of reversibility of the reaction by which hydrochloric acid gas is generated from solid sodium chloride by the action of sulphuric acid, the writer put it to the test one day on the off-chance of devising a method for the recovery of sulphuric acid alone from the nitre-cake, and was rather astonished to notice the ease with which gaseous hydrochloric acid or concentrated hydrochloric acid solution will cause the precipitation of sodium chloride from a solution of nitre-cake or from a solution of crystallised sodium bisulphate.

The reaction $NaHSO_4+HCl \rightarrow H_2SO_4+NaCl$ is apparently very rapid, and so soon as the solubility product of the sodium and chlorine ions is attained the reaction commences. The solubilities of sodium sulphate and bisulphate together with that of gaseous hydrochloric acid in sulphuric acid are the controlling factors. If the sulphuric acid is so concentrated as to dissolve little hydrochloric acid, then the solubility product of sodium chloride is not attained, and the hydrochloric acid gas passes off and so out of the sphere of reaction. It would perhaps be a desirable addition to the discussion of this reaction in students' text-books of Inorganic Chemistry, if the fact were emphasized that it is not the volatility of the hydrochloric acid gas which causes its evolution, but the relative insolubility of the gas in sulphuric acid of concentrations exceeding 70 per cent. which allows the reversible reaction $NaCl+H_2SO_4 \rightarrow NaHSO_4+HCl$ to proceed. The same result would be obtained if the HCl took the form of insoluble crystals instead of a gas.

The first results of a rough quantitative examination of the reaction were encouraging, inasmuch as a clear saturated solution of crystalline sodium bisulphate yielded sulphuric acid of over 40% H_2SO_4 and containing less than 0·5% solid residue. The bubbling of HCl gas through a solution of nitre-cake in contact with solid nitre-cake at room temperature yielded an acid containing 60% of sulphuric acid. Thus the reaction is very promising, and seems to hold out the hope of a cyclic process in which the two reactions

[I.] $NaCl+NaHSO_4 \rightarrow Na_2SO_4+HCl$
[II.] $NaHSO_4+HCl \rightarrow NaCl+H_2SO_4$

are combined. The hydrochloric acid is seen to be in circulation, and theoretically one molecule of sodium chloride suffices for the process. The two end-products are sulphuric acid and sodium sulphate, both being eminently more useable and saleable than the inconvenient nitre-cake. There is, of course, some sodium acid sulphate contained in the sulphuric acid which is produced in contact with solid nitre-cake, but where this acid could be utilised on a large works this should not prove a fatal objection, and if the acid could be obtained in a form suitable for use on a nitric acid plant it would be no objection at all. Sodium sulphate and crude sulphuric acid are quoted in the current issue of *Chemistry and Industry* at £5 and £3 10s. per ton respectively, and this seems to offer a satisfactory margin over the 7s. per ton obtained by the firm mentioned above, and to be more satisfactory than the general nuisance of nitre-cake accumulations.

The results obtained above, whilst of great promise, are only preliminary, and the writer has no doubt that a satisfactory scientific examination of the three-component system represented by equation II. would yield interesting results. For example, the nature of the reaction indicates the usefulness of increased pressure, and results might be obtainable which would justify the overcoming of the technical difficulties which would probably stand in the way of using hydrochloric acid gas under pressure. Undoubtedly the use of hydrochloric acid gas under pressure would increase the concentration of the resultant sulphuric acid, but both laboratory and large scale investigations would be necessary before the best temperature and pressure could be ascertained. The margin in price between the possible products and the almost unsaleable nitre-cake would seem, in the writer's opinion, to justify quite a considerable outlay in experimental work, seeing that his laboratory results have been so satisfactory.

PAPER *

By J. HUEBNER, M.Sc.

Paper is a fabric made by depositing fibres in a very finely divided state, from suspension in water, by the means of a sieve. Paper, although a comparatively new invention, was manufactured in a crude state so far back as 123 B.C. by the Chinese. Prior to that any material which possessed a suitable surface for carving or writing upon was used for writing purposes—*e.g.*, metal, wood, clay, skins of animals, etc. One of the earliest writing materials used was parchment, which was prepared from skins of animals. Another one, the papyrus of the Egyptians, was used in 3000 B.C.

The invention of paper travelled first from China to Corea and Japan, and was then brought by the Arabs to Egypt. From here it developed further along the north coast of Africa, whence it ultimately reached Spain and Italy. Paper-making may then be traced to other European countries, and the first paper mill in this country was established towards the end of the fifteenth century. We find records of another paper mill during the reign of Elizabeth, and in 1770 the well-known mills at Maidstone were established by Whatman.

Vegetable fibres form the chief raw materials used in the manufacture of paper. Animal and mineral fibres are but rarely used; the former in the manufacture of some blotting and calender bowl papers, the latter for fireproof papers and boards. The vegetable fibres may be divided into two classes—rag fibres and rag-substitute fibres. The rag fibres are linen, cotton and hemp, whilst all the other vegetable fibres, such as esparto, straw, wood fibres, etc., are rag-substitute fibres. Until about 1850 papers were made exclusively of rags, although attempts had been made by Koops in 1800 to make paper from straw, wood and old paper.

In 1840 mechanical wood pulp was first made by a hand loom weaver in Saxony. From that time onwards wood fibres have formed one of the principal raw materials for the manufacture of paper. It should be clearly understood that there are, however, two distinct types of wood pulp used :—(1) Mechanical wood pulp, which is prepared by disintegrating wood (chiefly pine) by mechanical means only: this pulp consists chiefly of ligno-cellulose; and (2) chemical wood pulp, or wood cellulose, which is prepared by boiling wood either with caustic soda, with caustic soda and sodium sulphide or with bi-sulphites. The product obtained, if properly prepared, therefore consists of pure cellulose.

Whilst the durability of paper made from mechanical wood pulp is doubtful, there is no reason to assume that paper made from wood cellulose should be inferior to rag paper. The first process through which the fibrous raw material has to pass in the manufacture is that of boiling with alkaline liquids. This is followed by bleaching. In order to produce a material suitable for converting into paper it is now necessary to disintegrate the fibres. Prior to 1700 this was achieved by hammering or beating, a process which is still carried out in Japan at the present time.

About 1700 a Dutchman invented a rag engine or "Hollander," in which the fibres are disintegrated between metal knives fixed to a revolving cylinder and similar knives placed below the cylinder in what is known as the bed-plate. The result of the disintegration by the two methods differs considerably. In the slow beating process the fibres are not only reduced in length but they are actually split lengthways into fibrillæ, which interlace or felt readily, and therefore produce a paper of considerable strength. In the more modern process, which is more rapid, the fibres are apt to be cut or torn, with the result that papers made from them are as a rule weaker. Only by very careful treatment in the rag engine is it possible to avoid this difficulty and to convert the fibres partly into fibrillæ. The beating of the paper pulp is one of the most important operations in the manufacture of paper, because the properties of the finished sheet are very considerably influenced by the beating.

Prolonged beating produces "hydration" of the cellulose, with the result that the fibres become gelatinous, and the sheet of paper becomes more or less transparent. This property of the cellulose is made use of in the manufacture of "imitation parchment," or "grease-proof" paper. Such paper is highly transparent, and when a lighted match is placed underneath it becomes blistered.

The beaten fibres are finally strained in order to eliminate fibre bundles and impurities, and the pulp is now ready for the manufacture of paper.

The discovery of chlorine, and its application to the bleaching of cotton rags used in the manufacture of paper, took place towards the end of the eighteenth century. Without doubt, the greatest invention was that of the paper-making machine in 1797. Although the original patent was taken out by Robert, a Frenchman, the first paper machine was completed by the English engineer, Bryan Donkin, in 1803. In connection with this the name of Fourdrinier, a firm of stationers in London, who supplied the necessary money for the experiments, should be mentioned. Although this invention has proved of such enormous benefit to the whole world, the Fourdriniers did not only not derive any benefit from the invention, but lost everything they possessed. The working of the Fourdrinier machine was such that there was a difference between paper made on this machine and that made by hand. The tensile strain of the former is always greater in the direction in which the paper has passed over the machine than in the cross way ; whilst that of hand-made paper is practically uniform in both directions.

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* Abstract of a paper read before the Manchester College of Technology, Evening Students' Chemical Society.

Paper made from the pure fibres is always absorbent, like blotting paper or filter paper. In order to make it suitable for writing and printing purposes, it is necessary to apply water-repellent substances, that is, to size the paper. Two methods of sizing are commonly practised. In the first, resin soap is added to the paper pulp whilst in the beater, and by then adding aluminium sulphate or alum, free resin is deposited on the fibres, which produces the necessary water repellency. This method of sizing is known as engine-sizing. In the second method of sizing, the absorbent sheet of paper, known as water leaf, is passed through a solution of gelatin, and is then dried. This method is known as tub-sizing. Hand-made papers are invariably tub-sized, whilst machine-made papers may be either engine-sized or tub-sized, or both engine and tub-sized.

The minute disintegration of the fibres played a very important part in dyeing of paper pulp. They absorb most of the dyestuffs more readily and they hold them more firmly than the fibres in the state in which they are used in spinning. Thus a number of acid dyeing dyestuffs which have little or no affinity for vegetable fibres can be used in dyeing paper pulp, and acid and basic dyestuffs can be used in combination. Alum and aluminium sulphate are employed as universal mordants, and the resin used in engine sizing also assists in fixing the dyestuffs on the fibres.

It was too early to express a definite view on the advantages and disadvantages connected with the uses of rubber latex in the manufacture of paper. It should be borne in mind that rubber was not a water-repellent agent like resin, but that it was a water-proofing agent. The question of price would no doubt play a *rôle* in the manufacture of some papers, but the product will probably find application in the manufacture of certain papers.

As regards the waste liquors from esparto boiling and from wood pulp manufacture, in which caustic soda was used, from these the soda was invariably recovered. Waste liquors from sulphate-cellulose manufacture were evaporated and treated with sodium sulphate to produce the sodium sulphide used in a subsequent boiling. Many uses have been suggested for waste liquors from sulphite mills—for instance, in the sizing of paper and in the manufacture of alcohol.

Wool was not used in the manufacture of paper. The particular objection to the use of wool fibres was their high elasticity, which resulted in a tendency to change their position during the drying of the paper. Some of the principal paper-making qualities of fibres were their fineness, non-elasticity and strength.

THE POSITION OF THE NITROGEN INDUSTRY IN FRANCE

By MAURICE DESCHIENS

The problem of the manufacture of synthetic ammonia, so vital for every nation, has recently formed the subject of an important discussion in France. On February 6 and 8 the Chamber of Deputies approved the agreement made on November 11, 1919, by M. Loucheur, representing the French Government, and the Badische Anilin und Soda Fabrik, the owners of the Haber process. Under this agreement France would not only acquire the right of exploiting the Haber process, but would be supplied by the B.A.S.F. with all information and data necessary to operate the processes employed in the works at Oppau and Merseburg for the production of synthetic ammonia, and its transformation into sulphate and nitrate. The agreement applies to a works capable of fixing 100 metric tons of nitrogen in the form of ammonia solution every 24 hours. For this concession, the French State would pay 5,000,000 francs, part to be paid at the moment when the agreement is ratified and the remainder when the factory has produced a minimum of 20 tons of fixed nitrogen per day in the form of ammonia solution during 15 consecutive days. For each kg. of nitrogen fixed, the B.A.S.F. would receive a royalty varying between 2 and 4 per cent. of the price of the kg. of nitrogen, but only after production had reached at least 30 tons of fixed nitrogen per day. The concession has a duration of 15 years, and the French State acquires the right to cede it to a public company, and to the most favourable terms if the B.A.S.F. makes other and similar contracts.

Before the war the annual consumption of combined nitrogen in France amounted to 73,000 metric tons, of which 90 per cent. was in the form of sodium nitrate (45,000 tons of nitrogen) and ammonium sulphate (100,000 tons of nitrogen). The French production, however, totalled only 19,000 t. of combined nitrogen (15,000t. in the form of ammonium sulphate, 1750 t. as cyanamide and calcium nitrate, and 2250 t. as organic manure). It was therefore necessary to import 54,000 t. of combined nitrogen, mainly in the form of nitrate of soda and sulphate of ammonia, the total value of the import then being 83 million francs, or over 248 million francs at present rates. Production still remains at about 19,000 tons per annum, whereas the agricultural consumption alone has increased to roughly 110,000 tons. It is true that a clause in the Peace Treaty required Germany to furnish 30,000 tons of combined nitrogen as reparation, but the deliveries are no longer made.

Many processes are available which could be utilised to compensate for this deficiency. Amongst them may be mentioned the processes of Birkeland & Eyde, Häusser, Haber, Claude

Casale (purchased by the Cie. d'Alais et de la Camargue), the Synthetic Ammonia & Nitrates Co., Ltd., the General Chemical Co., Matignon and Fréjacques (transformation of ammonium into urea), Bücher (cyanamide), Serpek (nitride) and the cyanamide process. Discrimination between these various processes is difficult, and for this reason the French Government asked the Académie des Sciences in February, 1921, to form a commission under the presidency of M. Théophile Schloesing to examine the question and to report whether there was any process for the manufacture of synthetic ammonia and of the hydrogen required for that purpose which worked satisfactorily and produced ammonia more cheaply than the Haber process. The report was kept secret, but sufficient is known of its contents to make it possible to state that the conclusion was that the Claude and Haber processes then offered more or less equal advantages, except that the Claude process was more economic when coke-oven hydrogen was used.

The French Government then drew up the Bill, which after revision by a committee of the Chamber of Deputies gave rise to the agreement which has just been adopted, but still awaits the approval of the Senate. By this Bill the Government would be authorised to establish a company to utilise the national powder factory at Toulouse and its plant for the annual rental of 500,000 francs and a share in the profits. The company would have a capital of 50,000,000 francs divided into 500,000 shares of 100 francs each, of which 300,000 would be retained by the State, 50,000 allocated to Agricultural Associations, 20,000 to Chambers of Commerce, 30,000 to Associations of Chemical Manufacturers, 50,000 to Workers' Associations and Co-operative Societies, and 50,000 reserved for public subscription. Any shares not subscribed by these various groups or the public would be taken up by the State. The Company would be administered by a board of 20 members, including 8 nominated by the shareholders, and 14 nominated by the Government, including 3 representing Agricultural Associations, 2 specialists on nitrogen fixation, 3 representing the staff of the company, the remainder representing various public bodies and Ministries.

An annual production of 36,000 tons of fixed nitrogen would be aimed at, and the company would have the right to utilise any process for that purpose, whether of French or foreign origin. If it was found impossible to form a company, the Service des Poudres would carry out the project at Toulouse.

This agreement has naturally given rise to most lively discussion, and the supporters of the various methods of nitrogen fixation have explained the advantages of their processes in numerous lectures and publications. It still, however, remains difficult to express any opinion on the respective values of the different processes until they have been tried on a large scale over a considerable period. It should be noted that since the report of the committee was issued certain of the processes have been greatly improved and new ones have been brought out. Utilisation of the arc processes would be difficult in France, with the present conditions of water-power, because they require 60 kilowatt-hrs. per kg. of nitrogen fixed, whereas the manufacture of cyanamide requires only 17 to 18 kilowatt-hrs. At the Montereau factory the Claude process is now producing 5 tons of ammonia per day regularly and easily. This process is therefore satisfactory from the industrial point of view, and a large plant to utilise coke-oven hydrogen is already working at Béthune. The advantages of the Claude process are fairly well known, but it may be remarked that per gram of catalyst the Claude process yields 6 grams of ammonia against 0·5 produced by the Haber process. The gas has to be passed only four times over the catalyst to produce the same effect as the Haber process in 15 days. In addition, the Claude process can be utilised wherever coke-ovens are present, and the plant is very much smaller and cheaper to install. It may be observed that, according to the report by the Director of the Service des Poudres to the Finance Committee of the Chamber of Deputies, the Casale process has given extraordinary results. Improvements, however, are being made in all the processes for fixing nitrogen, and it is to be hoped that no process will be unduly favoured, so that actual commercial competition will finally decide which process or processes are to remain.

CHEMISTRY AND THE SAFETY OF THE WORKERS

Industrial Hygiene is of interest to all readers of this journal and is becoming a subject of considerable importance. Last week we gave a brief account of the admirable work of Mr. G. E. Duckering, the Director of the Government wool-disinfecting station at Liverpool, and next week we hope to publish a notice of the paper recently read by Dr. T. M. Legge before the London Section of the Society. The Home Office has during the last twenty years reduced the amount of industrial disease and deaths from it to an extent which is quite inadequately recognised, and it is to be warmly congratulated on having such men as Dr. Legge and Mr. Duckering to advise it. Among the experts their reputation is very high, and it should be equally high among all those who are interested in the application of science to the benefit of mankind.

In asking works chemists to watch for the earliest indications of danger from injurious substances, and in inviting the co-operation of the works chemist in Industrial Hygiene, Dr. Legge has performed a useful service.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

THE JOINT MEETING of the Manchester and Liverpool Sections of the Society, held in Manchester last week, was a great success. It began well at the luncheon, when nearly 70 members were present, and I thought the after-luncheon speeches served to give the right note to the day's proceedings. I was particularly interested in the few words which Sir William Kay, the Chairman of the Gas Committee of the Manchester Corporation, had to say in reply to the toast of his health. Evidently he has devoted himself whole-heartedly to the task of giving Manchester a first-rate supply of gas. The President was also in good form, and I believe his devotion to the work of the Society is a valuable stimulus not only to the officials but to the rank and file.

THE TRAM WAITING at the door of the Hotel was a powerful inducement to the speakers not to deliver long speeches, and we were away to visit the gas works very shortly after the time arranged. The works proved well worth braving the elements, which were not too kind, and everyone was enthusiastic in praise of Sir William Kay, who had arranged the visit. The next official appointment was not until 7 o'clock, and the interval was taken up by little informal gatherings, at the Textile Institute, the Engineers' Club and elsewhere, which I thought were not only very pleasant but likely to prove most stimulating to the work of the Society. Indeed, from the commencement of the day's proceedings until the last stragglers caught the last train at midnight the hospitality of the Chairman (Dr. Ardern) and the Secretary (Mr. Guy Radcliffe) of the Manchester Section never ceased. The whole of the arrangements worked most smoothly, and I hope we shall have more of these joint meetings.

DR. LEVINSTEIN'S PAPER on "The Progress of Chemical Industry in Great Britain since 1914," was listened to with the greatest attention. He spoke for an hour and a quarter in such an interesting way that the audience seemed oblivious to the flight of time. In an historical sketch of this kind some of the facts are necessarily known to those who listen, but there were various comments which the speaker made as he went along which I thought very illuminating. He contrasted the panic in the textile industry in 1914, when the supply of German dyes was cut off, with the entire absence of any such panic to-day when the French are in the Ruhr. When one thinks about it this seems one of the most striking testimonials to the progress of the British Dyestuff Industry which could be imagined. A second point was the extent to which our Foreign Office might have been handicapped in dealing with the present international situation if they had to have at the back of their minds the dependence of this country on the dyestuff factories on the Rhine. Fortunately this additional complication no longer exists.

SIR MILTON SHARP the other day gave to the shareholders of the Bradford Dyers Association one of those statesman like addresses to which we are accustomed. Incidentally, I rather fancy he supplied the key to a little problem which has troubled me for a long time. We have been told recently on quite good authority that the British makers have now brought the average price of their dyestuffs down to three times the pre-war German price. On equally good authority, Sir Milton Sharp to wit, we find that the Bradford Dyers Association basis price of 100 in 1913 was 424 in 1922. Superficially there is something wrong here, but not really, for Sir Milton also tells us that the general demand to-day is for superior qualities in dyed goods and that his firm is now using dyes of a superior quality to those in general use pre-war. Further, he tells us that his firm are using 77·66 per cent. of British made colours. So that's that!

THE BRITISH INDUSTRIES FAIR is past and over for the year. I talked with some of the exhibitors and was astonished to find them protesting vigorously at the suggestion that the Fair should not be held next year owing to the arrangements for the exhibition at Wembley. However, it has now been definitely decided that the Fair will be held in 1924. On the whole, the Fair reflected very faithfully the general upward trend of chemical trade, and the majority of the exhibitors in the Chemical Hall were quite satisfied with the business done. Right up to the close the Fair was receiving many distinguished visitors. Dr. Herbert Levinstein spent some hours in examining the exhibits, and another visitor who took considerable pains to make himself acquainted with what was being shown was the Prime Warden of the Worshipful Company of Dyers. Drawing closer together day by day, the various organisations, scientific and commercial, which are connected with Chemistry seem to be learning the lesson of co-operation. I am told that a sub-committee of the Royal Society met a committee of representatives of other learned, quasi-learned and industrial bodies only this week. If it be true this is good news.

FORTHCOMING EVENTS

Mar. 10. The Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Atomic Projectiles," by Sir E. Rutherford.

Mar. 12. The Ceramic Society, Central School of Science and Technology, Stoke-on-Trent, at 7.30 p.m. "Note Books on Josiah Wedgwood." by Mr. Bernard Moore and Dr. J. W. Mellor.

Mar. 12. The Royal Society of Arts, John Street, Adelphi, Strand, W.C. 2, at 8 p.m. "Accurate Length Measurement," by J. E. Sears, jun. (Lecture 2.)

Mar. 12. The Biochemical Society, the Lister Institute, Chelsea, at 5.30 p.m. Annual General Meeting. "The Reversibility of the Action of Urease," by H. D. Kay. "The Effect of Air Irradiated with the Mercury Vapour Quartz Lamp upon the Growth of Rats fed upon a Diet Deficient in Vitamin A," by Miss E. M. Hume and Miss H. Henderson Smith. "The Possible Significance of Hexosephosphoric Esters in Ossification," by R. Robinson and others.

Mar. 13. The Royal Photographic Society of Great Britain, 35, Russell Square, W.C. 1, at 7 p.m. Annual General Meeting. (Members only.)

Mar. 13. The Institution of Petroleum Technologists, at the Royal Society of Arts, at 5.30 p.m. Annual General Meeting.

Mar. 13. Institute of Metals, *Birmingham Local Section*, the Chamber of Commerce, New Street, Birmingham, at 7 p.m. "Casting Temperature Conditions and the Properties of Phosphor-Bronze," by G. L. Bailey.

Mar. 13. Institute of Metals, *North-East Coast Local Section*, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. "The Corrosion of Metals," by W. H. Hatfield.

Mar. 13. Institute of Metals, *Scottish Local Section*, Institution of Engineers and Shipbuilders, 38, Elmbank Crescent, Glasgow, at 7.30 p.m. Annual General Meeting. Discussion on "Problems Awaiting Solution."

Mar. 15. The Chemical Society, Burlington House, Piccadilly, W. 1, at 8 p.m. "The Oxime of Mesoxamide (Isonitrosomalonamide) and Some Allied Compounds. Part 3, Ring Formation of the Tetra-substituted Series," by E. H. Usherwood and M. A. Whiteley. "The Interaction of Hydrogen Sulphide, Thiocyanogen, and Thiocyanic Acid with Unsaturated Compounds," by F. Challenger, A. L. Smith, and F. J. Paton. "The Polarity of Double Bonds," by T. M. Lowry.

Mar. 15. Society of Chemical Industry, *Bristol Section*, St. Stephen's Restaurant, Baldwin Street, Bristol, at 7.15 for 7.30 p.m. Annual Dinner.

Mar. 16. Society of Chemical Industry, *Liverpool Section*, Muspratt Lecture Theatre, the University, Liverpool, at 6 p.m. "Some Aspects of Fractional Distillation," by A. Brittain and C. Elliott.

NEWS FROM THE SECTIONS

OTTAWA SECTION

The function of chemistry in the service of the State is of increasing importance, especially in a young country like Canada, with her great abundance of undeveloped natural resources. The following series of papers, read before the Ottawa Section, briefly set forth the main functions of the chemist in the Departments of the Canadian Government.

Chemistry in the Department of Mines

The Department of Mines was established by the Geology and Mines Act, 1907, which divided the Geological Survey, founded in 1843, into two branches, the Geological Survey and the Mines Branch. The Geological Survey is concerned with the study of the geology and mineralogy of Canada, whereas the Mines Branch is concerned with the investigation and economic development of the mineral resources. It follows therefore that the majority of chemists will be employed by the Mines Branch, which comprises five divisions, viz.: (1) Mineral Resources; (2) Ore Dressing and Metallurgical; (3) Fuels and Fuel Testing; (4) Ceramic and Road Material; (5) Chemical. Each division has chemists on its staff.

The Mineral Resources Division collects detailed information and statistics on mineral deposits, mining operations and market conditions in Canada, and carries out investigations on various phases of the mineral industry. Examples of such work at present in progress are: (*a*) The development of chemical and metallurgical industries in Canada; (*b*) molybdenum, its occurrences, production and uses; (*c*) mineral pigments in Eastern Canada; (*d*) sodium-sulphate deposits of Saskatchewan and Alberta; (*e*) bituminous sands of Northern Alberta; etc.

The Ore Dressing and Metallurgical Division is concerned chiefly with special problems of the treatment of the Canadian ores. During 1921 tests were made on the treatment of gold ores from Manitoba, and on the concentration of low-grade copper and nickel-copper ores. Other subjects of investigation are the recovery of metals of the platinum group from placer concentrates and from certain copper-nickel ores, the use of Canadian-made flotation reagents, the production of electrolytic iron from pyrites and pyrrhotite, and the removal of impurities from coal by washing and flotation. The chemical staff of this division consists of five chemists and assistants, and their work varies from the simplest of qualitative analysis to complete quantitative mineral separations.

The Fuels and Fuel Testing Division has the largest chemical staff of any in the division, comprising a chief, four chemists and two assistants, besides the necessary laboratory help. Their work is in part analytical, such as is required in testing boilers, producer-gas plants, etc. The coals of Canada are being systematically analysed; lubricating oils and gasoline samples are examined; but much of the work is of an investigatory nature. The following problems are illustrative :—The determination of the physical constants of coals; the development of a standard method for testing oil shales; tests of processes for retorting oil shales; the carbonisation of lignite and peat.

The Ceramics and Road Materials Division has charge of the development and investigation of Canadian materials used in ceramic industries and in road-making. There is no chemist as yet on the staff of the division, and most of the chemical work required is done by the chemical division.

In the Chemical Division the staff consists of a chief, three chemists, two assistant chemists and laboratory assistants. The work carried on is very varied, many samples of rocks, minerals, alloys, waters and gases being sent in for identification or for analysis. In 1921, 754 samples were dealt with. Special investigations also receive attention. At present the peculiar properties of the colloidal clay, bentonite, are being studied. Another problem is the use of natural gas as a raw material for the production of industrial chemicals. The air-drying of peat has been under study for some years.

The Explosives Branch was established by the Explosives Act of 1914, and its functions are to regulate the manufacture, importation and use of explosives in Canada. Its duties range from the investigation of accidents due to explosives, the inspection and licensing of explosive plants, and the examination of all types of explosives.

Work done by the *Mineralogical Division of the Geological Survey* comprises the study of rocks and the chemical analysis of new minerals. The methods of analyses employed are based on those of Hillebrand, supplemented by special methods developed in the laboratory.

The attention of the staffs of these laboratories is often also given to problems of a chemical or physical nature submitted by other Government Departments.

Laboratories and equipment.—The five laboratories in which chemical work is carried out in the Department of Mines, are well equipped with the most modern types of chemical apparatus, in addition to physico-chemical apparatus, a micrographic outfit, and an X-ray apparatus. There are four branch chemical libraries apart from the main departmental library. Every facility is provided for the manufacture and repair of special and ordinary apparatus. The number of chemists employed in the Department of Mines has risen from three in 1910 to twenty in 1923, and with the increasing development of Canada's valuable mineral resources the number must rapidly grow. The salary paid is not sufficient, but it enables a man to live fairly comfortably. The work is interesting and there is every opportunity for original investigation and publication of results.

Chemistry in the Department of Customs and Excise

The chemist plays an important part in the administration and control of the tariff laws and regulations. The chemical laboratories of the Department of Customs and Excise, now two in number, were among the earliest to be established in Ottawa. At present the staff consists of six chemists and several laboratory assistants. The work required for the enforcement of the Excise regulations chiefly requires the determination of alcohols, the examination and control of denaturants and the standardisation and supervision of hydrometers. Much control work on raw sugars and molasses is carried out. Many technical matters concerning Excise regulations requiring chemical knowledge are also submitted for opinions. The work required by the Tariff regulations is exceedingly varied and requires considerable experience and encyclopædic knowledge of the composition and properties of drugs and manufactured products of all kinds, besides close acquaintance with the many Customs regulations. In November last, the two laboratories examined a total of 250 samples, which ranged from drugs and medicines to dyes, tar oils, cements, alloys, soap and washing powders, ores, fish offal and metallurgical products. Besides such analytical work the Chief Chemist is often called upon for opinions on technical matters that arise in formulating and enforcing the Customs' regulations.

Division of Chemistry, Dominion Experimental Farms

The establishment of the Division of Chemistry coincided with that of the Dominion Experimental Farm System, of which it is an integral part. Its functions and duties have been interpreted as including two main lines of work :—(1) the solution of agricultural problems requiring the aid of chemistry and (2) chemical service, *i.e.*, educational and advisory work for the man on the land. In addition the division has undertaken analytical and research work for the Department of Agriculture and other Government Departments.

The types of investigation required range from the complete chemical and physical analysis of soils, fertilisers, the investigation of nitrogen-fixation in leguminous plants, research on the effect of climate and soil on the crop, control work on sugar-beet and forage crops, feeding stuffs, and the testing of insecticides, fungicides, to work in connexion with the administration of the Meat and Canned Foods Act, and the Oleomargarine Act. The results of the work are issued from time to time in the form of bulletins, which, like the Annual Report, are of wide interest to the farming community. The division started in 1887 with one man and a small room, but to-day the staff numbers 20 and includes 15 chemists. The chemical building housing the division contains six laboratories; an extension is planned which will afford much needed room for expansion.

Laboratory for Testing Materials, Department of Public Works

This laboratory was established about 1890 for the purpose of testing all the cement used by the Department of Public Works. Later it was enlarged to include the testing of concrete aggregates and concrete mixes, and still later, tiles, bricks, reinforcing materials and limes and plasters were included in the work. During the last eight or nine years the laboratory has tested all structural and other materials purchased by the Department. The laboratory is now purely departmental, and no work is carried on for other departments or outside interests. The staff of this laboratory has increased from one, at its inception, to nine permanent employees and two temporary employees during the summer months.

Chemistry in the Department of Health Laboratories

The Canadian Government has for many years maintained a well-equipped laboratory staffed with chemists and bacteriologists who give their whole time to the detection of adulteration and the education of the public in the intelligent purchase of food and drugs. The laboratory, situated at Ottawa, was established in 1885 under the control of the Inland Revenue Department, but is now controlled by the Department of Health, and has well-equipped branches located at Halifax, Winnipeg and Vancouver. The central laboratory has normally a staff of about 10 analysts, and in each branch there is a senior analyst and one assistant. In order that the work of control may be carried out more effectively, the Dominion has been subdivided into 25 districts, in each of which there is a resident inspector, who forwards suspected samples to the nearest departmental laboratory for examination. In order that adulteration of a sample may be established, it is necessary to know the chemical characteristics of genuine commercial samples of that product and its limits of variability. For this reason, examination is constantly being carried out of large numbers of samples of known authenticity, and when sufficient data have accumulated a tentative standard is drawn up. This is submitted to interested parties as well as an advisory board of three of the leading analysts of the country. When approved, the standard is legalised, being promulgated by Order in Council.

There is hardly a Department which does not find it necessary at intervals to obtain the assistance of these laboratories in the elucidation of their chemical problems. In spite of the handicap imposed by the inadequate technical staff, during the last fiscal year over 5400 samples were examined, many requiring a number of long and difficult determinations, and 225 prosecutions were entered for violation of the Food and Drugs Act alone. In addition to the work briefly outlined above, much educative work has been carried out both by correspondence and by means of the publication of bulletins, of which 440 have been issued to date. The officials of these laboratories are always glad to furnish interested parties with the latest information regarding the composition and value of the foods and drugs on the market. Providing also that the work required does not conflict with the interests of commercial analysts they are also willing to assist manufacturers with their chemical problems.

A meeting was held in the University Club on February 7, Mr. Hambly in the chair. The chairman asked for references to current literature, and Dr. Macintyre gave a very interesting outline of the discovery of the new element hafnium by Profs. Coster and Hevesy, as announced in *Nature* and by Dr. Scott at a meeting of the London Chemical Society. He showed the association of the new element with the titanium-zirconium group, and suggested that it would be very interesting to Canadians if the black titaniferous sands of the Lower St. Lawrence, near the Moisie River, were found to contain this new element in an appreciable percentage. In announcing the subject of the evening's discussion, Mr. Hambly said that much of the recent activities in chemical research had to do directly with life problems. He mentioned the joint meeting in London, in January, of the London Section of this Society and the Biochemical Society. In referring to a review of Dr. MacCallum's book on the " Newer Knowledge of Nutrition," he said that some of the most interesting parts of the book were devoted to the thesis that various states of illness, both mental and physical, were to be attributed to faulty diet and not to disease.

Mr. G. Ennis Smith, Biochemist of the Research Laboratory, Hull, then gave an interesting talk on " Biochemistry in Relation to the Rearing and Nutrition of the Silver-black Fox". He spoke of the difficulties and problems that were harassing the fox industry and urged the necessity of careful attention to feeding, particularly during the time of breeding. The most favourable results were obtained by feeding a maintenance ration during this period. Over-feeding caused the arrest of the development of the young pups. A discussion followed in which Dr. Shutt, Mr. Hambly, Dr. Macintyre, Mr. Ellsworth and Mr. Hossack took part.

Mr. J. H. Harris, M.P. (East York), referred to his long association with the Society of Chemical Industry, and expressed his pleasure at being present at the meeting. He urged the necessity for putting before the public the results of chemical activities in a greater measure than is now done.

MONTREAL SECTION

An extra meeting was held on January 8, 1923, in order to hear a paper by Dr. Abrams, who is the professor in charge of the Structural Materials Research Laboratory, Lewis Institute, Chicago. Dr. Abrams' paper, "Scientific Methods of Making Concrete," was on a subject of such broad interest that the co-operation of the Engineering Institute of Canada resulted in an unusually large attendance.

Special stress was laid on the importance of correct proportion of water, sufficient to produce proper plasticity only yielding the best result. Unsatisfactory jobs were invariably traced to the use of too much water, added with a view to obtaining a mix which would flow very easily. Charts were used to show the increase in strength of concrete due to maturation, and this increase has been demonstrated to progress steadily for at least five years, a period during which the test samples had been kept in a moist atmosphere. It was also shown that, should maturation be arrested by cold or dryness, the process would be resumed if moist conditions were again encountered, and that the maximum strength would be eventually reached, though so far the actual period had not been determined, the tests having been conducted continuously during a period of only five years. The effects of the presence of calcium hydroxide, calcium chloride, and tannic acid were shown graphically, the weakening action caused by the last-named being very marked.

The February meeting was held at the Queen's Hotel on February 19, Mr. Frank W. Horner, Vice-Chairman, presiding. The responsible committee reported on their award of the prize of $50 for the best essay by a senior student of McGill University on his summer vacation work in applied chemistry. Mr. Monro, who was adjudged to have deserved this distinction, was congratulated, not only on the work done, but on the concise and systematic essay presented in very excellent language. In elaborating the reasons which influenced judges in making awards, Mr. Hazen laid special stress on the importance of using good English, and of presenting the facts clearly, with careful illustrations that are easily comprehended and tell their story accurately. Mr. Monro will read his paper at the April meeting.

"Chemical Patents" was the subject of the paper presented by A. E. MacRae, B.Sc., F.C.I.C., Chief Examiner at the Patent Office, Ottawa. Mr. MacRae showed that the inventing chemist was faced with two alternatives for the protection of his inventions, viz., (1) to keep his processes and methods secret, or (2) to protect them by patents. Of these, the latter was by far the more efficacious, since with modern methods secrecy was practically impossible. On the other hand, it was difficult to get patents that really protected, and even more difficult to prevent infringements of such patents. One of the difficulties experienced at the Ottawa Patent Office was the fact that the growth of industrial requirements and the general trend of inventive genius and research to meet these needs had led to similar inventions being produced simultaneously throughout the world. The result was, sometimes not only conflicting claims on the part of inventors working along the same lines independently in different places, but also that unless the man who hit on the most valuable invention did not patent it he ran the risk of losing the rewards of his research and inventive genius. Patents were indispensable, and to ensure proper utilisation, inventions must be properly protected by patents, because without such safeguards there would be little incentive for independent scientific research and invention.

Mr. Macrae proceeded to show the historical development of the law of patents, which, he said, was simply a contract between the nation and the individual. Under this contract the inventor had to disclose to the public the effect of his intellectual work. By so doing he stimulated invention, research and enterprise, while in return he was guaranteed a monopoly for a certain period (in Canada 18 years) of the benefit accruing from his inventive genius and research.

GLASGOW SECTION

Mr. W. E. Moodie presided over the meeting held at the Institute of Engineers and Shipbuilders on March 2, and Prof. J. H. Andrew, D.Sc., read a paper on "The Solid State of Matter."

Prof. Andrew showed how the metallurgist could help the engineer by studying the physical properties of alloys in relation to the physical and chemical properties of their constituent elements. It should be possible ultimately to calculate the properties of any kind of steel from its chemical composition and the conditions of its formation. New theories of the structure of matter and of the union of atoms by means of their electrons were throwing light upon the nature of the solid state, and particularly on the properties of metallic alloys used in engineering.

It was shown, for example, that the engineering industry, as regards ferrous metals, depended upon the fact that iron exists in two forms according to its temperature, and that the high-temperature form dissolves carbon whilst the low-temperature form does not. It was also pointed out that steel containing 13 per cent. of chromium was rustless because the atoms of iron within it were surrounded by atoms of inert chromium, and so protected from atmospheric oxidation. Thus emphasis was laid on the importance of the study of metallurgy on physico-chemical lines, because in that direction lay the possibility of development in the industrial application of metals.

MEETINGS OF OTHER SOCIETIES

SOCIETY OF GLASS TECHNOLOGY

Prof. W. E. S. Turner, D.Sc., presided at the meeting held in Armstrong College, Newcastle-upon-Tyne, on February 21.

The first paper was entitled "Organising for Production from Pot Furnaces," by W. W. Warren, A.M.I.C.E., A.M.I.E.E. The paper was based on experience gained at the Lemington Works, where electric-lamp bulbs were made from pot furnaces. Bulb manufacture magnified possible sources of waste—waste of time, waste of metal—and demanded a close control of both system and workmanship. Comparing actual practice at Lemington with that of 1918, when the output of hand-made bulbs was approximately the same in number and weight, only 20 pots were now in commission, as against 70 in 1918. This intensification of production had effected a great saving of coal, pots, and labour. The furnaces that had been shut down were direct coal-fired furnaces. In 1918, four men worked at a pot, where there were now six; and the time-table system of founding by night and working by day was not so perfect as it was now. Production on a satisfactory basis could never be achieved unless the furnace permitted rapid melting, perfect and elastic control of temperature, and uniform distribution of heat. Time occupied in working-out pots, cooling-off pots beyond the "plaining stage," and charging with batch and cullet, should be regarded as operations, albeit necessary, which lowered melting efficiency. For most purposes circular gas furnaces, either regenerative or recuperative, were preferable to those of rectangular shape. The semi-circular or "D" shaped furnaces developed at Lemington, although not efficient in fuel consumption, had an appreciable range of temperature control above that necessary for melting, and rose quickly when set away for the found. The heat stored in the wall representing the straight line of the "D" was considerable and made for uniform heat conditions. The maximum temperature of the furnaces when using covered pots was 1500° C., and when using open pots 1400° C. During the working period the temperature was lowered to 1100° C. inside the pot. Among the advantages of working to a time table, when founding and working during definite periods, were:—(*a*) A responsibility devolved on the producer and furnace men to have metal ready in time for their co-workers; (*b*) mixing, filling pots, and all labour subsidiary to glass-making worked smoothly in an appointed groove. The importance of checking the output of pots should be realised, and figures taken out daily to inform the management of variations in pot efficiency. Reduction of costs when idle plant was brought into commission, thereby increasing production, needed no comment; but the similar effect as the result of operating more efficient plant was striking.

In view of the practical demonstration at Lemington of the possibility of ladling either lead or lime-soda glasses from pots into a tank, and the successful operation of the Westlake bulb-blowing machine in conjunction therewith, it would appear reasonable to expect to derive the full advantages of such practice if used in producing hand-made ware. The disadvantages were those attached to shift work and to ladling glass. The tank would probably throw small stones, and blisters might be prevalent. There would be the further disadvantage common to all large units of plant when under repair, viz., temporary cessation of a large output. Further, the large unit was not so elastic in coping with a variable demand. The first step in any scheme devised for intensifying production was to enlist the co-operation of the glass-blower or the worker in glass. Propaganda and foremen's meetings maintained enthusiasm and fostered the progressive spirit. Informal talks with the men's committee rarely failed to convince that foreign competitors' methods and prices were a challenge to business sport. But if there were rewards at the end of the production programme, the men must share.

During the forenoon, a party of members visited the Glass Works at Lemington.

Two papers on "The Effect of Boric Oxide on the Melting and Working of Glass," by F. W. Hodkin, B.Sc., and Prof. W. E. S. Turner, D.Sc., and "Some Physical Properties of Boric Oxide-Containing Glasses," by Violet Dimbleby, B.Sc., S. English, M.Sc., and Prof. W. E. S. Turner, D.Sc., were presented together by Prof. Turner. Although boric oxide had been used as a constituent of glass for at least a century, it assumed much greater importance owing to the researches of German workers at Jena about forty years ago. In the last few years borosilicate glasses had been used to an increasing degree, the new British chemical glass, the American Pyrex glass for chemical ware and cooking ware, and various forms of illuminating glasses, all containing it. Experience showed that the usefulness of boric oxide was limited, and further experiments on heat-resisting glasses must lie in other directions than the employment of boric oxide.

ROYAL SOCIETY OF ARTS

A paper on "Heat Resisting Glasses" was read by Prof. W. E. S. Turner at the meeting held on February 28.

The first cause of the tendency of glass to fracture on heating is its low thermal conductivity, but this alone does not entirely account for the fracture. In practice the thermal endurance, *i.e.*, the power of a glass to withstand thermal shock, might be determined by heating it to varying temperatures and determining the comparative tendency to fracture when dropped suddenly into cold water.

So far attempts to improve the heat-resisting power of glass have been either in the direction of increasing the mechanical strength by processes of hardening or of diminishing the co-efficient of expansion. In de la Bastie's method of hardening glass, introduced about 1874, the glass was heated up to the stage of softening and then placed in a bath of hot oil made up of a mixture of oils, wax, tallow, resin, etc. Experiments were made in this country to apply the new process, but without commercial success.

Of other systems of toughening glass, probably that of Siemens is best known, the process apparently being to subject the articles to mechanical pressure inside metal or fireclay moulds. The most successful method of providing mechanical strength to resist thermal shock was that of Schott (1892), who showed that glasses of different co-efficients of expansion could be united when gathered on the blowpipe in successive layers. This method of hardening by making compound glass has been used for boiler gauge tubes.

The second method, namely, that of controlling the co-efficient of expansion, has been the basis of many successful developments in recent years. The co-efficient of expansion of glass is intimately connected with its composition, and it has been found possible to make glasses of linear thermal expansion varying between 30 to 130×10^{-7}, so that on the one hand the expansion can be made much the same as that of the more expandible metals, and at the other extreme, approaching that of fused quartz. These results can be traced back to the systematic work of Schott, who in 1892, showed that the different constituent oxides had each a definite effect on the total expansion of the glass, and later the co-efficient of expansion was shown to be additive in character and capable of calculation. This work had found immediate practical application in the manufacture of heat-resisting glasses. Thermometer glasses of low depression constant and fairly low expansion represented one type, and Jena chemical glassware constituted another. Indeed, practically all modern glasses used for chemical ware are not only resistant to corrosion, but are also in varying degrees heat-resisting. Silica and boric oxide, for instance, increase the resistance, particularly to water and acids, as well as diminish the co-efficient of expansion. Lamp chimneys and miners' lamp glasses at Jena were made from a glass constituted largely of silica, boric oxide, antimony oxide and sodium oxide. In the combustion tubing glass made by Messrs. Kavalier, the most important constituent is silica, which reaches the very high value of more than 79 per cent., and successful combustion tubing made in this country also possesses a very high silica content. Kavalier's combustion tubing contains no boric oxide, and the basic oxides (potash and lime) used as fluxes, prevent the production of a low expansion glass. Modern glasses contain boric oxide in very considerable amount. Pyrex glass contains roughly 80 per cent. of silica and 12 per cent. of boric oxide, and there is a tendency to make chemical glassware and heat-resisting ware strongly acid, since the acid oxides, silica and boric oxide, are far superior to the basic oxides in giving low expansion.

In practice the use of silica and of boric oxide beyond a certain limit is attended by certain difficulties. With silica the difficulty is merely that of obtaining a sufficiently high temperature. Recent investigations have shown that with a glass composed of silica, boric oxide and soda, the amount of the last-named being constant, the durability rises to a maximum somewhere in the neighbourhood of 11 to 12 per cent. of B_2O_3; thereafter, the durability rapidly diminishes until, when 40 or more per cent. of boric oxide is present, the glass rapidly breaks up. Boric oxide is also limited because after a certain concentration has been reached, not only does the glass become unstable, but the expansion also increases. Nevertheless, by combining these two oxides in boro-silicate glasses big advances have been made possible. All the chemical glassware made in this country has been of the boro-silicate type.

The Corning Glass Co. of America led the way in using glass for baking and cooking dishes, tea pots, etc., and this development has already assumed big proportions. In this country Messrs. Ackroyd and Best are making cooking ware, and the manufacture in Great Britain is likely to be extended. Messrs. Kavalier, in Czechoslavia is the latest firm to make heat-resisting ware for domestic purposes.

The problem is to discover refractory materials which will withstand the action of fused silica at temperatures of 1550° to 1750°. Pyrex glass is melted in tank furnaces operating at a temperature not less than 1500°, and open hearth steel furnaces are operated at considerably higher temperatures, so there will be no no great difficulty in proceeding further when suitable furnace material is available. Already preliminary attempts have been made to produce glasses by adding small amounts of titania and zirconia to silica, the objects being to increase the resistance of the fused silica to devitrification and to attack by basic materials. Experiments have been made with glasses containing a series of oxides, including titania, but information has not been forthcoming of the effect on thermal expansion. At Sheffield both zirconia and titania have been added to ordinary glasses; when several per cent. of titania is present, small crucibles of glass can be cooled down without special precautions to yield unbroken lumps. This indicates either reduced thermal expansion or increased mechanical strength; in any case an improved heat-resisting glass. Given the requisite optical properties, the addition of either zirconia or titania to optical glass might make it possible to obtain a bigger yield of glass by reducing the amount of splintering.

INSTITUTE OF BREWING

At a meeting of the London Section, held in the rooms of the Institute of Chemistry on February 12, Messrs. H. Langwell, F.C.S., and H. Lloyd Hind, B.Sc., read a paper on "Cellulose Fermentation with Special Reference to the Utilisation of Spent Hops and Brewers' Grains." Hitherto, the only method of making cellulose available for the production of alcohol has been to hydrolyse it with mineral acids, such as sulphurous or hydrochloric acid, and then to ferment with yeast the hexose so produced, but commercial success has not so far attended this procedure. The authors seek to overcome this difficulty by introducing the biological factor at an earlier stage, using for the purpose, not yeast, but a slender rod bacillus $(4\mu \times 0{\cdot}4\mu)$, capable of fermenting cellulose without preliminary treatment. The organism—which has no name and is derived from horse-manure—is a spore-forming anaerobe with an optimum working temperature of 140°—150° F. (60°—65° C.). At such a temperature the bacillus can ferment as much cellulose in four days as would require 110 days at 80° F. ; in addition, the high temperature which can be employed renders the use of pure cultures unnecessary, since automatic pasteurisation is ensured, the continued use of the process actually causing the strain to become purer and purer. Potash and phosphates should be present, and ammonium salts suffice as the source of nitrogen.

There are two defects in the useful application of the organism : (1) Its extreme susceptibility to traces of copper, even when present in amounts such as occur in spent hops which have been boiled in a copper ; and (2) the fact that it cannot attack pure cellulose in the presence of lignin, and thus cannot be used in fermenting sawdust, although sulphite pulp and all non-lignified cellulose can be readily fermented.

The products of fermentation include alcohol, acetic, lactic and carbonic acids, together with marsh gas and hydrogen, in ratios which vary under different conditions, but can be largely controlled. A ton of fermentable matter yields about 15,000 cb. ft. of gas and 120 gallons of liquid products. Most cellulosic material yields from 40 to 70 per cent. of fermentable matter.

Spent hops are a cellulose waste product of which some 12,500 tons are available annually in the British Isles. Hitherto it has been very difficult to dispose of them, many brewers being forced to pay for their removal. As manure, litter and fodder they have found a certain sale, but if they could be utilised for the production of alcohol and other substances, their value would be greatly enhanced, although the success of their conversion to alcohol depends on a low price. This involves the elimination of carriage, so that it would be necessary to erect the necessary factories at large brewing centres to work up the spent hops of the district. No definite idea of the financial possibilities of the utilisation of spent hops can be given until more exhaustive trials have been made, but the experiments so far made show that spent hops will yield about 40 gallons of a mixture of alcohol and acetic acid per ton of dry material. From the acetic acid, acetone and valuable solvents may be obtained valued at about £10. Grains which are readily fermentable generally give a higher yield, amounting to 70 gallons of solvents per ton, valued, say, at £17 10s. Valuing wet grains at 9s. per quarter, and the cost of drying at from £4 to £5 per ton, a price of about £10 per ton for dried grains is arrived at.

INSTITUTE OF CHEMISTRY

At the Annual General Meeting, held on March 1, the President (Mr. A. Chaston Chapman, F.R.S.), in presenting the Report of the Council, remarked on the progress of the organisation of the profession of chemistry under the Institute. The roll of Fellows and Associates had increased during the past year by 421, to a total of 4,062, and the register of Students by 72, to a total of 955. The Institute was taking an increasing part in the affairs of the country and was frequently appealed to by Government Departments and other authorities for advice and help. Science was coming into its own and scientific men would be given their proper status and rightful place in the affairs of the country. The Institute, in common with other societies and associations, was actively promoting a spirit of solidarity and comradeship among all concerned with chemistry, with a view to welding the profession into one coherent whole. With the advances which chemistry was making in all directions, and with the high degree of specialisation of to-day, many societies had come into existence, but the dangers of decentralisation were greatly lessened by the practice of holding joint meetings of the societies. The direct utilisation by the State of the services of the professional chemist was not only of immediate concern to chemists themselves, but also of high importance to the community at large, and in the interests of the country no less than in those of its members the Institute was bound to do all it could to ensure that the relations between the appointing authorities and those who held official chemical positions were of a satisfactory character. Unfortunately, some public bodies did not appear to be aware of the expensive nature of the chemist's training or of the difficulties and responsibilities connected with his work, and consequently the Institute sometimes found that the advertised conditions of certain public bodies were not commensurate with the importance of the services demanded. It was of public importance that men of good general education, of high professional attainments, and of high moral character should be chosen to fill these public positions. For the appointment of public analyst the remuneration offered was often entirely inadequate and, in some cases, even below that paid before the war, notwithstanding the enormously increased work and responsibility attaching to the post. A statement on the whole subject would shortly be published by the Institute jointly with the Society of Public Analysts. There was a tendency on the part of local authorities to utilise the services of unqualified or imperfectly trained persons in routine processes, a practice against which the Council had felt bound to protest vigorously on the ground that it constituted a serious danger to the community and involved waste of public money. The Institute had also been obliged to complain of the competition of State-aided institutions with private practitioners, and it was a source of gratification that the Ministry of Agriculture and Fisheries had recognised the legitimate grievance of the private practitioner and had taken steps towards limiting the work done in Agricultural Institutions receiving its grants to that required for strictly educational purposes or necessary to the advisory work of the Institutions.

The disinterested zeal of the scientific worker was something without parallel in the whole world, but it was not wise for any country to presume too much on this disinterestedness. Science was one of the greatest and freest of all givers, but it had a right to demand that it should receive that recognition and that proper position in the councils of the country to which it was entitled.

The President said that although the supply of qualified chemists exceeded, for the moment, the demand, he did not think that there was cause for serious alarm. The profession had attracted a larger number of young men during the last four years than in any previous corresponding period, but he was very optimistic in regard to its future, and it was a remarkable fact that, notwithstanding the increased output from the colleges and the intense industrial and commercial depression, the new members of the profession were being steadily absorbed. This absorption might be taken as a definite indication that chemistry was more highly valued by the manufacturer than formerly, and as evidence that the leaders of industry and commerce were turning more and more to science to assist them in the solution of their various problems.

CHEMICAL SOCIETY

The Annual Dinner will be held on March 22, in the Hotel Cecil, and it is expected that a number of foreign guests will be present. Prof. Le Chatelier, F.R.S., the Abbé Sanderen, and Prof. Urbain will represent the French Chemical Society, and MM. P. Kestner, Jean Gérard, Maurice Deschiens, and J. A. Le Bel, F.R.S., will represent the French Society of Chemical Industry. Of these, Prof. Urbain, the Abbé Sanderen, and Prof. Le Chatelier are honorary members of the Society of Chemical Industry. Tickets for the Dinner cost 12s. 6d. (not including wine), and applications should be sent as soon as possible to S. E. Carr, Esq., Chemical Society, Burlington House, Piccadilly, London.

Five papers were communicated to the meeting of the Chemical Society on March 1, Prof. H. B. Dixon presiding.

In the first paper, entitled "Co-ordination compounds and the Bohr atom," Prof. Sidgwick briefly outlined the Bohr theory, and showed its applicability to compounds, illustrating this especially by reference to double compounds of platinum, and correlating it with the work of Werner. The arrangement of electrons in groups of 4 and 6 was emphasised, and this was contrasted, whether the compounds ionised or not, with the stable configuration of the atoms of the rare gases, showing also how apparent contradictions to the laws of valency could be explained.

Mr. W. H. Gray gave a paper on silver salvarsan, dealing with the reaction between salvarsan and silver nitrate. He quoted contentions of previous workers since Erlich, on the reaction with which the evidence he adduced did not agree.

The third paper, "On the propagation of the explosive wave. Part I. Hydrogen and carbon monoxide mixtures," by H. B. Dixon and N. S. Walls, was read by Prof. Dixon, who mentioned that Prof. Bone and Prof. Wheeler were working on the problem of combustion of the same gas mixtures under different conditions. The suggestion that it would be of interest to measure the rate of the explosive wave in the case where two combustible gases were present, was made by Langmuir. Mixtures of hydrogen and carbon monoxide were therefore tested with: (1) enough oxygen to combine with both of the gases present, and (2) only sufficient oxygen to combine with one of the constituent gases. The rates of the explosive wave were shown under these conditions. The results were compared with a relay race and a three-leg race. As the firing was initiated with electrolytic gas Prof. Dixon suggested that the combination of these gases probably produced a temperature too high for the carbon monoxide to be oxidised. Prof. Bone, in the discussion, mentioned that he had carried out experiments under pressure and also at ordinary atmospheric pressure, which was attended with experimental difficulties which had been eliminated. He referred to the different results which were attained under varied conditions, and observed that the problems still to be solved in the combustion of water-gas mixtures were greater than those which had already been elucidated. Mr. Garner pointed out the bearing of the radiation hypothesis on the question, and Prof. Bone said he had taken that into consideration in his paper.

A paper on "The molecular configuration of polynucular aromatic compounds. Part II. 4 : 6 : 4 trinitrodiphenic acid and its resolution into optically-active components," by G. H. Christie and J. Kenner, was read by the former. The authors have resolved the acid.

CORRESPONDENCE

THE CALCIUM CARBIDE INQUIRY

Sir,—I am afraid that your readers must be weary of this topic, and I should have refrained from any further communication upon the matter but for your request that I should send you any comments I might think desirable upon Sir William Pope's further articles purporting to deal with this subject.

At the outset, I feel compelled to state, once again, that in this correspondence I have never discussed the question whether Calcium Carbide is a synthetic organic compound. Accordingly, I have no comment to make upon the reasons Sir William advances in his articles for the view he holds that it is such a compound. The industry he has devoted to the selection and grouping of his facts and the cogency of his reasoning in applying them in support of his view, make it all the more to be regretted that his absence from this country at the time rendered it impossible for him to give evidence in support of the application.

The origin of this correspondence was a letter Sir William wrote to the *Times* criticising, as I thought, and still think, unfairly, the conduct of the Calcium Carbide Inquiry by the learned Referee appointed as provided by the Act by the late Lord Chancellor. If I may be allowed to quote one or two passages from our respective letters to the *Times*, they will, I think, serve quite sufficiently to test, when contrasted with what Sir William has since written, whether I was justified in my intervention on behalf of one, who, by his position as Referee, was precluded from replying to Sir William's criticisms. I take, in the first instance, the mistranslation of a passage from Meyer and Jacobson's *Lehrbuch der organischen Chemie*, and my excuse for so doing is the prominence given to the matter in Sir William's letter to the *Times*. I agree that the passage was wrongly translated and I pointed out the mistake at the time, but the Referee did not accept my emendation. The dispute between Sir William and myself as to this matter appears quite clearly from the following extracts from our letters.

He wrote: "The referee, in his decision, quoted a very carefully worded definition by a German authority, but quoted it in the form of a mistranslation which entirely altered its meaning; *on this erroneous statement of fact, the referee rejected the application.* Calcium Carbide, one of the most typical synthetic organic compounds, *is declared by the referee, on a false translation of a German definition, not to be an organic chemical.*"

I wrote: "*On the evidence as a whole, and not on any isolated definition*, such as Sir William says was mistranslated, *the Referee decided the case*, holding that the applicants had not established that Calcium Carbide was a synthetic organic chemical."

From the words in these extracts which I have underlined, the issue between us is made perfectly clear. What is Sir William's position now? In the article appearing in your issue of February 9, he now says that the Referee attached "considerable weight" to this passage. Doubtless he did, as also to many other matters in the evidence, but to say that he attached considerable weight to it is very different from saying, as Sir William did originally, that the Referee decided the case on it, and seems to me to be saying what I have throughout contended was the fact.

With regard to a broader aspect of the controversy, I wrote in my letter to the *Times*:—

"I submit that, had Sir William been better informed, he would have refrained from criticising these inquiries or their results, at any rate in language which does not bear the impress of that accuracy in statement or care in consideration which in fairness to the learned Referee and those who have taken part in such inquiries, may reasonably be demanded."

He had written that these inquiries "have become ridiculous farces played to the shame of British methods of legal procedure," referring more especially, as his letter showed, to the Calcium Carbide Inquiry. He now admits that the evidence in that case justified the Referee's decision. Need anything more be said? Sir William's changed position in this respect, as also in the matter of the mistranslation, amply warrants, as I submit, the views I ventured to express upon his letter.

In his article, Sir William adopts a new attitude. His quarrel is now with the evidence which he calls, "a sketchy outline of the subject," and in another passage, "trivialities." I quote the sentence; it is a characteristic passage:—

"I am well aware that the trivialities which he" — meaning myself — "describes sententiously as 'the evidence' were received with great decorum, although they would have excited hilarity if produced before an assembly of Chemists."

The evidence—by which I mean the oral and documentary evidence—and I do not know—even to please Sir William—how to expand the expression further, was that of chemists, and was given in an assembly, the major portion of which was composed of chemists. It excited no hilarity, and I am sure it was received with due decorum. I leave it to Sir William to decide whether in allowing himself to speak so lightly of the views expressed and the reasons advanced in support of the same by his distinguished colleagues, he is treating those gentlemen with the respect due to them.

Sir William, in his last article, also discloses that he has a quarrel with the legal profession. His references thereto are, as it seems to me, coming from him, unexpectedly tolerant. They are, however, characteristically based upon misconception of the pertinent facts. He says:—

"The case is a very simple one and if my contention is correct it follows that the legal profession has failed in its duty by dealing so perfunctorily with the question submitted to it that an indefensible decision has had, perforce, to be pronounced."

Bearing in mind that Sir William had in an earlier part of the article admitted that the learned Referee was justified in his decision by the evidence upon which he pronounced it, and so had absolved the only member of the legal profession to whom any question was submitted, the meaning of the passage is obscure. If counsel engaged in the case are intended to be referred to, I naturally hesitate to say anything. I may, however, be permitted to make one or two remarks, on the assumption that such is the intention. In the first place, the word "perfunctorily" is one, the use of which in respect of an inquiry which lasted many days, may occasion surprise and some doubt as to Sir William's object in using it. I think, however, that elsewhere in his article he has made it sufficiently clear that his choice of the word was determined by his view that the evidence was not sufficiently exhaustive. If I am doing him justice in so regarding the true intent of the word in the passage I have quoted, I am utterly unable to understand wherein the legal profession, according to Sir William, failed in its duty. I suspect that when he wrote it, he was labouring under the erroneous belief that counsel have the duty not only of presenting their clients' case, but also of obtaining the evidence in support of it. He will probably recognise on reflection that in general counsel have to use the materials supplied to them, and that in such a case as the one under consideration, the scientific gentlemen, by their advice and evidence, provided the materials. As I do not believe that he doubts that every legitimate use was made of all such materials by the counsel for the respective parties to the dispute, it seems to me that the only basis for the sentence I have quoted above is Sir William's conviction, for which I have the greatest respect, that the application would have been greatly assisted by his own advice and evidence.

One further matter, and only one, I feel I must say something about. He refers to the question I put to him, whether he thought the Referee would have had the assistance he, Sir William, considered desirable, had the assessor been one of the eminent gentlemen who gave it as their opinion that Calcium Carbide was not a synthetic organic compound. I refer to this only to say that Sir William is quite wrong in thinking that in putting the question I had any idea of claiming for His Majesty's counsel or for any "practitioners of the law," the exclusive possession of the virtue of impartiality, much less of denying possession of that virtue by Sir William's colleagues. I put the question quite seriously and believing, as I still do, that the assessor contemplated by my question honestly held the view which he supported by his evidence, that Calcium Carbide was not a synthetic organic compound. When Sir William says :—"I am quite sure that such an assessor would have warned the Referee that the evidence placed before him was so fragmentary as to be fictitious, that he was being misled, and that he would do well to call for facts upon which to base a decision" he is attributing to those of his colleagues who gave it in evidence that Calcium Carbide was not a synthetic organic compound, that their evidence was the reverse of their knowledge and convictions. Again, I suggest to Sir William that his colleagues may reasonably complain that he has overstepped the limits which courtesy demands should control in such a controversy as that which has developed from our respective letters to the *Times*.

I apologise for the length of this letter and conclude by putting it on record that I do not intend or desire to make any further communication on the subject of the Calcium Carbide Inquiry, and that I leave the field to Sir William.—I am, Sir, etc.,

The Temple, London　　Arthur Colefax
February 27, 1923

THE SMOKE PROBLEM

Sir,—A few days ago the horticultural expert of the *Daily Telegraph*, calling attention to the damage done to city gardens by smoke, stated:—"The prevention of fog has so far baffled chemists, physicists and other scientific men—and even modern London County Councillors." If the chemists and other scientific men were allowed their own way a good deal could speedily be done to mitigate the smoke nuisance.

Prof. Bone, I think, has pointed out that the open, domestic fire, which is a luxury in countries with a "diviner air," is a necessity here, and whatever house-heating methods other people may adopt, the Englishman will not be robbed of his open fire. This being admitted, together with the fact that the Briton's home fires account for 75 per cent. of our smoke pall, what fuel can we offer him to mitigate the nuisance ? The answer is that smokeless semi-cokes can now be obtained at reasonable prices, which give an excellent fire in any good, modern grate. The use of such fuels is extending enormously, and it is not extravagant to believe that gradually a brighter Britain will result.

As to smoking factory chimneys, half-a-dozen smoke inspectors, with the powers of our very efficient factory inspectors, could do a great deal, and as their experience grew their advice would be welcomed by manufacturers, who would learn how to effect vast economies with little or no interference with industry.—I am, Sir, etc.,　　N. F. Graham

Trafalgar House, Regent Street, London
February 23, 1923.

THE NOMENCLATURE OF COAL CONSTITUENTS

Sir,—I notice that in your editorial reference of the 23rd ultimo to Mr. A. R. Pearson's recent paper, you make certain comments upon the nomenclature of coal constituents and question the desirability of adding a new phraseology to a subject regarding which so little definite is known.

I have long been of the opinion that the present system of nomenclature is in need of reconsideration and reform. The terms *alpha*, *beta*, and *gamma*, are being used to-day in ways which confuse and obscure the whole subject, just as formerly the terms "resinic" and "cellulosic" were unscientifically applied to constituents which had not been properly characterised. The subject was referred to in the recent Fifth Report of the Fuel Economy Committee of the British Association, and, with your permission, I should like now to reproduce, without further comment, the following paragraphs from that report for the consideration of your readers :—

"It has long been recognised that bituminous coals contain three easily distinguishable components, which until recently had usually been designated (*a*) 'mother of coal' or 'mineral charcoal,' (*b*) 'dull hard coal' (German = 'Mattkohle'), and (*c*) 'bright coal' (German = 'Glanzkohle'), respectively, the last named being a structureless, lustrous substance with a conchoidal fracture. Recently Stopes (Proc. Roy. Soc., B. 90 (1919), p. 470) proposed new names for them, namely (*a*) *fusain*, (*b*) *durain*, whilst (*c*) is termed by her either *clarain* or *vitrain*, according as it does or does not contain recognisable plant tissues and structures. In putting forward these proposals Stopes recognised that none of the four said ingredients (with the possible exception of vitrain) are either homogeneous or chemical molecular units ; also that they do not even approximately represent the crystals in a petrological section of a rock. Provided that such qualifications are kept clearly in mind, and that it be realised that clarain may prove to be merely vitrain in which plant structures occur in suspension, the Committee sees no great objection to the provisional substitution of the proposed new names for the older ones, regarding the matter more as one of convenience than as involving any new principle."

"The Committee also feels that the growing practice among coal-chemists to use the terms *alpha*, *beta*, *gamma*, etc., to designate the several components obtainable from the coal substance by fractional extraction of it by means of various solvents, is one which, unless regularised in some definite way, is likely to lead to much confusion and obscurity, to the detriment of progress. It is obvious that coal may be 'fractionated' in as many different ways as there are suitable solvents and modes of applying them ; and therefore unless, as the result of some particular treatment or procedure, components of a reasonable degree of purity and well-defined properties are isolated, it is undesirable that definite names should be assigned to them, as though they were the actual chemical constituents of the coal instead of unknown mixtures of them. The Committee, therefore, would suggest that the time has come when chemists should agree in conference upon some common plan of labelling, such 'coal fractions' which, whilst recognising them to be such, shall also in some way indicate how they have been obtained.

"Supposing, for example, that a particular investigator extracts a coal with two solvents A and B, he might designate the fraction which is insoluble in both as the α AB fraction, whilst β AB might be used to denote the fraction which is soluble in A but not in B, and the γ AB that which is soluble in both A and B, assuming all solvents to be used at their respective boiling points at atmospheric pressure. Thus, a fraction termed the 'α-pyridine-chloroform' fraction would mean the residual insoluble portion of a coal after successively extracting it with pyridine and chloroform at their respective boiling points ; the 'β-pyridine-chloroform' fraction would be that portion of the pyridine extract which is insoluble in chloroform ; whilst the 'γ-pyridine-chloroform' fraction would mean the portion of the coal which is soluble in both pyridine and chloroform, and so on. In cases where the coal is extracted at some particular temperature other than the boiling point at atmospheric pressure of the solvent employed, the actual temperature employed might be designated by putting it in small type above the name of the solvent, thus '-benzene 120°' denoting that benzene had been used at 120° C."—I am, Sir, etc., William A. Bone

London,
March 1, 1923

"BAYBERRY OIL"

Sir,—I have recently heard of an oil (I presume an essential oil) known as "Bayberry oil." Does anyone know what this is, from what it is manufactured, and from where it can be obtained ?

I am greatly interested and would much appreciate any information.—I am, Sir, etc.,

Birmingham. W. Leslie Carter
March 5, 1923

"NOTES FROM HEATHFIELD"—A QUERY

Sir,—I cannot find the poem, "The Progress of Man," referred to by the Rev. B. V. White, in any of my books, and shall be glad if you will tell me where it can be found.—I am, Sir, etc., Sales Manager

Liverpool, March 5, 1923

ADVERTISEMENTS

SIR,—As a member of the Society and one who has some knowledge of the technicalities of advertising, I was particularly interested in your observations on this subject in the current issue of the *Journal.*

Whilst there has recently been a noticeable improvement in its advertisement pages, it still, in common with most technical publications, contains an unduly large proportion of decidedly mediocre and even antiquated advertisements. Many of them remain unchanged for months, and one or two have actually remained in their present form for years! How many purchasers would a publication have if the editorial pages were similar? Yet, what are advertisements but news of advertisers' products?

The comparatively uninteresting appearance of the advertisement section is due, not to the advertising staff of the publication—who are usually only too willing to help advertisers to get the best result from the space taken—but to the apathy of the advertisers themselves. Many seem to regard the buying of space as a sort of necessary evil or as a "duty" that they owe their trades' journal.

It is almost incredible that, to-day, there should be anyone who does not realise the necessity for, and the potentiality of, advertising, and its efficacy when properly conducted.

That there are such people is only too evident, especially among advertisers in the technical press. This is all the more remarkable inasmuch as the majority of such advertisers have exceedingly well-printed and convincingly-written literature of their products. Yet they do not even make an effort to induce prospective buyers to write for that literature!

Your implication that the prospective buyers are to be found in the counting-house and the secretary's office seems hardly likely to be the case as regards the products advertised in a technical publication. Surely, such buyers are to be looked for among the technical staff and those who have the decision with regard to the spending of money—viz., the directors, managers and heads of technical departments—these are the people whom it is necessary to reach and to interest.

And there is no reason why the advertisement pages should not, in their way, be as interesting and informative as the editorial pages. They can be made so, with corresponding advantages to both the publication and the advertisers, but only when the latter awake to the fact that their advertising is part and parcel of their sales organisation—that an advertisement is twin brother to their salesman—and should be equally efficient.—I am, Sir, etc.

HARRY V. HODGSON

Balham, S.W. 12.
March 5, 1923

PERSONALIA

Prof. A. Smithells, F.R.S., has been re-appointed Pro-Vice-Chancellor of Leeds University.

The Council of the Institution of Electrical Engineers has made the second award of the Faraday Medal to the Hon. Sir Charles Algernon Parsons, K.C.B., F.R.S., honorary member of the institution.

Mr. G. W. Robinson, lecturer in Agricultural Chemistry in the University College, North Wales, Bangor, has been awarded a Travelling Research Fellowship by the Ministry of Agriculture, and will shortly proceed to the United States to study soil problems.

* * *

Prof. J. W. Caldwell, emeritus professor of chemistry in Toulane University, Louisiana, has died at the age of 80.

We regret to announce the death of the well-known metallurgist, Mr. W. M. Hutchings, at the age of 73. Mr. Hutchings was mainly associated with the lead industry, and published numerous papers on the petrology of shales, clays and slates. He was at one time a member of this Society.

NEWS AND NOTES

AUSTRALIA

Gold Output in 1922

According to a return furnished by the Under-Secretary for Mines, the production of gold in Australia during 1922 amounted to 25,222 oz. fine, valued at £107,139, compared with 51,175 oz. fine, valued at £217,370 in 1921, and the lowest recorded output since the first discovery of payable gold in Australia in 1851.—(*Bd. of Trade J., March* 1, 1923.)

NEW ZEALAND

Discovery of Glass-making Sand

The *Auckland Weekly News* announces that, during prospecting for coal at Mount Somers, Canterbury, an immense body of sand was discovered. Analysis revealed that the sand contained 99 per cent. of silica, and that it was admirably suited for glass-making.—(*Raw Materials Rev., Feb.*, 1923.)

UNITED STATES

Lead and Zinc Production

According to estimates published by the United States Geological Survey, the output of refined lead in the United States during 1922 was 531,000 tons, of which 461,000 tons was produced from home ores and 70,000 tons from imported ores. The total in 1921 was 448,589 tons. The production of zinc during 1922 was 339,000 tons (200,500 tons in 1921), of which all but 1,000 tons came from home ores.

GERMANY

The Atomic Weights of Boron and Silicon

Prof. A. Stock and E. Kuss, in the *Berichte* (1923, 314), announce that they have utilised the reaction between gaseous boron trihydride, B_2H_6, and water, which takes place according to the equation $B_2H_6+6H_2O=2H_3BO_3+6H_2$, to redetermine the atomic weight of boron. Six determinations using pure trihydride gave an average value of 10·8055, which is somewhat lower than the figures obtained by analysis of the trichloride, viz., 10·82 to 10·84. A similar determination of the atomic weight of silicon by hydrolysis of silicon tetrahydride also gave a value lower than 28·3, which is generally accepted.—(*Chem.-Z., Feb.* 17, 1923.)

The Occupied State Mines

The following details concerning the State mines of Westphalia recently occupied by the French are taken from the annual report for 1921 of the " Preussischen Bergverwaltungen."

		1921	1920
Number of workers		28,526	26,618
Output of coal	Tons	4,685,155*	4,377,389
Sales—			
Coal	,,	2,472,279	2,450,405
Coke	,,	1,499,097	1,414,237
Briquettes	,,	23.049	24,874
Ammonium sulphate	,,	18,861	18,396
Tar	,,	31,792	31,267
Benzol	,,	9,823	9,122

* About 5% of the total output of the Ruhr district.

In 1921, 3,246,997 tons of this coal and coke was consumed in Germany and 416,748 tons exported (339,050 tons to France), figures which show a decrease of 164,353 tons and an increase of 260,278 tons, respectively, compared with those for 1920.

GENERAL

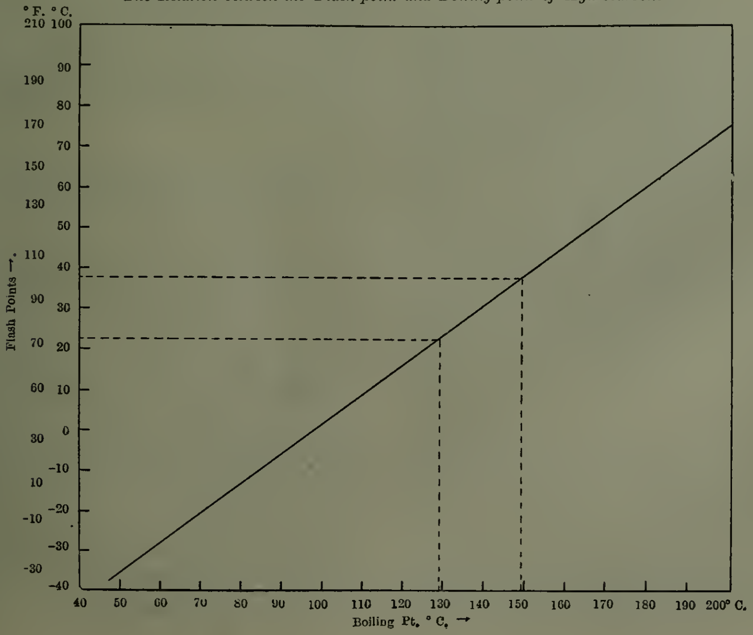
Relation between Flash-point and Boiling-point

Dr. W. R. Ormandy and Mr. E. C. Craven call our attention to an interesting relationship which has been found between the flash-point and the boiling-point of a number of inflammable liquids. The diagram printed below shows this clearly. Any point on the oblique line shows the boiling-point as the abscissa and the flash-point as the ordinate. A liquid boiling at 150° C. will have a flash-point of 100° F. or 38° C. They have verified this relationship for pentane, hexane, heptane, benzol, toluol, naphthalene, phenanthrene, amyl benzene, cyclohexanol and decahydronaphthalene. The relationship, with suitable observations, holds for mixtures of these substances. Expressed as a formula, the rule may be stated :—

$$F.P.=0{\cdot}736\ (B.P.+273)-273$$

where F.P. is the flash-point in degrees centigrade and B.P. is the boiling-point in degrees centigrade. This handy rule, if found to be reliable, should be of great value to those who·

The Relation between the Flash-point and Boiling-point of Hydrocarbons



handle large quantities of petrol and petroleum, or who have to consider the alterations in flash-point or boiling-point suggested or enforced by legislation. A somewhat similar relationship, but involving a different factor, has been found for a number of the alcohols.

Messrs. Ormandy and Craven state that this law is true for pure hydrocarbons and mixtures of pure hydrocarbons; but all commercial hydrocarbons appear to contain dissolved gases, which reduce the flash-point to varying extents.

The Polish Sugar Industry

Sugar production in Poland is making steady progress, and 88 factories are now at work. In 1922, 266,773 acres were planted with sugar-beet, the production amounting to 330,000 metric tons (compared with 155,000 t. in 1921), of which 150,000 t. are available for export.

Swedish Iron and Steel Trade in 1922

According to statistics supplied by the Swedish Consulate-General in London, imports of iron and steel into Sweden during 1922 amounted to 139,700 tons as compared with 129,500 tons in 1921, whilst exports of iron and steel amounted to 174,300 t. and 147,600 t. respectively.—(*Bd. of Trade J., Feb.* 15, 1923.)

COMPANY NEWS

COURTAULDS, LTD.

The report of the Directors of this Company states that the profit during 1922 amounted to £3,018,432, which compares with £1,684,593 in 1921 and £1,804,796 in 1920; £418,467 was brought forward, £1,000,000 was carried to reserve and £639,899 carried forward, leaving £1,800,000 available for the payment of the dividend, which has been fixed at 15 per cent., compared with 11¼ per cent. in 1921 and 23⅜ per cent. in 1920. The shares held in the Viscose Co. of America have been exchanged for shares in the American Viscose Corporation with an authorised capital of $100,000,000, of which $93,559,500 has been issued. The par value of the shares received in exchange by Courtaulds, Ltd., is $85,014,900, valued in the balance sheet at £7,804,021, thus bringing up the share capital to £12,000,000. The reserve is stated to be £3,000,000 and investments in securities, etc. amount to roughly £7,000,000.

BRADFORD DYERS' ASSOCIATION, LTD.

At the annual meeting of this Association held on February 28, Sir Milton S. Sharp, who presided, said that the textile trade had progressed markedly towards recovery in 1922. The great difficulty confronting the cotton industry was the high price of cotton, due largely to the fact that whereas in 1901-2, 71·8 per cent. of the total American cotton crop was exported, domestic consumption had increased so greatly that in 1920-1 only 41 per cent. of the crop was exported, despite the fact that the crop in that year was 40·6 per cent. greater than in 1901-2. The development of Empire cotton resources was absolutely essential and the British Cotton Growers' Association would certainly leave nothing undone to ensure this. There were, however, possibilities of substitute fibres, of which an example was the new Arghan fibre grown in the Malay States. After referring to the burden of taxation and the unemployment problem, Sir Milton Sharp discussed the Dyestuffs (Import Regulation) Act and said that the Act was passed to ensure the establishment of the dye-making industry on account of its vital importance to national safety, and he had no sympathy with the outcry for its repeal. Although he was not entirely in agreement with the way in which it had been administered, the Act was doing effectively the work for which it was designed, for whereas our consumption of British made colours averaged 22 per cent. of the total in 1910 to 1914, in 1922, 77·66 per cent. of our total consumption was British-made. The British makers were extending their ranges of the better types of colour, but could not yet equal their continental competitors in variety. The high prices of dyestuffs were causing loss of business to foreign competitors, and he agreed with the suggestion of the Colour Users' Association that the proceeds of the sale of Reparation dyestuffs should be utilised as a contribution by the Government towards establishing the dye-making industry. The dividend on the ordinary shares was fixed at 7s. per share, less income-tax, for the year ended December 31, 1922, making a total distribution of £406,943; and £467,369 was carried forward.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for March* 1)

TARIFF CUSTOMS EXCISE

Australia.—"Dumping" duties have been applied to perfumed spirits, spectacle glass and binoculars of German origin.

Colombia.—The duties of the customs tariff are increased by 10 per cent. from March 1.

France.—The export duty on raw bones has been reduced. Sugar may not be exported.

Germany (Occupied).—A statement of the position regarding customs duties and trade control is given in the current issue.

Newfoundland.—The surtax, payable on most imports, of 25 per cent. of the customs duties, has been abolished.

New Zealand.—The embargo on German goods is to be removed as from September 1.

Norway.—A temporary increase of 20 per cent. has been applied to all imports, except spirits, cork stoppers, and sugar.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina ..	Gum lac, gold leaf, bronze and aluminium powders ..	308
,, ..	Paper	7631/F.L./M.P.
Australia ..	Steel, bronze, copper and galvanised wire (tender)	*
British India	Perfumery, etc. ..	276
Canada ..	Scrap heavy melting steel, angle bars ..	†
,, ..	Dégras, castor, linseed, rapeseed, wool and leather oils	†
Egypt ..	Oils, chrysoidine, nigrosine, copper discs	302
France ..	Iron sheets, metals ..	286
Latvia ..	Kerosene	7058/F.R./C.P.
Spain ..	Chinaware	295
,, ..	Fertilisers	297
Sweden ..	Tinplate	300
,, ..	Manganese ore ..	7056/F.R./C.C/2.
United States	Tiles	304
,,	Glue	18088/F.W./C.C./2
,,	Calcium arsenate, white arsenic	5411/T.C./C.C./2
,,	Iron and steel ..	18677/F.W./E.C./2
Jugoslavia	Metals, hardware, enamelware ..	294

* High Commissioner, Australia House, Strand, W.C. 2.

† Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

GOVERNMENT ORDERS AND NOTICES

Safeguarding of Industries Act—Part I

The Board of Trade has received a complaint that formaldehyde has been improperly included in the lists of articles dutiable under Part I of the Act. The complaint will be submitted, in due course, to the referee, and those interested should communicate immediately with the Assistant Secretary, Board of Trade (Industries and Manufactures Department), Great George Street, S.W. 1.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Overseas Trade Department

In reply to Mr. Moreing, Sir W. Joynson-Hicks said that the staff of the Department of Overseas Trade at home numbered 369 persons, and the staff abroad included 34 commercial diplomatic officers, 11 trade commissioners and clerical staffs of about 120. The Department was also responsible for the administration of the consular service comprising 390 salaried officers—Feb. 26.)

Exports of Morphia

Mr. Bridgeman informed Mr. Gilbert that the exports of morphia, heroin and their salts from the United Kingdom totalled 322,464 ozs. in 1920, and 77,365 ozs. in 1921. The figures for 1921, on the contrary to those for 1920, included exports by parcel post and exports in the form of preparations. Average prices during 1921 were 12s. to 14s. for morphine and 10s. to 12s. for morphine salts.—(Feb. 26.)

German Alizarin

Replying to Mr. T. Thompson, Sir W. Joynson-Hicks stated that alizarin obtained under the Reparation scheme to meet Indian requirements had been handed to the British Alizarin Co. under an arrangement made between that company and the Government of India for distribution in India. No alizarin had been requisitioned for consumption in the United Kingdom.—(Feb. 26.)

Dyestuffs Import Regulation Act

Sir W. Joynson-Hicks, answering Mr. T. Thompson, said he was aware that the referendum recently taken among colour users resulted in a majority in favour of the repeal of the Act. He had no information of the firms to which the questions were sent or how the list was compiled, but only about 50 per cent. of the questions were returned. He did not propose to take any action.—(Feb. 26.)

Trade Marks Branch, Patent Office

Viscount Wolmer informed Mr. Hannan that the Treasury had approved a scheme for reorganising the Trade Marks branch of the Patent Office which would greatly reduce the present arrears of work.—(Feb. 26.)

Patent Fuel Industry

In a written reply to Mr. M. Jones, Lieut.-Col. Lane-Fox stated that he was aware of the plight of the patent-fuel industry in South Wales on account of the high price of pitch, the vital binding ingredient in the manufacture of patent fuel from small coal, but he believed that it was incorrect to attribute the high price of pitch wholly, or even mainly, to the use of tar and pitch for road-making. The representations recently made by the patent-fuel manufacturers to the Ministry of Transport were being considered.—(Feb. 26.)

Aluminium Hollow-ware

Answering Mr. Bonwick, Sir P. Lloyd-Greame said that the imports of aluminium hollow-ware during the quarter ended December 31, 1922, totalled 288 tons, valued at £43,318, compared with 294 tons, valued at £43,550, in the corresponding period of 1921.

Mr. Baldwin, replying to Mr. Bonwick, said that the duty collected under Part II of the Safeguarding of Industries Act on aluminium hollow-ware up to February 23 was £9690.—(Feb. 27.)

German Reparation Dyes

Sir P. Lloyd-Greame, answering Mr. Hope Simpson, stated that no Reparation dyestuffs other than indigo were being sold to any firms for re-sale in this country apart from the general scheme of distribution conducted by the British Dyestuffs Corporation. The supply of German indigotin was requisitioned from Germany under an arrangement between the chief consumers in this country and the British Dyestuffs Corporation, the only British manufacturers of that product. The quantities received were sold to the Corporation at the prices credited to Germany *plus* cost of importation. Under the arrangement the Corporation was delivering against all home orders for synthetic indigo two-thirds British make and one-third German make at an equalised price.—(Feb. 27.)

Sugar-Beet Cultivation

Sir R. Sanders, replying to Mr. Clarry, said that it had been the policy of successive Governments to encourage sugar-beet cultivation in this country, as was shown by the investment of public funds in Home-grown Sugar, Ltd., and by the remission of the Excise Duty on home-grown sugar.—(Feb. 27.)

Insulin Treatment of Diabetes

In reply to Dr. Chapple, Viscount Wolmer said that insulin could not be made available until a supply of known efficiency, potency and safety was attained on a manufacturing scale. Considerable progress had been made by the Medical Research Council in this direction and the successful manufacture in the near future appeared assured. No special Grant-in-Aid would accelerate production at this stage.—(Feb. 28.)

Sugar Duties

Answering Com. Bellairs, Mr. Baldwin said that since the sugar duty was reimposed in 1901, it had been reduced once only, viz., from 4s. 2d. to 1s. 10d. per cwt. in 1908, when the retail price fell by ½d. per lb. The preferential reduction in 1919 of one-sixth of the duty in respect of Empire sugar and the abolition in 1922 of the duty on home-grown sugar were not accompanied by any reduction in retail prices.—(Mar. 1.)

REVIEWS

ORGANIC SYNTHESES. *By* JAMES B. CONANT. *Vol. II. Pp. vii*+100. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.*, 1922. *Price* 7*s.* 6*d.*

The appearance of the second volume of this series, which aims at providing absolutely reliable methods for the preparation of organic research materials, will be welcomed by all interested in this branch of chemistry. In the present pamphlet, the methods of preparation of twenty-five compounds, in quantities up to 1 kg., are fully, but concisely described, and as with each the precaution of independent checking in separate laboratories has again been adopted, the repetition of the experiments by other workers is reasonably assured. As before, the compounds are arbitrarily chosen, but a certain number, such as benzyl cyanide, ethyl phenylacetate, phenylacetic acid, etc., group themselves together. Such important materials as ethyl oxalate, hydrazine sulphate, phenylhydrazine, *p*-dimethylaminobenzaldehyde and phthalimide, are also included. In many cases minor but valuable alterations in the previously recorded methods have been effected. As an example of this, the preparation of *p*-nitrobenzoic acid from *p*-nitrotoluene may be quoted, the reaction period having been cut down from about forty hours to one hour.

These volumes cannot fail to be of value to all organic chemists, employed either in academic work or in industry. Moreover, many of the preparations are highly suitable as exercises for students and, in this respect, the notes appended to each should prove extremely useful, exemplifying as they do the great care which must be taken if successful results are to be obtained in practical work of this type. The book is excellently printed and remarkably free from typographical errors. I. M. HEILBRON

A TEXT-BOOK OF INORGANIC CHEMISTRY. Vol. IX. Part 1.—COBALT, NICKEL AND THE ELEMENTS OF THE PLATINUM GROUP. *By* Dr. J. NEWTON FRIEND, Ph.D. *Second edition, revised. Pp. xxv*+367. *London: Charles Griffin and Co.*, 1922. *Price* 18*s. net.*

This volume, the fifth so far published of the series of ten which will constitute the complete Text-book of Inorganic Chemistry, edited by Dr. J. N. Friend, is now in its second edition. A review welcoming the appearance of the volume, and stating that it formed a valuable addition to the existing literature on the subject, has already appeared in these columns (this J., August 5, 1920, 282 R). Most of the printers' errors and inaccuracies that were then noted have apparently been corrected, and a new and important feature is the addition of short but valuable footnotes on the estimation of the platinum metals. In addition one of the tables has been revised. It would be an advantage if some indication of the contents could be provided on the cover.

Organic Chemistry or Chemistry of the Carbon Compounds. *By* Victor von Richter. *Edited by* Prof. R. Anschütz *and* Dr. H. Meerwein. *Translated from the eleventh German edition by* E. E. Fournier d'Albe, D.Sc. *Volume III. Heterocyclic Compounds. Pp. xviii* + 326. *London: Kegan Paul, Trench, Trubner & Co., Ltd.*, 1923. *Price* 25*s*.

It is a sad reflection, but nevertheless a true one, that Richter's Chemie der Kohlenstoffverbindungen is almost indispensable to all whose interest in organic chemistry extends beyond the acquirement of a B.Sc. degree. The appearance of Vol. III, which completes the English translation of the eleventh German edition, published in 1912, will therefore be welcomed by many chemists whose chief regret will be that they have had to wait so long for a book of such importance. The publication of this translation in three volumes, whereas the original appeared in two only, has not been necessitated by additions or alterations: "to meet the urgent demand at the hands of the British and American publics, the second volume was issued in England and in the United States as soon as it could be got out." As each of the three volumes contains its own index, this division is of little importance; in one way it is an advantage, in another, a disadvantage.

The table of contents of Vol. III is more detailed and more clearly set out than that in the original and the whole book is well printed, leaded type being used for the names of the compounds which are described. These are the heterocyclic compounds, classed primarily according to the number of atoms in the closed chain, and secondarily, according to the number of atoms, other than those of carbon, of which the closed chain is composed. It may be imagined, therefore, that parts of the book, such as those dealing with the *azoles* and the *azines* would not be chosen for holiday reading, and even the more interesting sections on pyridine and quinoline derivatives and on the alkaloids can hardly be spoken of as attractive literature. This is not a note of disparagement; as a work of reference, almost in fact a dictionary, its main aim is to give as completely and concisely as possible a summary of the literature of the heterocyclic compounds, and this aim has certainly been accomplished—excluding the publications of the last twelve years. The translator, naturally perhaps, has adopted the same system of numbering the atoms of the heterocyclic rings as that used in the original and which in some cases is different from that employed by the Chemical Society; it is a pity that such unnecessary confusion should exist, as the task of connecting names with formulæ is sufficiently troublesome even on an agreed system.

F. Stanley Kipping

REPORT

Report on the Commercial Situation in Siam, at the Close of the Third Quarter, 1922. *By* T. H. Lyle, *H.M. Consul-General, Bangkok. Department of Overseas Trade. Pp.* 44. *H.M. Stationery Office*, 1923. *Price* 1*s*. 6*d*.

The present Report refers chiefly to the port of Bangkok, through which over 80 per cent. of the foreign trade of Siam passes, and is based upon official statistics for the Siamese official year, 2464 (April 1, 1921–March 31, 1922). It is interesting to note that there are no standard weights and measures in Siam. The customary unit of weight is the tical (=15 grammes), and the unit of currency the silver tical (=2s. 1½d. approx.).

Total imports and exports for the year were valued at £13,958,518 and £17,170,776, respectively. This favourable trade balance is attributable mainly to the sale of a large rice crop at favourable rates and does not indicate the existence of flourishing trade conditions in the country. It is anticipated that sugar will continue to diminish in prominence as an item of Siamese export. Imports from the United Kingdom for the years 1920–1921 and 1921–1922, respectively, were valued at £4,744,623 and £2,480,154, imports from all British Dominions amounting to £9,743,303 in the latter year. It is important to note that the figures do not take account of the considerable volume of United Kingdom goods comprised in imports from Singapore. The competition of countries having low rates of exchange is amongst a number of factors which indicate that the British manufacturer must reduce prices if his pre-eminent position in the market is to be maintained.

The total values of various imports from all sources for the year 1921–1922 were as follows, the share of the United Kingdom being given in parentheses (av. val. of £1=9·58 ticals):—Iron and steel manufactures, £881,556 (£342,711); sugar and molasses, £516,136; kerosene, benzene and liquid fuel, £489,127; beer, wine and spirits, £219,701 (£44,977); oils, other than mineral oils, £162,498; coal and coke, £67,122 (£13,925); metals, £61,040; rubber manufactures, £49,486; dyestuffs, £33,584. Imports of manufactures of iron and steel from the United Kingdom consisted of railroad material, galvanised sheets, bars and sections, and tinplate. Germany is gradually acquiring the trade in wire and wire nails to the exclusion of Belgium, principally owing to lower prices. In enamelled goods, Japan continues to hold first place. Coal from the United Kingdom again appears amongst the imports, largely owing to cheaper rates of freight. It appears that the Siamese Government is still continuing its investigations for petroleum at Muang Fang and other places in North Siam, but no results have yet been made public.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

There has been little or no change in the volume of business passing in the chemical market but a strong undercurrent of opinion that a much brighter tone will shortly be seen. Whether this is the outcome of developments in Germany and the probable stoppage of shipment therefrom in certain articles, or whether it is partly caused by anticipated general improvement in trade, is hard to judge, but probably a combination of both is the true reason. The outstanding feature has undoubtedly been an enormous rise in the price of Carbolic Acid, which in a very short period has doubled, and even at to-day's figure shows signs of further increases.

Acid Acetic, 40% tech.	£22 10s. per ton. Firm tone still maintained. Advance expected.
Acid Hydrochloric	4s.-5s. carboy d/d.
Acid Nitric, 80° Tw.	£25 per ton. Not in much demand on the open market.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Fair request for home consumers, with a firmer tone for export.
Arsenic (White)	£70 per ton. Prices nominal and very few parcels available.
Bisulphite of Lime	£7 per ton, packages extra and returnable.
Bleaching Powder	£10 10s.-£11 10s. per ton. No change in position.
Calcium Chloride	£6 per ton. No change.
Copper Sulphate	£26 10s. per ton f.o.b.
Potash Caustic, 88/90%	£29-£30 per ton. No change.
Potass. Bichromate	6¼d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton. Price unaltered and manufacturers are offering more freely than of late, but business has not reached very large dimensions.
Soda Caustic, 76%	£20-£21 per ton. Not in very brisk demand at present.
Soda Crystals	£5 5s. carr. paid. Manufacturers have reduced their prices 5s. ton.
Sod. Acetate	£24 10s. per ton. In better demand with very small quantities available.
Sod. Bicarbonate	£10 10s. per ton.
Sod. Bisulphite Powder, 60/62%	£19-£20 10s. per ton f.o.b. or f.o.r. London.
Sod. Chlorate	Market dull with spot parcels offering at 2⅞d. per lb.
Sod. Nitrite, 100% basis	£30 per ton d/d.
Sod. Sulphide, solid 60/62	£15 per ton. No change.
Sod. Sulphite, Pea Cryst.	£17-£17 10s., 1-cwt. wooden kegs included.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£9 per ton d/d.
Grey, 80% basis	£18 10s.-£20 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefined. Somewhat lower prices, however, are reported in some quarters.
Wood Naphtha—	
Miscible	6s. 6d. per gall. 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead	£38 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 6d. per lb. Market very strong and higher prices are expected.
Crude 60's	3s. 9d.-4s. per gall. Demand still strong.
Acid Cresylic—	
97/99	2s.-2s. 2½d. per gall.
Pale 95%	1s. 11d. per gall.
Dark	1s. 9d.-2s. per gall. Fair inquiry.
Anthracene Paste, 40%	4d. per unit per cwt. Price nominal. No business.
Anthracene Oil—	
Strained	9d.-11d. per gall. Fair inquiry.
Unstrained	8¼d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6d.-1s. 8d. per gall.
Pure	2s.-2s. 6d. per gall. Demand poor.
Toluole—90%	1s. 9d. to 1s. 11d. per gall. Little inquiry.
Pure	2s.-2s. 3d. per gall. Poor demand.
Xylol	2s. 9d.-3s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.-1s. 1d. per gall. Fair demand.
Middle Oil	8¼d.-10d. gall.
Heavy	8¼d.-10d. ,,
Standard Specification	8¼d.-10d. ,,
	According to district. Market strong.
	Good inquiry forward.
Naphtha—	
Crude	9d.-9¼d. per gall.
Solvent 60/160	1s. 6d.-1s. 9d. per gall. Not much business.
Solvent 90/190	1s. 6d.-1s. 7d. per gall. Fair demand.
Naphthalene Crude—	
Whizzed or hot pressed	£9 10s.-£12 10s. per ton.
Drained Creosote Salts	£5-£9 per ton. Supply still short.
Naphthalene Crystals	£17 per ton.
Naphthalene Flaked	£15 per ton.

Pitch, Medium Soft	160s.-172s. 6d. per ton. Market strong. Good inquiry both prompt and forward.
Pyridine—90/140	10s. 6d.-12s. 6d. per gall. Little demand.
Heavy	8s.-9s. per gall. Price still nominal.

INTERMEDIATES AND DYES

Acetic Anhydride	1s. 5d. 100% basis.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 7½d. lb. 100% basis d/d.
Acid Neville & Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride—Anhydrous	1s. per lb. d/d.
Aniline Oil and Salts	10d. per lb. naked at works.
Antimony Pentachloride	1s. 1d. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene—48/50	8d.-9d. naked at works.
66/68	1s. 2d.-1s. 3d. naked at works
Diphenylamine	3s. 3d. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Meta Phenylene Diamine	5s. 6d. per lb. d/d.
Meta Toluylene Diamine	5s. per lb. d/d.
Monochlorbenzol	£70 per ton.
α-Naphthol	2s. 9d. per lb.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d.-9d. per lb., drums extra.
Nitronaphthalene	1s. per lb. d/d.
Naphthionate Soda	2s. 8½d. lb. 100% basis d/d.
Orthonitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Chlorphenol	4s. 6d. per lb.
Paradichlorbenzol	£55 per ton.
Paranitrophenol	1s. 9d. per lb. 100% basis.
Parachloraniline	3s. per lb. 100% basis.
p-Nitro-o-amido-phenol	4s. 6d. per lb. 100% basis.
Para Phenylene Diamine	12s. per lb. 100% basis d/d.
Para Toluidine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid Acetic, 80% B.P.	£46 10s. to £47. Market very firm.
Acid Acetyl Salicylic	3s.-3s. 2d. per lb. Price steadily advancing on the Continent. Raw material also advancing in price.
Acid Benzoic	2s. 3d. per lb. No change. Supplies restricted.
Acid Boric, B.P.	£61 per ton Crystals, £65 per ton Powder, packages in 2-cwt. bags.
Acid Citric	1s. 8d. per lb. Market steady with upward tendency.
Acid Gallic	3s. per lb.
Acid Pyrogallic, cryst.	5s. 6d. per lb.
Acid Salicylic	1s. 9d.-2s. lb. Firm and likely to go higher. Extraordinary variations in prices are recorded, sometimes as high as 3s. per lb.
Acid Tannic	3s. 3d. per lb. Little demand.
Acid Tartaric	1s. 2¾d. per lb., less 5%. Raw material still very firm. Price tendency upward. Demand expected to improve.
Amidol	9s. per lb.
Amidopyrin	12s. 6d.-13s. per lb. Now quoted.
Ammon. Benzoate	3s. per lb. for good makes.
Ammon. Sulphocyanide	2s. 6d. per lb.
Barbitone	14s. per lb. Higher.
Benzonaphthol	5s. per lb. Not much demand.
Bismuth Salts	Price per lb. for cwt. lots are as follows: — Carbonate 13s., Citrate 11s. 7d., Nitrate Cryst. 6s. 11d., Oxide 14s. 5d., Salicylate 10s. 5d., Subchlor 12s. 8d., Subgallate 9s. 6d., Subnitrate 11s.
Bromides	Market unsettled. Tendency to higher prices owing to possible difficulties in obtaining Continental supplies.
Calcium Lactate	2s. per lb. Firm and steady.
Chloral Hydrate	3s. 9d.-4s. per lb., according to quantity and holder.
Ethers (Methylated)	Makers have announced an all round reduction of 1d. per lb. in consequence of the lower price in force for industrial methylated spirit.
Formaldehyde, 40%	£90-£92 10s. per ton.
Guaiacol Carbonate	8s. per lb.
Hexamine	4s. per lb. Continental prices still rising.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	B.P. 2s. 5d. lb. Green 3s. 1d. lb. } Market quiet.
Magnesium Carbonate—Light Commercial	£37 per ton.
Magnesium Oxide—Light Commercial	£85 per ton.
Heavy Commercial	£28 per ton.
Menthol	37s. per lb., less 2½% for original cases. Small quantities 37s. 6d. nett.
Methyl Salicylate	2s. 3d. per lb. Steady demand. Price firm.
Methyl Sulphonal	13s. per lb.
Mercurials	English makers have reduced prices 2d. per lb. for all salts.
Paraformaldehyde	3s. 6d. per lb. present value.
Paraldehyde	1s. 6d. per lb. Unchanged.
Phenacetin	5s. 3d. per lb. Slightly higher and distinctly firmer.
Phenazone	7s. per lb. Price fully maintained.
Phenolphthalein	4s. 9d. Easier.
Potass. Bitartrate—99/100% (Cream of Tartar)	98s.-100s. per cwt. less 2½% for ton lots. Same tendency as with Acid Tartaric.

Potass. Iodide	15s. 8d. per lb. for cwt. lots. Cases free. Good market.
Potass. Permanganate ..	9d. per lb. Spot holders are unwilling to sell below.
Quinine Sulphate ..	2s. 3d.-2s. 4d. oz. Steady market.
Salol	2s. 4d. per lb. Demand limited, value steady.
Sod. Benzoate	2s. 3d. per lb. still quoted.
Sod. Citrate—P.B.C. ..	2s. per lb.
U.S.P. ..	2s. 3d. per lb.
Sod. Hyposulphite—Photographic	£15-£17 per ton, according to quantity.
Sod. Potass. Tartrate (Rochelle Salt) ..	82s. 6d.-85s. Fairly good demand.
Sod. Salicylate	2s. 1d.-2s. 3d. per lb. A further advance in price is probable.
Sod. Sulphite, Anhydrous	£27 10s.-£28 10s., according to quantity; f.o.r. London, drums included.
Tartar Emetic ..	1s. 4d.-1s. 6d. per lb.
Thymol	19s. per lb. for first quality product.

PERFUMERY CHEMICALS

Amyl Acetate	2s. 3d. per lb.
Amyl Butyrate	8s. ,,
Amyl Salicylate ..	3s. 3d. ,,
Anethol (Melting point 21°/22° C.)	4s. 6d. ,,
Benzyl Acetate (from chlorine-free Benzyl Alcohol)	3s. ,,
Benzyl Alcohol free from chlorine	3s. ,,
Benzaldehyde, free from chlorine	3s. ,,
Benzyl Benzoate. 19·5° C.	3s. ,,
Cinnamic Aldehyde, 98/100%, Natural ..	14s. 9d. ,,
Coumarine	12s. 6d. ,,
Citronellol	22s. 6d. ,,
Citral, 100%	9s. 6d. ,,
Ethyl Phthalate ..	4s. 3d. ,,
Eugenol, 100%	11s. ,,
Geraniol (from Palmarosa)	30s. ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	5s. 9d. per lb.
Iso Eugenol	18s. 6d. ,,
Linalol ex Bois de Rose ..	21s. ,,
Linalyl Acetate	22s. 6d. ,,
Methyl Benzoate ..	8s. 6d. ,,
Musk Xylol	8s. 9d. ,,
Phenyl Ethyl Acetate ..	10s. ,,
Phenyl Ethyl Alcohol ..	17s. 6d. ,,
Rhodinol	45s. ,,

ESSENTIAL OILS

Anise Oil, Red Ship Brand	2s. 1d. per lb.
Bourbon Geranium Oil ..	26s. 6d. for shipment.
Cananga Oil, Java ..	9s. Firm.
Cinnamon Oil Leaf ..	4d. per oz.
Cassia Oil, 80/85% ..	8s. 3d.
Citronella Oil—	
Java, 85/90% ..	3s. 9d.
Ceylon	3s. 6d.
Clove Oil	8s. 3d.
Eucalyptus Oil, 70/75%	1s. 8d.
Lavender Oil, Mont Blanc 38/40%	12s. 6d.
Lemon Oil, spot ..	3s. New crop for shipment 2s. 11d.
Orange Oil, sweet, spot	10s. New crop for shipment 10s. 6d.
Otto of Rose Oil—	
Anatolian	24s.
Bulgarian	26s.
Palma Rosa Oil ..	17s. 6d.
Peppermint Oil—	
English, Mitcham ..	80s.
Wayne County ..	13s.
Japanese	6s. 9d.

TRADE NOTES

Chemical Trade in British Malaya

The following statistics show the trade in chemicals, drugs and dyes of Malaya during 1921 and 1922: —

	Imports		Exports	
	1921	1922	1921	1922
	£	£	£	£
Drugs and medicines ..	243,904	341,754	133,522	100,176
Soap	187,304	162,134	53,382	37,006
Chemicals	158,868	148,942	35,519	38.674
Perfumery and cosmetics	105.989	126,504	20,323	14.614
Toilet soap	28,344	44,922	11,179	10,261
Druggists' and dentists' sundries	23.760	15,084	1.986	1,236
Acetic acid	23,462	118,924	7,199	9,527
Aniline dyes	10.693	6,466	959	2,560
Synthetic indigo ..	9,242	5,572	1,688	557

The exports go mainly to Siam, Borneo, French Indo-China and the Dutch Islands in the Archipelago. Imports of acetic acid used for coagulating latex amounted to 48,660 gallons in 1921 and 387,594 galls. in 1922.—(*Bd. of Trade J., Mar.* 1, 1923.)

International Gas Exhibition in Holland

The municipal authorities of Amsterdam are organising an International Gas Exhibition to demonstrate the use of gas for industrial purposes in metal and chemical works, food preserving factories, central heating systems, etc., and for household and scientific use. British firms may inspect the rules of the Exhibition at the Department of Overseas Trade, and a few copies are available for loan to firms unable to inspect the rules in London. (Ref. 7808/F.B./G.P.)

PUBLICATIONS RECEIVED

CHEMISTS' YEAR BOOK, 1923. *Edited by* DR. F. W. ATACK, *assisted by* L. WHINYATES. *Vol. I. Pp.* 422. *Vol. II. Pp.* 684. *Manchester: Sherratt and Hughes*, 1923. *Price* 21s.

THE DESTRUCTIVE DISTILLATION OF WOOD. *By* H. M. BUNBURY, M.Sc. *Pp. xx*+320. *London: Benn Brothers, Ltd.*, 1923. *Price* 35s.

AN ADVANCED LABORATORY MANUAL OF ORGANIC CHEMISTRY. *By* MICHAEL HEIDELBERGER, B.Sc., PH.D. *Pp.* 103. *New York: Chemical Catalog Co., Inc.*, 1923. *Price* $2.

ANORGANISCHE CHEMIE, EIN LEHRBUCH ZUM WEITERSTUDIUM UND ZUM HANDGEBRAUCH. *By* DR. FRITZ EPHRAIM. *Pp. viii*+742. *Dresden and Leipzig: Theodor Steinkopff*, 1923. *Price, paper* 8s. 6d., *bound* 10s. 7½*d*.

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EDITORIAL

INTEREST in the new element, or elements, continues unabated and investigation of the results announced is proceeding actively in several laboratories. Through the kind offices of Professor Biilmann, vice-president of the International Union for Pure and Applied Chemistry, we are able to print, in this issue, a most interesting paper by Professors Coster and Hevesy, whom we invited some little time ago to send us a communication on their discovery of hafnium. An interesting sidelight on the discovery is provided by the note (on page 276), very kindly supplied by Dr. E. B. R. Prideaux, on "New Zealand Ironsand," the source, it will be remembered, from which Dr. Scott obtained the oxide of his new element. The work now being done at Copenhagen is no longer confined to the X-ray analysis of minerals containing the new element, and in last week's *Nature* there is a letter describing the lines which appear in the ordinary optical spectrum of hafnium. Messrs. H. M. Hansen and S. Werner, who make the communication to *Nature*, state that none of these lines correspond with those ascribed by Urbain to the spectrum of celtium and point out that some of the most prominent hafnium lines have been present as weak lines in zirconium spectra measured by earlier investigators, particularly Bachem in 1910. It is of interest to note that a full account of the hafnium spectrum, with measurements of the wave-lengths of the characteristic lines, will be issued shortly.

* * *

The therm, after undergoing what was claimed to be universal condemnation, has now been rehabilitated. The Committee appointed by the Board of Trade to report on the method of charging for gas on the thermal basis has recommended that the system should be continued, but adds that the public should be provided with indications to show the relation of the old system of charging by volume, to the new one of charging by calorific value. To the unprejudiced observer, the fact that there has been a public inquiry into the application of such an admittedly logical system of charging for gas—gas, be it noted, that is of no value nowadays for direct lighting purposes—is almost ludicrous. We are glad to note that at least one large daily paper predicted that the therm would be "acquitted with a caution." The confusion in the public mind has been undoubtedly due to the introduction of the new system without adequate explanation, at a time when the cost of producing gas was actually higher. An interesting point in the report is the conclusion that the control over the calorific value of the gas supplied is adequate in London, but the committee is not satisfied that tests are sufficiently frequent in other areas, and therefore recommends that maintenance of the standard calorific value should be ensured by the use of continuously recording calorimeters. With regard to the question of carbon monoxide in coal gas, the committee states that this is outside the terms of reference, but recommends that, as gas is now in many cases supplied under an increased pressure, precautions should be taken to see that the fittings are properly adjusted.

Owing to the prominence with which the gas industry has been brought before the public of late, some interest has been taken in the origin of the word "gas." We understood that the word was invented by the Dutch chemist, J. B. Van Helmont, somewhere in the 17th century, and that he derived it either from the Greek word "chaos," or from the Dutch word "geest," spirit, but this has been doubted. We should be glad if our readers would enlighten us on this point.

* * *

We commented recently on Professor Lowry's article on the Uniqueness of Hydrogen, and are not surprised that this and a subsequent one on a Method of Representing Co-ordination have received a good deal of attention. Two or three years ago Langmuir showed many diagrams of possible constitutions of chemical compounds based on the octet theory, and other workers have contributed to this study; but we do not call to mind any chemist who has applied the relation of the positive electricity on the nucleus to the negative electricity on the outer sphere of the atom with such care and boldness as Professor Lowry. We shall publish shortly some further contributions from him and it seems quite likely that the field of investigation he now enters, is a considerable tract of territory which will keep him and his associates busy for a long period. All chemical combination seems to be due to the mutual attraction between the positive nucleus of one atom and an electron which belongs wholly or partly to another atom. If we understand Professor Lowry's views aright he draws a sharp line of distinction between (*a*) the case of a nucleus, with, say, 7 units of positive electricity surrounded by 8 electrons and its attraction for a nucleus with 9 units of positive electricity surrounded by 8 electrons, and (*b*) the case of two nuclei with 4 and 6 units of positive electricity respectively, and partially surrounded by 2 electrons each, but held together by their common attraction for 6 electrons lying between them and cementing them together. The one is comparable to the companionship of husband and wife, the other to the companionship of the two wives of a Turk or a Mormon. If the wife is considered as a lost rib the analogy is more exact, but the comparison must not be applied too closely; Lowry rather ignores the importance of the Turk as an element in the family; in the case of units of electricity, at any rate, attractiveness is not a function of mass.

It is not clear that anyone before Lowry has paid attention to the units of positive electricity as factors explaining the binding together of various organic compounds, and we feel sure that our readers will derive considerable satisfaction from the articles which are shortly to appear.

THE PRODUCTION OF LEAD IN BRITAIN

By PROF. H. LOUIS, M.A., D.Sc.

Lead ores occur abundantly, and are widely distributed throughout the greater part of Great Britain—more so, indeed, than any other mineral of similar economic importance. Taking the line of Secondary rocks which crosses England diagonally from about Whitby to about Lyme Regis as the dividing line between the geologically more recent and more ancient areas, between the flatter and the more mountainous portions, there is hardly a county within the latter area in which lead ores have not been met with. Lead ores in this country are essentially characteristic of the Palæozoic rocks, as may be seen from the following table of the distribution of the more important deposits:—

Metamorphic.—Greater part of Scotland.
Cambrian.—Merionethshire and other portions of North Wales.
Cambrian-Ordovician.—Anglesey, West Carnarvonshire and some other portions of North Wales; Lake District.
Ordovician.—Scotland (Leadhills and Wanlockhead district); Central Wales; Shropshire (Minsterley and Shelve district).
Silurian.—Scotland (Lanarkshire and Kirkcudbrightshire); Central Wales; Denbighshire and Flintshire; Anglesey.
Old Red Sandstone.—Caithness; Orkney.
Lower Devonian.—Cornwall (New Quay district).
Middle Devonian.—Devonshire (Combe Martin); Cornwall (Liskeard, etc.).
Upper Devonian.—Cornwall (Liskeard, etc., Tavistock district).
Carboniferous Limestone.—Cornwall (Tavistock), Devonshire (Teign Valley), Somersetshire (Mendips), North Wales (Denbighshire), Pennine Chain (Northumberland, Durham, Yorkshire, Derbyshire), Northumberland.

This list shows clearly the wide distribution of lead ores through all portions of the Island in which Palæozoic rocks occur. No one knows with any definiteness either the primary source of these lead ores or the reason why they are always found in the older rocks, but the fact is very obvious.

In all these places lead ores are found in fissure veins frequently accompanied by a small amount of faulting, the veins being vertical or steeply inclined, so that well-marked outcrops are the rule. In some of the limestone districts the ore also occurs in flats and pipes occupying joints in the limestone, but in every case closely connected with fissure veins.

There is only one primary ore of lead—namely, galena. Sometimes this ore holds up comparatively unchanged or covered only with a thin crust of sulphate up to the grass roots, and in many places masses of detached ore or shoad-stones, as the miner calls them, of galena similarly encrusted are found in the overlying alluvial, ranging in size from fragments the size of a pea up to boulders weighing several hundredweights. In other cases the galena has undergone oxidation, which may extend for some distance down the vein, producing a series of oxidised lead ores, the more important of which are the sulphate, carbonate, phosphate and arsenate, the characteristic yellow and green shades of the latter having given rise to the Derbyshire miners' name of " linnets " for such ores. The reasons why these chemical changes have occurred in some veins and not in others is somewhat obscure, but the chemistry of the changes is obvious enough, and it may be noted that these oxidised ores are more plentiful in limestone than in slate country. All lead ores carry silver, the amount of which is very variable. Thus, in the Weardale and Alston districts the ore runs about 6 oz. of silver to the ton ; in Yorkshire and Derbyshire, 1 oz. to 2 oz. ; in Shropshire, 2 to 3 oz. ; in Cardiganshire and Montgomeryshire, 3 to 4 oz. ; Flintshire, 5 to 6 oz. ; Denbighshire, 3 to 4 oz. ; Somersetshire, about 2 oz. ; in Wanlockhead and Leadhills, 3 to 5 oz. ; the blue-stone of Anglesey carries from 5 to 15 oz. ; the lead ores of the Isle of Man, 30 to 40 oz. ; of Cornwall and Devon, 40 oz. ; whilst some mines like Beer Alston are said to have carried up to 45 oz. ; in the Lake District lead veins low in barytes carry 6 to 8 oz. ; those rich in barytes, 25 oz. or more per ton of ore. The average for the whole of Great Britain may be taken as between 4 and 5 oz.

All lead ores have this characteristic in common—that they are easily reduced, simply sprinkling any of them upon an ordinary fire being sufficient to cause reduction of a large portion of the lead. The galena is reduced by being partially oxidised, the oxide or sulphate so formed interacting with some of the unoxidised galena. Oxidised ores appear to be mostly reduced by simple contact with the glowing carbon, especially in the presence of a base such as would be furnished by wood ashes. The elementary metallurgy of lead is therefore exceedingly simple, and the reactions above indicated all take place at quite low temperatures.

Lead in Ancient Times

Under such conditions it is inconceivable that lead should not have been one of the earliest metals to be discovered by the primitive races of mankind, but its use to primitive man was no doubt limited. He would be interested merely in such metals or alloys as were capable of taking a cutting edge and would have no use for a soft material like lead. The cave man, or even his immediate successor, would have as little use for sheet lead for roofs as for lead pipes for water, and apparently it was only at a relatively late stage that the use of leaden missiles, such as sling stones, appears to have occurred to him. Even in the centre of our ancient civilisation the use of lead is relatively recent. Leaden objects have been found at Nineveh and were used by the Assyrians about 900 B.C. ; Schliemann found leaden objects at Mycenae and Tiryns, and the Greeks are known to have used lead freely.[1]

In Britain very few examples of the use of lead in prehistoric times have been met with. Lead has been quite often found as an ingredient in bronze, in some cases up to about 10 per cent., but whether this admixture was accidental or should be looked upon as a deliberately added adulterant is doubtful. Sir John Evans[2] mentions that two swords found near Tosson, in the parish of Rothbury, had pommels of lead ; he also points out[3] that a bronze celt mould has been found with a little lead adhering to it, and that " several socketed celts made of lead have from time to time been found." He suggests that these may have been used as patterns for casting from, in the same way that white metal patterns are used in the foundry to-day.

In the times immediately preceding Cæsar's invasion of Britain there is no evidence of the production of any lead in this country. Some of the writers of this period mention Britain as a producer of silver, and it is difficult to see how this could have been obtained save from argentiferous lead ores (except, perhaps, from certain of the Cornish and Devonshire mines), though it is of course possible that the silver may have been extracted without recovering the lead associated with it, in the metallic state. Strabo,[4] writing about the time of Cæsar, says that Britain produces gold, silver and iron. We learn from him that, according to Posidonius, the Cassiterides produced tin, and that from the Britannic Islands this metal is carried to Marseilles.[5] His own statement is that the Cassiterides are ten in number ; of the metals they have lead and tin.[6] Cæsar[7] himself, after his second invasion, mentions the production in Britain of tin and iron, but makes no reference to lead. It is not until a century later that the classical writers speak of the production of lead in this country. Tacitus, 97 A.D., is somewhat vague, saying only that Britain produces gold and silver and other metals,[8] but Pliny the elder, in his History written twenty years before the latter date, makes a very definite statement in the oft-quoted passage,[9] in which he says that in Britain lead occurs in the upper crust of the earth, and so plentifully that a law had been passed restricting its production. There seems little doubt that by this time Britain was not only an important producer of lead but also exported this metal on a considerable scale. It is most probable that there was no true mining for lead before this time ; all the lead smelted in pre-Roman times and in the earlier periods of the Roman occupation will have been smelted from float ore, either picked up on the surface or obtained by washing the surface soil in the lead mining districts, where the mineral occurred in large quantities. That the Romans lost no time in turning this mineral wealth to account is evident from the fact that in the Mendip Hills a pig of lead has been found bearing the name of the Emperor Claudius, date A.D. 49, and thus only six years after their occupation of Britain. Fifteen years later they were smelting lead in Flintshire. In succeeding centuries they must have exhausted a large portion of the float ores and commenced true underground mining in various places. In the mines of the Mendip Hills Roman lamps made of lead have been found, and there is ample evidence of actual mining by the Romans. Leaden objects of Roman age have been found in comparative abundance ; pigs of Roman lead have been found in various parts of the country, not only in the mining districts but also along the great trade routes in such counties as Norfolk and Sussex, a fact which indicates clearly that this lead was intended for export. Dr. Percy points out that some of these pigs are marked "*Ex Arg.*" or desilverised. It is, of course, well established that the Romans were familiar with the process of extracting silver from lead by cupellation long before their arrival in Britain, and it is highly probable that they worked the lead ores not only for the sake of the lead but also for the sake of the silver which they contained ; and there is no doubt but that they knew how to recover both of these metals. As has been shown, all British lead ores are comparatively poor in silver, but it is well known that when an argentiferous lead ore weathers a great deal of lead may be dissolved away from it, probably as a chloride or as an organic compound, while the silver is not thus affected, so that the ore is naturally enriched by the process of weathering. Thus a boulder of float ore picked up in Weardale yielded some 120 oz. of silver to the ton, whereas the ordinary ore, as mined in depth, only contains 3 oz.

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[1] Lead Work, by W. R. Lethaby, 1893, p. 6.

[2] Ancient Bronze Implements of Great Britain, 1881, p. 285.

[3] *Ibid.*, p. 445.

[4] Strabo, Book IV., C. V., s. 2.

[5] Book III., C 2, s. 19.

[6] Book III., C V., s. 11.

[7] De Bello Gallico, Book V., cap. XII.

[8] Agricola, Cap. XII.

Among the leaden articles belonging to this period are hammered plates, pipes, coffins, cists, and other vessels. At Corstopitum a hoard of Roman gold coins was found enclosed in a leaden receptacle. A lead tablet with an inscription was found amongst the Roman remains at Lydney.[10] The Romans also used articles made of pewter, an alloy of lead and tin, though this did probably not come into use until a relatively late period. Thus, at Minton, Roman pewter has been found associated with coins dating from 360 to 410 A.D.[11] In all probability this pewter was produced by deliberate mixing of the two metals, the Romans being well acquainted with the use of such an alloy for soldering purposes. It is, however, just possible that it may have been produced in the first instance from a natural mixture of the two ores found together in alluvials in Devon or Cornwall. The author has recorded such an occurrence in the Far East, where he found the Chinese smelting a natural mixture of lead and tin ores obtained by washing certain alluvials in the State of Patani in the northern part of the Malay Peninsula.[12] Before the Romans retired from Britain lead mining and smelting must have been a firmly established industry, and there is no reason to doubt that it continued to exist even through the troublous times that followed their departure. Lethaby is of the opinion that "There is just enough evidence to show that the use of leaden coffins was continued by the English after they had superseded the Romans."[13]

The Venerable Bede, in his History of the Church of the English People, says that Britain is rich in veins of the metals copper, iron, lead and silver :[14] "*Venis metallorum, aeris, ferri et plumbi et argenti fecunda.*" It is interesting to note that in Alfred's translation of this passage, circa 900 A.D., we find the first use in English of the word "leade" (lead), which is apparently derived from the Frisian. Further on Bede states that Eadberct, Bishop of Lindisfarne, took the old thatch off the church at that place, which had originally been built by Finan, and covered the roof and sides with sheets of lead. The date of this must have been about 680 A.D. Wilfrid in the same way covered the decayed roof of the church of York with pure lead and glazed the windows.[15] In neither case does the description read as though the use of lead for that purpose were anything of a novelty.

Lethaby mentions a leaden book cover of Saxon work with an inscription of Aelfric's Homilies. Lead mines were evidently in operation at the time of the Norman invasion, for the "Domesday Book" records the existence of lead mines "*plumbaria*" in Derbyshire. From the earliest times of the Norman Conquest onwards lead was in ordinary use for coffins ; numerous leaden fonts and leaden church ornaments are known through many centuries, so that lead production in Britain must have been active and continuous. To quote Lethaby[16] again :—" In Saxon England lead was a staple commodity for export and used in great quantities at home. . . . During the Middle Ages it was largely applied to many purposes. . . . England was still the best esteemed source of supply."

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[9] Book XXXIV., C. XVII.

[10] W. R. Lethaby, op. cit., p. 67.

[11] John Ward, The Roman Era in Great Britain, p. 191.

[12] On the River Telubin, The Geographical Journal, Sept., 1894, p. 235.

[13] Op. cit., p. 45.

[14] Book I., Cap. I.

[15] Vita Wilfridi, Eddio Stephano Auctore (about 710), C. 15, in Raine's Historians of the Church of York.

Lead Smelting

Seeing that underground mining was introduced by the Romans, they must have been quite familiar with crude methods of breaking up and washing the ore. Possibly at first they confined their underground operations to following up ribs of solid galena, but they no doubt soon mined ore which required some form of dressing, and we know that they were familiar with a certain number of primitive methods of attaining this object; so that it may be assumed without much hesitation that they prepared fairly clean ore for smelting purposes. As to the methods employed up to the late Middle Ages for smelting lead ores, we have no definite knowledge; but, as has already been pointed out, this is one of the easiest of all smelting operations and was certainly well within the capability of the early British metallurgists, who were evidently highly skilled workers in bronze long before the advent of the Romans. How simple the operation of lead smelting may be made can be gathered from the following extract from *The Useful Metals and their Alloys*, by Robert Oxland and other writers (1861) :[17] " If a western backwoodsman wants shot or bullets, he will kindle a fire in a hollow tree or an old stump of a tree, place some galena on the charred wood and melt it down. After cooling, he finds the metal at the bottom of the hollow. Formerly lead was smelted in log-furnaces, in Missouri . . . a rude kind of square furnace, constructed of logs or stones. The front wall of such a furnace is about eight feet wide and seven feet high. The hearth in the bottom of the interior is about two feet wide, eight feet long, and ten or twelve inches high, forming ledges or boshes with the side-walls one foot in width. The arch in front, which admits air into the furnace, is about two feet high and wide, and is temporarily shut by stones, clay or brick. A basin in front of the furnace receives the fused metal, from which it is ladled into the pig-moulds. The operation in this furnace was simple. A layer of heavy logs was placed horizontally in the bottom; then billets of split wood were set upright, and these covered with galena; the top of the ore was covered by small wood. A fire kindled in the front arch will char the lower parts of the wood first, and by the time the heat is conveyed to the ore sufficient for melting, the hot charcoal below will expel sulphur and precipitate the metal, which flows out as it is formed. One heat requires twenty-four hours, after which the furnace is cooled and the ashes removed; then it is charged anew. About 50 per cent. of metal is thus obtained from the ore. The ashes which remain contain much metal, and are subjected to a second smelting in the ash-furnace."

" Bolehills "

It is obvious that such crude metallurgical appliances are well within the capacity of a primitive race, and it is equally evident that few traces of their existence are likely to have survived. The most evident indication we have of ancient smelting methods is in the discovery of the so-called balehills or bolehills in certain of the lead-mining districts. There is some doubt as to the origin of the word, but it is now generally referred to the old English " bole," meaning a blazing pile. Sir John Pettus, in his *Fodinae Regales*, says, " Boles or Bolestids are places where in ancient times (before smelting mills were invented) the miners did fine their lead." These bolehills have been referred to by various writers. Thus, Bishop Watson, in his *Chemical Essays*, writes :—" There are several places in Derbyshire called Boles by the inhabitants, where lead has been anciently smelted, before the invention of moving bellows by water. These places are discovered by the slags of lead, which are found near them; there is no certain tradition concerning the manner in which the ore was smelted at these boles; it was, probably, as simple as that of the Peruvians, for in Derbyshire, as well as in Peru, they seem chiefly to have relied upon the strength of the wind for the success of the operation, the boles being always situated upon high grounds, and mostly upon that side of a hill which faces the west. This situation was not fixed upon without design, since the wind blows in England, in the course of a year, near twice as many days from that quarter as from any other." And Dr. Joshua Childrey, in his *Britannica Baconica*, describes them as follows :—" The lead-stones in the Peak lye but just within the ground next to the upper crust of the earth. They melt the lead upon the top of the hills that lye open to the west; making their fires to melt it as soon as the west wind begins to blow; which wind by long experience they find holds longest of all others. But for what reason I know not, since I should think lead the easiest of all metals to melt, they make their fires extraordinary great." These bolehills are by no means confined to Derbyshire, but are known also in other lead-smelting districts, as, for instance, at Wolsingham and Stanhope, in Weardale.

(*To be continued*)

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[16] Op. cit., p. 15.
[17] P. 611.

THE GROWTH OF PLANTS

By PROF. E. E. C. BALY, C.B.E., M.Sc., F.R.S.
The University, Liverpool

Dear Sir,—I am more than pleased to accept your invitation to reply to Mr. White, and to offer him a helping hand in the difficulties in which he finds himself. Those difficulties are, perhaps, shared by others whose enthusiasm for plants, with their infinite variety of form and colour, is somewhat chilled by the formal and austere atmosphere associated with a scientific communication in the journal of a learned society. The charm of Mr. White's letter has appealed to me, and I may confess at once to a very keen appreciation of the honour that has come to me in that the work has been deemed worthy of record in latin hexameters. Such honour comes to few men, and fewer still perhaps appreciate it at its full value. The years I spent at Aldenham under John Kennedy, one of the finest and most inspiring of headmasters, taught me to be one of those few.

I will endeavour to explain what Professor Heilbron and I believe to be the process which takes place in the living plant. In the first place there is the well-known process whereby formaldehyde is burnt with oxygen to give carbon dioxide and water, with the evolution of a large amount of energy, the equation being $CH_2O+O_2=CO_2+H_2O+130{,}000$ calories.

The reverse process, namely, the production of formaldehyde and oxygen from carbon dioxide and water, is bound to take place provided that sufficient energy is available, the reaction being highly endothermic. It is impossible to realise the process by the ordinary methods of heating, etc., owing to the very large amount of energy necessary. It is, however, possible by the use of light energy to bring the reaction about, since carbonic acid has the power of absorbing ultra-violet light of very short wave-length, and without discussing in detail the energy quantum theory it is established by this theory that the energy thus absorbed is just the right amount to stimulate the reaction. We have proved this fact by a variety of methods and have demonstrated in several ways that formaldehyde is produced from carbonic acid by the action of ultra-violet light.

We have also proved in more than one way that if the carbonic acid is in combination with a visibly coloured basic substance the formaldehyde is produced when the compound is exposed to visible light. The importance of this lies in the fact that it explains the function of the chlorophyll in the leaves of the plant, since chlorophyll forms a compound with carbonic acid and this compound gives formaldehyde on exposure to sunlight. The energy relations of this process are more complex since there are present four pigments, chlorophyll A, chlorophyll B, carotin, and xanthophyll, and all these have their own *rôle* in the four component equilibrium which is both chemical and photochemical. This complexity, however, does not alter the fact that the chlorophyll combines with the carbonic acid, and on exposure to sunlight gives formaldehyde.

The second point is one of considerable interest, for the formaldehyde molecule when first formed by this photochemical method is not in the same condition as the ordinary formaldehyde molecule and contains far more than the normal amount of energy. This highly reactive formaldehyde does not, as is usually the case, lose its excess of energy and change into the ordinary form, but instantaneously undergoes chemical reaction. If no substance is present to combine with this active formaldehyde, it polymerises at once into sugars which are hexoses and have the general formula $C_6H_{12}O_6$. These sugars are perfectly definite entities for we have succeeded in preparing their pentamethyl derivatives. Mr. White says we have made a syrup which may be a sugar but in saying this he understates what we have done. Our syrup certainly contains sugars which have been definitely established to be hexoses, and therefore we know far more about it than is suggested by the words "formose whose composition is unknown." We have even more information than this for we have found some evidence that the synthesis goes beyond the simple sugar stage and that more complex bodies are formed of the nature of polysaccharides. Since this is actually the case in the living leaf it is by no means extraordinary that we should find the same process in our experiments.

Mr. White seems also to be unaware of what we have done on the nitrogen side of the problem. It is known that plants absorb nitrates from the soil, and that as a result nitrates or nitrites are present in the leaf. It has further been found that when the leaves are kept in the dark the nitrates or nitrites are equally distributed throughout the leaf, but that these salts disappear if the leaves are exposed to light when chlorophyll is present. In an etiolated leaf where chlorophyll is absent these salts are unaffected by light. We have found that, whereas freshly synthesised formaldehyde in the absence of salts polymerises to give sugars, if a nitrate or nitrite is present the formaldehyde preferentially combines with it to give formhydroxamic acid, and that this acid then combines with more of the active formaldehyde to give more complex compounds which I will deal with later. Further, when the formaldehyde is produced at a greater rate than can be utilised by the nitrate or nitrite and the first synthetic product, formhydroxamic acid, the excess polymerises to form sugars.

These observations seem to be of some importance for three reasons. In the first place, they explain the disappearance of the nitrate or nitrite from chlorophyll-bearing leaves in sunlight. In the second place, they prove that many of the nitrogen compounds present in plants can be directly synthesised from carbon dioxide, water, and a nitrate or nitrite, since we ourselves have made many of these compounds in this way. In the third place they explain the simultaneous formation of sugars and nitrogen compounds in the living plant, for it is known that there is never present sufficient nitrite to react with all the active formaldehyde which is being produced by the aid of the chlorophyll.

To turn to the nitrogenous products themselves we have found that when freshly synthesised formaldehyde acts on a nitrite two classes of compounds are formed, namely, amino acids and nitrogen bases of the type of piperidine, pyridine, pyrrole, glyoxaline, etc. Many of these bases react with the amino acids to give the so-called substituted amino acids and in our experiments we have found evidence of as many as eight of these complex compounds, although we have not, as yet, been able to identify them. The condensation of the substituted amino acids to give a protein is but one stage further, and here again we have some evidence that bodies of greater complexity than the substituted amino acids can be synthesised in the laboratory by the action of light, starting from carbon dioxide, water, and a nitrite or nitrate.

Those nitrogen bases which do not condense with the amino acids combine with more formaldehyde to form complex bodies of alkaloidal nature, and I am inclined to believe that the alkaloids are produced from those bases which have not the power of condensing with the amino acids. They form the final end products of the bases which are rejected in the direct protein synthesis.

The question may well be asked as to how we can explain the great variety of alkaloids found in the vegetable kingdom and the constancy in quantity and nature of the alkaloids in a given plant. We have found that the course of the photosynthesis of nitrogen compounds is dependent to a remarkable degree on the conditions. The amino acid synthesis is apparently not altered but the nature of the bases and the alkaloids produced seems to vary very decidedly with the alkalinity of the solution, and thus it may be suggested that each type of alkaloid-bearing plant has a constant alkalinity of its own in its chloroplasts or photosynthetic cells.

Mr. White appears to find an element of insecurity in our experiments on the action of active formaldehyde on ammonia, in view of Stas' observation that it is very difficult to free ammonia from complex organic bases. I hasten to bring comfort to him in his anxiety, for we were fully aware of this well-known fact, and I give him my assurance that the most rigid tests failed to indicate the presence of any such base in the ammonia we used. After the ammonia had been saturated with carbon dioxide in the dark, again no trace of any complex base was found, but after this solution had been exposed to ultra-violet light the presence of complex bases was readily detected.

There are several other points of great interest in Mr. White's letter, and to one of his questions I hesitate very much to reply, namely, whether the chemicals make the plant or the plant makes the chemicals. One's views on this seem to me, after some discussion with my friends, to depend on how one was brought up. A morphological botanist inclines to the latter view, but I wonder whether he is right. Photosynthesis seems to be common to very many of the lowest forms of life and radiant energy must be accepted as the oldest fact of this world of ours. For my own part, rightly or wrongly, I hold the view that photosynthesis is the real driving force behind all life and that the plant is the living mechanism developed from photosynthetic beginnings. In short, I venture to believe that the chemicals make the plant. It is perfectly true that each plant has certain inherited characteristics, by which the production of certain groups of compounds is determined. I have already written of the profound influence that a variation in alkalinity has on the course of the photosynthesis. Might not a similar simple cause influence the other processes of the plant to which so much of what Mr. White writes is due? Speaking as a very humble philosopher I do not think that these differences between different plants need influence our views on the main question.

Now, Sir, this is a very long letter, but I have been led into it by Mr. White's desire for information. I have done my best to be as lucid as the subject allows me, and I trust, too, with all my heart that I am as modest as Dr. Benjamin Franklin could have wished when I say that we claim to have achieved little beyond a simplification. The production of active formaldehyde, sugars, starches, celluloses, amino acids, proteins, and alkaloids is merely a question of energy. When the right amount of energy is given to carbonic acid it is converted into active formaldehyde and oxygen, the latter being transpired into the air again. The former, in the presence of small quantities of a nitrite, reacts to give all the above compounds, every stage of the synthesis being accompanied by a loss of energy. Each separate series of reactions is one of most attractive simplicity, there being no need for the use of the condensing agents which are the tools of the organic chemist when he is synthesising his more complex compounds. The function of these tools is to supply the energy necessary to activate his reactant molecules, and since the whole of the energy in the case of the plant is gained from sunlight in the very first step, namely, the formation of the active formaldehyde from the carbonic acid by the agency of the chlorophyll, the need of agents to supply energy at any later stage vanishes. Although these results in themselves may mark an advance it is the simplicity of the whole that seems to be so important, for it leads one to believe that the vital processes of the higher animals are equally simple and so, perhaps, it may be that the chemistry of their derangement or disease is simple, too.

ON THE NEW ELEMENT HAFNIUM

BY DR. D. COSTER AND DR. G. HEVESY

While the great majority of the elements exhibit conspicuous differences in their chemical behaviour we find as we proceed from hydrogen to uranium, that we suddenly meet a group of chemically closely related elements, the so-called rare earth group, the members of which exhibit so close a resemblance in their chemical properties that their separation encounters great difficulties.

Why does the normal sequence of the elements in the natural system get interrupted through the sudden appearance of the rare earth group? This question could be first answered by the quantum theory of the atomic structure proposed by Bohr. Starting from Rutherford's nucleus atom and the so-called quantum theory of radiation, he has shown that what we call the atom's chemical properties are determined by the number and the arrangement of the electrons of the atom and chiefly by the number and arrangement in the outermost group of electrons. When proceeding from hydrogen to uranium in general we meet appreciable differences in the outermost group of electrons of two neighbour elements, hence the marked difference in the chemical behaviour of these elements. It has been shown, furthermore, by Bohr that we have to encounter at a certain place in the periodic table a group of elements, the members of which only show differences in the constitution of the deeper lying electron groups of their atoms. To such differences in the inner groups correspond only small differences in the chemical behaviour, hence the great similarity in chemical behaviour of the elements within the group of the rare earth elements.

According to Bohr's theory this successive change in the inner groups of electrons happens in the interval between lanthanum (57) and lutetium (71). The element of atomic number 72 however, should, according to the theory, already show in the constitution of the outermost electron group of its atoms differences from the foregoing one—*i.e.*, the element 72 should exhibit properties entirely different from those of the rare earth elements and be a proper analogue of zirconium.

In 1911 Urbain detected the presence of several unknown spectral lines in a preparation of rare earth elements, and, based on this evidence, and on certain measurements of the magnetic properties of his preparation, he announced the discovery of a new rare earth element, celtium. About half a year ago, by investigating Urbain's preparation, using Moseley's method of X-ray spectroscopy, Dauvillier found two exceedingly faint lines in the region where the characteristic X-ray lines of the element 72 should be expected, and announced on the basis of this measurement that celtium is identical with the missing element of the ordinal number 72. This announcement could not be reconciled with Bohr's theory. To settle this point of utmost interest for the theory we tried to find an element which is a proper analogue of zirconium and has the number 72. By investigating zirconium minerals with the aid of Moseley's method we ascertained the presence of a new element in appreciable amount, ranging from 2 to 20 per cent. in all minerals investigated, including specimens from Norway, Greenland, Italy, France, Russia, Ceylon, Brazil and North Carolina. Also in all commercial "pure" zirconium preparations the presence of at least 1 per cent. of the new element could be revealed. The determination of the exact wave length of eight characteristic X-ray lines gave the conclusive evidence that the new element has the atomic number 72. By using suitable methods to separate zirconium from thorium and titanium we succeeding in isolating the new element called hafnium (Hafnia=Copenhagen) from zirconium. Hafnium could easily be separated from the rare earth elements, and apart from this the determination of the optical spectrum of hafnium, which has been found entirely different from the optical spectrum found by Urbain for celtium, this affords conclusive evidence that hafnium is entirely different from celtium.

The chemical properties of hafnium lie closer to zirconium than to their other neighbour in the fourth vertical column of the periodic table, thorium. The high melting point, high power of light emission of the oxide, and the electron emission of the heated metal, exhibited by zirconium, are also shown by hafnium and the corresponding hafnium compounds. How far the latter have properties which, from the industrial point of view, are more advantageous than those of the corresponding zirconium compounds further investigations will reveal. Hafnium is abundant enough to be used for industrial purposes; it is found fairly concentrated in common zirconia and other zirconium minerals. For comparison the abundance of the elements of the silicon-thorium group in the earth's crust as estimated by Clark and Joly are given in the following table:—

Silicon	27·7	per cent. of the earth's crust
Titanium	0·46	,, ,, ,, ,, ,, ,,
Zirconium	0·017	,, ,, ,, ,, ,, ,,
Hafnium	>0·002	,, ,, ,, ,, ,, ,,
Thorium	0·002	,, ,, ,, ,, ,, ,,

THE PROGRESS OF THE BRITISH CHEMICAL INDUSTRY SINCE 1914

By H. LEVINSTEIN, M.Sc., Ph.D.

On July 17, 1919, I addressed a Conference on Dyestuffs, Synthetic Drugs and associated products at the Annual General Meeting of the Society of Chemical Industry.

On that occasion I stated the reasons which rendered the dyestuffs industry vital to the nation in peace as in war. None of the arguments used has been refuted since, but on the contrary they have been confirmed by subsequent events, for in 1921 the Dyestuffs (Import Regulation) Act was passed.

Similar considerations apply to the fine chemical industry, and this has been recognised by the passing into law of the Safeguarding of Industries Act. At the last General Election an attack on this Act was made by many who disliked it, only because they considered it to be the thin end of the wedge of Protection, and it is clear that at the present session it is again to be made an object of Parliamentary attack. Recently a referendum taken by the Manchester Chamber of Commerce showed a considerable body of opinion favourable to a repeal of these measures. It was shown, however, that few people question the necessity of maintaining the Dyestuffs Industry. The country in general holds the objects desired as essential to security.

During the last week or so two important statements have been issued by the Association of British Chemical Manufacturers—" The British Dyestuffs Industry " and " The Safeguarding of Industries Act and the Fine Chemical Industry." These publications give particulars of the growth of the industries. They deal very clearly and concisely with part of the ground which I am asked to cover. The pamphlets issued render my task easier and I am not going to give you a complete review of what has been done.

Heavy Chemicals

In the heavy chemical industry by far the most important development is the building of a synthetic-ammonia plant at Billingham by Messrs. Brunner, Mond & Co., Ltd. In the course of the war the Badische Co. built a very large Bosch-Haber plant at Merseburg, which is situated in the Stassfurt area. Salt, ammonia, carbon dioxide and lime are the important raw materials required for the ammonia-soda process. Ammonia is the most important of these. Carbon dioxide comes second. As carbon dioxide is a by-product obtained in the Haber ammonia synthesis you can see that a Haber ammonia plant erected on a brine field offers a great advantage in the manufacture of ammonia soda. The erection of a synthetic-nitrogen plant at Merseburg was therefore a threatening gesture to the British alkali industry. It is fortunate that Messrs. Brunner, Mond and Co., the most powerful British chemical company, have themselves undertaken to counter it.

The Billingham factory is to have a plant for the manufacture of 100 tons of 100 per cent. ammonia per day with provision for a rapid extension to 300 tons per day equal to 150,000 tons, rising to 450,000 tons of sulphate per annum. These figures compare with 250,000 tons of 100 per cent. ammonia, the annual production of Oppau. Merseburg has, I believe, double the production of Oppau.

The Billingham factory is well on the way to completion and the process is expected to be in full commercial operation during the current year. In conjunction with a contact nitric-acid plant the factory goes far to diminish our dependence on Chile saltpetre.

The importance of this in war time is clear. Germany must have collapsed after the Marne but for Oppau. We could not have carried on if the German blockade had cut off our Chile saltpetre. At Billingham is being created a new industry employing a large number of men to manufacture an indispensable product used in large quantities hitherto imported. It is the best kind of new industry. It enables us to become exporter of a bulk product of which we were formerly importers. We have 50 million people to feed and supply with raw materials. New industries which enable us to export additional quantities are essential.

The real significance of this development lies deeper. The country is impoverished by war. How can you seek more wisely to regain your lost wealth than by seeking to increase the fertility of our soil? What shorter road to wealth can chemists show than the way to compel the air and the earth to greater service in food production? In this sense the Haber process is one of the greatest achievements of practical science. Hitherto the winds directed the nitrogen uncontrolled over our surface. We wanted it, but knew no practical way to use it. Cyanamide and the Birkeland-Eyde process were impracticable for us. We had to use the nitrogen stored up Heaven knows how many years before in our coal or in saltpetre.

I look forward to what appears the natural corollary to this invention. Just as Chile nitrate beds or the guano deposits of the South Seas produce nitrogen fixed ages ago, so our coal fields and petroleum deposits give us cellulose degraded before our civilisation began.

Why should we wait for nature to carry out a change so clearly within the range of modern chemistry? The industries over whose development we are struggling all use coal tar as their raw material. What a way to make benzene from cellulose! It appears to me not inconceivable that we are on the verge of discovering a method of obtaining liquid fuels directly from cellulose. Sir John Russell has told us that by a simple fermentation 6–7 cubic feet of methane and hydrogen can be obtained from a ton of straw. I hope some day that we shall be able to make our liquid fuels by methods which will find employment for our synthetic industries and eliminate the lag of countless ages. There is at least to-day a glimpse of such a possibility.

Just as the Badische Anilin und Soda Fabrik impinged by its Merseburg factory on the alkali territory, so did an alkali firm, the Greisheim Elektron Co., the pioneers of electrolytic alkali and bleach, many years ago first impinge upon the dyestuffs industry to find an outlet for its liquid chlorine. The United Alkali Co. has followed a similar course and has developed an organic manufacturing branch which can feed the dyestuff and allied trades. Some twenty years ago this firm, already making benzol, commenced the manufacture of monochloro- and dinitrochlorobenzols.

During the war their dinitrophenol production was increased to 100 tons weekly. Pure ortho- and paranitrochlorobenzols were added and from the latter paranitrophenol was made. Benzyl chloride and benzoic acid have been made by the United Alkali Co. for three or four years, also acetic anhydride.

Other useful chemicals for colour makers, for instance, antimony pentachloride, anhydrous aluminium chloride, sulphuryl and thionyl chloride are also made.

The more recent additions to this company's range of intermediates include phosgene (carbonyl chloride) ortho- and parchloroaniline, dichloroaniline and its sulphonic acid, parachlorophenol and paranitro-orthoamidophenol. Many of these chemicals had to be made by my firm during the war and very troublesome some of them were.

When the manufacture of sulphur black commenced I think all the dyestuff makers obtained their dinitrochlorobenzene from Greisheim. Dinitrophenol itself was very quickly abandoned on account of its toxic character. Some of the larger German firms having chlorine plants subsequently made their own, but until the United Alkali Co. commenced the manufacture British industry at least continued to draw its supplies from Greisheim. Subsequently, Castner-Kellners made monochlorobenzene and this plant, too, was greatly developed during the war and proved of signal value to the dyestuffs industry.

One of the great advantages of the dyestuffs industry is that it acts as an outlet for chlorine and we may reasonably expect it will afford a still further outlet for the excellent chlorine products now made by Castner Kellner and the United Alkali Co. Phosgene was a particularly important substance during the war; it is now particularly important for the dyestuffs industry where the consumption is of course only a fraction of war-time requirements.

Apart from the above it appears to me that the most important developments in the heavy chemical industry have been the great increase in the manufacture of oleum and of liquid chlorine and the recent introduction of the elegant synthetical process for the production of hydrochloric acid.

Organic Chemicals

Acetyl cellulose.—With great deference to the Official Referee I propose to call this substance an organic chemical and not a heavy chemical.

The large works at Spondon manufacturing this substance are important and interesting for several reasons. In the first place they have a large carbide and synthetic acetic acid plant, now, unfortunately, not in operation. This new industry has attained large proportions in Canada. Clearly the manufacture of substances such as acetone, acetic acid and acetaldehyde from coal and lime marks a great technical advance important particularly to those countries where wood is scarce. It appears to me that the manufacture of carbide, acetylene and its derivatives are just the industries which we wanted, and which Providence intended us to have, when it permitted our forefathers to destroy our forests.

The synthetic manufacture of acetic acid has affected the price of methyl alcohol. A synthetic process for the manufacture of methyl alcohol would be invaluable to this country.

Secondly, acetyl cellulose is one of the war industries which appear likely to be important in peace. It links up the chemical industry with the cotton trade and should provide us in the future with a valuable industry.

Everybody knows the great increase that has taken place in viscose production necessitating considerable quantities of carbon bisulphide and caustic soda. The manufacture of viscose is a world industry and it is a British industry discovered, worked out and developed technically and commercially by British brains and British capital.

Photographic Chemicals

This industry prior to the war was in the hands of Germany, whose products had attained a great hold in all countries. During the war several firms took part in supplying the deficiency, especially Johnson & Sons and Claus and Co.

Four of the most important developers used in photography are :—

Metol (monomethylparamidophenol sulphate).
Amidol (diamidophenolhydrochloride).
Hydroquinone.
Paramidophenol hydrochloride.

Before the war none of these developers was manufactured in this country; the business was almost entirely in the hands of German agents, who were selling these developers under their German names.

In 1915 there was an urgent demand for metol from the War Office for the hospitals, because it gave the best results in X-ray work.

The manufacture of metol was not easy and it was some time before metol was produced in this country, and for a time what stocks there were had to be most carefully conserved for the use of the Government Departments.

In 1916 photographic aerial observation was realised to be of very great military importance and consequently there was an urgent need for metol and amidol for the development of the thousands of photographs which were taken by the airmen observers.

Fortunately by the time this aerial photographic observation had reached large proportions, metol was being made in this country, and though the Government demands were ever increasing, the British production was successfully increased to meet it.

British-made metol, amidol and other developers were supplied, not only to the War Office and other Government Departments, but to the Belgian Army, Italian Army, and when America came into the war large supplies were available for the American Air Force.

A good day's work for a photographic aerial observer produced 5000 negatives, from which 150,000 photographic prints would be made within 24 hours. On occasions photographs of positions 5 miles behind the enemy lines were taken by British airmen and finished photographs sent to Headquarters within half-an-hour.

The position at the present time is that British manufacturers are in a position to supply enough metol, amidol, paramidophenol, etc., to meet all the home requirements and to have a large surplus production for Colonial and export markets. The prices at which amidol and metol are now being sold in England are equal or below those at which the same developers were sold in the English market by the Germans before the war.

As a matter of fact, the German agents are doing their utmost to close down English production of these developers by selling them at prices which in some instances are 40 per cent. to 50 per cent. lower than their own pre-war prices. This they are able to do on account of the exchange and because the 33⅓ per cent. import duty is quite insufficient to adjust the German price.

The quality of the English developers has been pronounced on all sides by photographic users and by chemical analyses to be equal, if not superior, to the German productions.

Finer Chemicals for Research, Essences, Perfumery, Medicine and Industry

We have in this country many old-established firms who possessed international reputations before the war for some of their products—drugs, essences, perfumes, research and some industrial finer chemicals. To take but one instance, Howards were famous for quinine preparations before any one of us here was born. But the German firms controlled the markets and fixed the prices. No English firm made a range of research chemicals like Kahlbaum; bacteriological stains were Grubler's undisputed territory; photographic chemicals, like fur dyes, were the specialty of A.G.F.A. Synthetic perfumes were almost entirely foreign; there was no English Merck, no de Haen, no Schuchardt. Why not? Because in most cases the turnover of the English firms did not permit much research. The war created a demand. War restrictions made it difficult or impossible to meet the demands for products not directly required for war purposes. After the war, owing to prohibition, followed by the S.O.I. Act, many old-established firms enlarged their laboratories and with great boldness and skill put on the market a large range of these finer chemicals of unimpeachable quality.

In the statement on the fine chemical industry issued by the A.B.C.M. we are told that 2½ tons of this type of substance is now made for every ton made in 1913, and that double the number of hands are employed in their manufacture.

Mr. Carr tells me that the British Drug Houses alone have a list of over 3000 research chemicals.

A notable example of the effect of the S.O.I. Act is afforded by Messrs. Albright & Wilson. This firm has been a famous manufacturer of phosphorus and phosphorus derivatives certainly for longer than I can remember. The beautiful range of products manufactured by them and recently exhibited is a delight to any industrial chemist.

Their ammonium persulphate is far purer than the Continental product. The crystals are of 99·5 per cent. to 99·9 per cent. purity. They are stable in air and can even be packed in ordinary paper bags without losing strength. As everybody who has handled this product knows this was not so before the war as regards the German product. Surely this is important. Once specialists in phosphorus and its derivatives, they have been induced by the S.O.I. Act to take up the manufacture of other chemicals formerly only made abroad. Without this Act they would not have enlarged their research department, which has produced such admirable results and added to the prestige of British chemical industry.

Thorium Nitrate

The manufacture of thorium nitrate in this country, bringing along with it as a by-product mesothorium, is of importance because formerly monazite sand was controlled by Germany, and consequently the manufacture of thorium nitrate and of gas mantles became German territory. It is therefore important that Messrs. Hopkin & Williams possess a factory at Travancore where monazite sand is concentrated and that thorium nitrate is now a British product. These facts have become so well known owing to the recent litigation that I will not dwell upon them. It is well to bear in mind that titanium and zircon oxides can also be obtained from monazite sand and should if they have not already done so find application in the arts.

We had some contact quite early in the war with Messrs. W. J. Bush & Co., who now make so complete a range of products for perfumery, essences, drugs and other chemicals. I think they were the first makers of salicylic acid in this country; certainly it was possible to obtain salicylic acid, aceto-acetic-ester and other very useful products comparatively early in the war from this firm, all of which were of service to the dyestuffs industry.

Messrs. Burroughs Wellcome, whose pre-war research work stood out as a solitary but brilliant beacon on the coast, took over the salvarsan plant from Ellesmere Port when we acquired the indigo factory, and they quickly produced their now well-known kharsivan and neokharsivan of a purity not less than that of the Germans. These products are "difficile" to make and very toxic if impure. Their quick production was a fine and valuable work.

Messrs. Boots' work on saccharin was notable and to us particularly interesting, for the by-product paratoluol sulpho-chloride was of great use to us.

Chloramine T is another Boots' product which proved a notable success.

Aspirin was quickly made. The dyestuffs industry took some part in this and the quick improvisation of anæsthetics, novocaine and acriflavine, followed by proflavine and now euflavine.

Kerfoots also manufactured novocaine quite early in the war, the chief difficulty being the manufacture of ethylenechlorhydrin so largely used by the Badische both for the manufacture of indigo and mustard gas and not previously made here.

These early fruits just have their interest because they were so soon produced to meet urgent war necessities.

Of new industries which have arisen not covered in the above headings one should mention the manufacture of erinoid, a casein preparation, and the working of the German patents for the manufacture of synthetic tannins and for electro-osmosis. In the main, in my opinion, the chief developments of tanning by synthetic products remain to come; electro-osmosis has not fulfilled, as far as I can judge, the sanguine hopes that German literature might have encouraged. The separation of china clay into its finest particles by this method is not without importance, while the recent use of this fine china clay as a specific against cholera and dysentery is interesting.

Research Chemicals and Price

Twelve months ago a comparison with Kahlbaum's price list showed that on the average British products were only 29 per cent. dearer than the German pre-war prices for research chemicals, and we know that since that date British prices have been reduced. I have compared the prices of quite a number of research chemicals taken haphazardly from the British Drug Houses list and Kahlbaum's pre-war list, and on the whole Kahlbaum's seems to be dearer. Of course, to-day the Germans could use the exchange to undercut any British manufacturer for any chemical product, but that is hardly a circumstance that the Universities should trouble over. If they can get an assured supply of English chemicals of equal purity from British sources at Kahlbaum's pre-war price or thereabouts, they are in fact getting far better value than Kahlbaum ever gave them before the war, or would give to-day if the home supplies failed.

General Conclusions

You will observe that the developments in the fine chemical industry have mainly been carried out by old established firms who had world reputations prior to the war for some of their products. No real progress has been made by new comers without knowledge or experience. These old-established fine chemical firms had nucleus staffs and accumulated knowledge from which alone the developments could spring.

I should be very glad if those who are responsible for the formation of public opinion in connexion with the Acts we have already discussed would bear this in mind. You cannot create this kind of industry unless you have core, and this takes years to build; that we have always had. But the conditions were unfavourable as regards finance. Their turnover was restricted and the amounts that could be spent on research were consequently limited and the developments proportionately slow. Once the inhibiting factors were removed developments were extremely rapid, but in each case the firms had long experience. They had shown themselves capable of existence under trying conditions. These firms have increased their facilities for research, and within the next few years, with reasonable security, they should make important contributions to the nation's wealth.

The fact that we had these old and well-known firms placed us in a good jumping-off position. Now we have larger firms with more research laboratories, where new inventions may spring so that we may not always have to follow, but sometimes lead the world in the creation, abroad and at home, of demands for fresh products discovered by British chemists, made in British factories and marketed by British salesmen.

(*To be continued*)

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

Quite a Lot

of interest seems to be taken in the scientific exhibit in the Chemical Section at the Empire Exhibition next year. Although, especially in organic chemistry, the total output of research has been greater in Germany than in this country, if we consider the discoveries of really first-rate importance, this country has turned out at least its fair share. And now even in organic chemistry the amount of high-class research here is very gratifying. If the scientific exhibit is intended—as I believe it is—to show that British chemistry of the scientific variety is good enough for all the demands of the industry, then there is a very interesting story to tell. In particular in the modern work on radio-active bodies, the structure of the atom and similar subjects we make an uncommonly good showing, and Aston, the Braggs, Rutherford, Soddy and Thomson, to mention only six pioneers, make a team which is unique. I have put their names in alphabetical order to avoid displaying my ignorance of the relative degrees of their importance, besides which, when you have both a father and son to consider, the thing gets a little delicate.

Poetical Quotations

seem to appear in our *Journal* in all kinds of places, and I was calling the attention of an Oxford friend to these the other day and found some of them came from the works of our Poet Laureate, Dr. Bridges, who is himself—or at any rate once was—a chemist, and learned his chemistry from Odling and Matthieson. By the way, the death of Matthieson was not correctly given by Sir William Tilden in his pleasant recollections of his early youth. Matthieson died in 1870. I wish some of our senior chemical folk would give us some more recollections. A chatty account of Sir Charles Tennant, Dr. Mond, and other founders of the industry would be of interest to quite a number of us. What a change there is if we compare the chemical industry of to-day with what it was fifty years ago!

Advertisements

have always interested me, and I read them, or look at them, in several journals. I see there is to be a Professor of Chemical Engineering at University College, and wonder that more prominence is not given to such an announcement. I could furnish a number of instances which seem to show that our advertisers do not yet realise the varied interests of our many readers, who now include a goodly number of the pure and academic professors. Our readers not only read chemistry but all kinds of other books, some of the frivolous ones read novels, and even poetry. Professor Baly confesses to a love for Latin hexameters. If I were an editor I should organise a prize competition for the article which gave the best indication of the kinds of advertisements which will add most to the usefulness and interest of the *Journal*. I am not at all sure our advertisers have read our recent numbers with this aspect in their minds. If the firms who advertise in our *Journal* do not also read it, they not only fail to keep abreast of modern progress, but they miss the ingenious comments which I submit each week. They say that he who runs may read, but I often have to do my writing in this way. I wish someone would tell me what persulphate of ammonia is used for; I suppose I ought to know. I give my lawn a dressing of sulphate of ammonia every summer, but have not experimented with the *per* variety. At any rate, at Manchester the other week, Dr. Levinstein told us that we now make ammonium persulphate so much better than the Germans that it can be packed in paper bags. What the advantage of this is I don't quite know, but there it is.

The Editor Complains

that important communications reach him on Wednesdays just too late for insertion in that week's issue. I am an older hand at journalism than he is, and have got used to that sort of trouble. After all, a few days doesn't matter very much, and I have reached a period of life when I can view other people's troubles with considerable equanimity. All the same, it may be worth while to remind our readers that our *Journal* appears in two forms, and the printing of these cannot be done simultaneously, and the greater the number of *Journals* printed, the longer it takes to print and to dry and to bind and to post them. So if any writer is anxious to have his announcement appear at an early date, let him send it in at an early date. The day that any journal goes to press is a busy day for the editor, and he is generally in a bad temper. I do not know whether this is true of *Chemistry and Industry's* editor, for I always keep clear of him on Wednesdays. It is the only principle I rigidly adhere to. This is the busiest time of the year for a scientific journal; our own sections and those of other Societies are all hard at it and this is a sort of harvest time, which will be followed in the summer by a slackness due to holidays. Our editorial staff can then look forward to a time when the members cease from troubling, and the sections are at rest.

FORTHCOMING EVENTS

Mar. 17. Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Atomic Projectiles," by Sir E. Rutherford.

Mar. 19. The Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. 1, at 7 p.m. "The Walschaert Locomotive Valve-Gear," by R. C. Bond.

Mar. 19. Institution of Rubber Industry, the Midland Hotel, Manchester. "Economic Side of the Industry from the Standpoint of the United States," by E. S. Babcox.

Mar. 19. The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, at 7 p.m. Discussion on "The Need for Co-operation between Electrical Manufacturers and Contractors" (opened by H. T. Young and a Manufacturer).

Mar. 19. Royal Society of Arts, John Street, Adelphi, W.C. 2, at 8 p.m. (Cantor Lecture) "Accurate Length Measurement," by J. E. Sears, Junr. (Lecture 3).

Mar. 20. Royal Photographic Society of Great Britain, 35, Russell Square, W.C. 1, at 7 p.m. "The Preparation of Metol and its Homologues," by W. F. A. Ermen, M.A.

Mar. 21. Royal Society of Arts, at 8 p.m. "Some Curious Phenomena of Vision and their Practical Importance," by F. W. Edridge-Green, M.D.

Mar. 21. Society of Glass Technologists. Meeting in Birmingham.

Mar. 22. The Society of Dyers and Colourists, *Manchester Section*, 36, George Street, Manchester, at 7 p.m. "The Regularity of Yarns," by Dr. A. E. Oxley, M.A.

Mar. 23. Society of Chemical Industry, *Glasgow Section*, the N.B. Station Hotel, Glasgow, at 7.30 p.m. Annual Business Meeting.

Mar. 23. Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 9 p.m. "Life History of an Alpha Particle from Radium," by Sir E. Rutherford.

Mar. 24. Royal Institution of Great Britain, at 3 p.m. "Atomic Projectiles," by Sir E. Rutherford.

Apr. 4. Society of Public Analysts, Chemical Society's Rooms, Burlington House, W. 1, at 8 p.m. (1) "Physiological Standardisation," by Dr. Stanley White. (2) "An Investigation into the Chemistry of the Reinsch Test for Arsenic and Antimony, and its Extension to Bismuth," by B. S. Evans, B.Sc. (3) "The Estimation of Boric Acid in 'Liquid Eggs' and other Foodstuffs," by G. W. Monier-Williams, Ph.D.

Apr. 6. Society of Chemical Industry, *Manchester Section*, the Textile Institute, 16, St. Mary's Parsonage, Manchester, at 7 p.m. Annual General Meeting. "Activated-Sludge Process of Sewage Purification—Nitrogen Recovery," by Messrs. E. Ardern, P. Gaunt, and C. Jepson.

SOCIETY OF CHEMICAL INDUSTRY

ANNUAL GENERAL MEETING, 1923

The Annual General Meeting will be held on Thursday, June 21, at 11 a.m., and will be preceded by a meeting of the Council at 10 a.m. At the former, members will be welcomed to Cambridge by the Vice-Chancellor of the University, and the President of the Society, Dr. E. F. Armstrong, F.R.S., will deliver his address. In the evening there will be a reception and dance, also a lecture on Cambridge and its Colleges by Dr. Cranage.

On the Monday, Tuesday and Wednesday of the same week, the International Union of Pure and Applied Chemistry meets in Cambridge and the President of the Union extends a welcome to members of the Society to attend any of the public meetings of that body.

On Friday, June 22, the Society's Medal (1923) will be presented to Dr. C. C. Carpenter, who will then give an address. On the afternoon of the same day there will be an address by Dr. F. W. Aston, F.R.S., on "Isotopes," and in the evening the Annual Dinner of the Society, which ladies may attend, will be held. It is hoped that a large number of Cambridge guests will be present.

On Saturday there will be a visit to Ely.

At this Annual Meeting there will be no official Luncheon, but members and ladies may lunch in various College Halls. Arrangements will be made for parties to visit the various Colleges and Laboratories and a *rendez-vous* will be arranged, probably in one of the College gardens, where members may meet each other and where tea will be served in the afternoons. It is thought better to allow members to make up parties and plan their own excursions rather than that a pre-arranged programme should be provided for them. Information regarding hotels, etc., will be supplied later.

All communications should be addressed to the General Secretary at the offices of the Society in London until further notice.

NEWS FROM THE SECTIONS

BRISTOL SECTION

The annual meeting was held on March 1, Mr. M. W. Jones presiding, and Dr. H. Rixon read a paper on "Research."

The history of science reveals the fact that, unless research be undertaken with pure motives, it never attains a high level; work undertaken with a view to material advantage of any description is liable to stultify itself and represents, in the final balance, a very considerable energy loss. The investigator must be an altruist and he must publish his work, but publication should not be confused with advertisement. A much wider scope for publication is desirable. The censoring of publications, due in a measure to limited space, is not always an advantage, and a journal for the publication of negative experimental work would possibly save an enormous amount of time and be very valuable.

Research must be considered from the points of view of (*a*) the worker and his effect on research, and (*b*) research in its effect on the worker.

The second point is an educational question, as many students are unfitted to undertake research, and will never add anything new to the total of knowledge; but though they may contribute nothing to research, research may contribute very largely to their training in a manner that no other type of work can. The man who is to make any adequate addition to knowledge must possess insatiable curiosity, persistent energy, willingness to undertake and carry out the most arduous, dangerous, laborious or tedious work, and whilst capable of abstract and logical thought he must also be capable of imaginative flights. Physically he should be "tough," he should have no anxieties arising from income or domestic problems, and not too large a salary, but this should not depend upon the amount of work he turns out. Such a man will ultimately, in the course of his work, have to decide whether he prefers to work alone or with collaborators. The former method—typically English—results in small bulk of work with high quality; the latter—typically German—in greater quantity with a lower general quality. Different problems call for different methods, so that no comparison of the two methods is needed. Research must not be undertaken for gain, as a life devoted to the discovery of truth results in a certain limited fame and a modest competence; but the chief satisfaction should be in knowing that work has been well and truly done and the sum total of human knowledge increased.

SOUTH WALES SECTION

The first Annual Meeting of this Section was held in Cardiff on March 2, Prof. C. M. Thompson being in the chair. After the usual formal business the following officers for 1923-24 were elected:—Chairman, Capt. Hugh Vivian; Vice-Chairman, W. R. Bird; Hon. Treasurer, H. W. Webb, M.Sc., F.I.C.; Hon. Secretary, H. E. Cox, M.Sc., Ph.D., F.I.C.; Hon. Assistant Secretary, J. R. Green, M.C., B.Sc. Committee: H. J. Bailey, O.B.E., F.I.C., F. J. Bloomer, F.I.C., J. E. Coates, O.B.E., D.Sc., W. J. Cooper, F.I.C., G. W. Clegg, J. H. Duncan, W. J. Jones, D.Sc., F.I.C., Geo. Madel, C. A. Seyler, B.Sc., F.I.C., C. M. Thompson, D.Sc., M.A., E. A. Tyler, M.A., F.I.C., and J. H. Wells.

On the motion of Mr. A. Grounds it was decided to levy the sum of 5s. from all members of the Section (not associates) to form a Special Purposes Fund to be used for hospitality and sundry private expenses. The Chairman then presented the Hon. Secretary (Dr. H. E. Cox) with a clock with the best wishes of the members of the Section on the occasion of his recent marriage to mark their appreciation of the work he had done in connexion with the formation of the Section. He then reviewed the work and progress of the Section during the session; papers have been read at eight meetings, five in Cardiff and three in Swansea, and two visits have been paid to works. The membership now stands at 95 plus 9 associates.

Prof. Thompson then gave an address on "The Rare Earths in Relation to Incandescent Lighting." The subject dates from Berzelius, who, in studying the rare earths, noticed that thoria and zirconia gave out a bright light when heated; other landmarks in the history of the subject were the introduction of limelight in 1826 by Drummond and the illumination of parts of the city of Paris in 1876 by cones of zirconia and magnesia. The earliest forms of mantles were introduced about the year 1880, and consisted of platinum cones impregnated with rare oxides. Then began the classic researches of Auer von Welsbach, which led to the development in 1883-1891 of the familiar incandescent gas-mantles.

The lecturer outlined the chemical discoveries and researches of Welsbach, dwelling at some length upon the curious fact that a concentration of 1 per cent. ceria in 99 per cent. thoria exhibits a maximum luminosity. The belated success of the mantle industry led to the further investigation of monazite, the principal source of the rare earths, and to the development of magnetic methods for its separation from worthless sands. The peculiar solubility relations of the sulphates and phosphates of these elements were explained and illustrated by experiments. In conclusion, reference was made to the unsolved problem of why these compounds, when heated, emit such a good light; the speaker thought it probably due to the abnormal distribution of energy in their spectra, a greater amount appearing as light than as heat.

Mr. W. R. Bird then proposed a vote of thanks to Prof. Thompson for his interesting discourse and for his services in the chair during the session.

EDINBURGH AND EAST OF SCOTLAND SECTION

The Annual Meeting was held in the Hall of the Pharmaceutical Society, Edinburgh, on March 6, Dr. H. E. Watt in the Chair.

The following officers were appointed for the year 1923-24:—Chairman, Dr. Alexander Lauder; Vice-Chairman, Dr. H. E. Watt; Hon. Sec. and Treasurer, Mr. W. T. H. Williamson, B.Sc. The four vacancies on the Committee were filled by the election of the following members:—Messrs. W. A. Williams, G. F. Merson, D. S. Dawson, and J. G. Annan. Dr. T. Rettie was re-appointed Auditor. The Secretary's report on the work of the session showed that the membership stood at 149 in addition to 14 Associates.

The Annual Meeting was followed by an ordinary meeting, Dr. H. E. Watt presiding, and Mr. J. Rutherford Hill, Ph.C., read a paper on "Some Interesting and Historical Museum Specimens."

Specimens shown included several alkaloids isolated by historic chemical workers in Edinburgh, and a monkey-skin container filled with aloes brought from the Island of Socotra by Prof. Sir Isaac Bayley Balfour on his famous expedition in 1876. The aloes yielded only about 5 per cent. of crystalline aloin although therapeutically quite active. Some of the original crystalline aloin was exhibited that was made by T. and H. Smith, by whom it was discovered in 1850. Follicles and seeds were shown of *Strophanthus hispidus* sent by Buchanan from the Nyassa Lake district of Central Africa in 1883, to Prof. T. R. Fraser, and with which the latter made his classical researches on the pharmacology of strophanthus and the active glucoside strophanthin. A ball of Indian opium of date 1835 was shown, which was identical with the opium of which 1,000,000 balls were run into the harbour at Canton by the Chinese commandant, thus leading to the Chinese Opium War of 1840, in which the British and French compelled the opening of Chinese ports to British and French commerce. A sample of absorbent cotton was exhibited that was made in Edinburgh in 1879 by boiling in a 6 per cent. solution of potassium hydroxide, washing, placing in a bath of dilute hydrochloric acid, again washing and drying. This sample was made two years previous to the publication of the practically identical process of Slocum in 1881, which was usually regarded as the first known process. An original specimen was shown of the Ordeal Bean or Chopping Nut of Old Calabar (*Physostigma venenosum*), given by Rev. H. M. Waddell, first Scottish Missionary at Old Calabar, in 1846, to Dr. John Brown, author of "Rab and His Friends," and brother of Prof. A. Crum Brown. Sir Robert Christison narrowly escaped death by swallowing 12 grains of the bean; on becoming sick he swallowed his warm, soapy shaving water which acted as a prompt emetic. The seeds were successfully germinated in the garden of the famous surgeon, Dr. Syme, and also by Prof. J. Hutton Balfour in the Royal Botanic Garden. By the latter the plant was first described and named *Physostigma venenosum.* Specimens were shown of the original amorphous alkaloid, physostigmine or eserine prepared by Hesse and the crystallised alkaloid and its sulphate and hydrobromide recently prepared by T. and H. Smith. Prof. Sir T. R. Fraser was Christison's assistant and selected the Calabar bean as the subject of a pharmacological research for his M.D. thesis for which he was awarded the gold medal. He was Professor of Materia Medica while Crum Brown was Professor of Chemistry in the University. Crum Brown was a friend of Waddell and interested in the Calabar bean. In this way the chemist and the pharmacologist came to work together in a joint investigation of the relationship between chemical constitution and physiological action. Thus originated an epoch-making report on several aklaloids by Fraser and Crum Brown to the Royal Society of Edinburgh in 1863. This marked the pioneer work on a line of investigation which largely explains the wide modern developments in the production of synthetic drugs. Specimens were also shown of cinchonidine sulphate, quinidine, and an unnamed cinchona alkaloid presented in 1856 to Sir Robert Christison by John Elliot Howard, the great pioneer in production of cinchona alkaloids. The specimens are labelled in the handwriting of Howard, and it is stated that they were prepared by the "new and improved process" of Pasteur published in 1853. There was shown an interesting specimen of large prismatic double-refracting crystals of sodium salicylate containing six molecules of water. These had separated from an aqueous solution containing one ounce in three fluid ounces which was normally quite stable, but probably owing to exposure to a low temperature had crystallised. The crystals rapidly effloresced when exposed to the air. Remarkably large tubular crystals of salicin were exhibited, some as large as 25 × 8 × 2 mm., accidentally obtained by spontaneous evaporation in a basin that had been overlooked in the factory of T. and H. Smith. Samples were exhibited of oil of wintergreen (*Gaultheria procumbens*) and natural salicylic acid and sodium salicylate made therefrom, also of oil of sweet birch (*Betula lenta*). Both oils are nearly pure methyl esters of salicyclic acids, and attention was drawn to the fact that the glucoside in the leaf of wintergreen and the glucoside in the bark of sweet birch in contact with the enzyme in each in presence of water produced methyl salicylate at ordinary atmosphere temperature and pressure, whereas synthetic methyl salicylate was only obtainable in the laboratory by drastic treatment: in making sodium salicylate from sodium phenate and carbon dioxide by Kolbe's process, a heat gradually rising from 100° C. to 200° C. and continued for six or eight hours was required. It was the problem of bio-chemistry to discover the methods by which vegetable organisms accomplish these syntheses.

An interesting discussion followed the reading of the papers.

The Nichols Medal of the American Chemical Society has been awarded to Mr. Thomas Midgley, junr., of the General Motors Corporation, for his work on "anti-knock" compounds for internal-combustion engines.

MANCHESTER SECTION

The meeting of the Section, held on March 2, was preceded by a joint luncheon of the Manchester and Liverpool Sections, which has already been described by "Eye-Witness" and by a visit to the Manchester Corporation Gas Works in Bradford Road, which was visited by a large number of members.

This Gas Works is one of four stations under the control of the Manchester Gas Committee. The plant consists essentially of two retort houses of horizontal retorts and two new houses of vertical retorts—one, the Glover-West system, by the West Gas Improvement Co., Ltd., of Manchester; the other, the Woodall-Duckham plant, built by the Woodall-Duckham Co. Steaming is practised, and the yield of liquor is approximately 30 gallons of 10 oz. liquor per ton of coal charged. The coal is broken to about 1–1½ in. cubes, before being passed to the storage hoppers by bucket conveyors. The storage bunkers for coal will hold about three months' supply.

The Station makes its own electricity during the day by dynamos driven by steam from a series of Stirling water-tube boilers, fitted with chain-grate automatic underfed stokers and firing coke breeze. The three systems mentioned above are working under identical conditions from the point of view of coal supply, coke handling and treatment of the by-products and coal gas. A comparison of the results obtained from each plant will, therefore, be possible, and will yield most valuable information as to the relative efficiencies of the separate systems. This information will be available to the Gas Committee when they commence the construction of a new "super" gas works at Partington.

In the evening Dr. Levinstein, the new Chairman of the Manchester Section, read a paper which will appear nearly in full in this issue and the next. Before the paper was read Mr. Guy Radcliffe gave an interesting retrospect of the activities of the Section during the last forty years. The First General Meeting of the Society was held in London on June 28th and 29th, 1881, Prof. H. E. Roscoe being the President. Papers were read by Messrs. E. K. Muspratt, C. Graham, J. Mactear, Siemens, and Ludwig Mond. The London Section and the Liverpool Section both came into existence in 1881. The First Annual Meeting of the Society was held in Manchester on the 5th, 6th and 7th July, 1882, and the Manchester Section was formed in January, 1883. The Newcastle Chemical Society became a Section in the early part of 1883. Mr. Radcliffe gave some useful particulars of the early officers of the Society, and some of the early papers read, and we wish that the space available enabled us to print his retrospect at length.

The earliest history of the formation of the Society has often been a subject of controversy and is full of interest to the members.

CHEMICAL ENGINEERING GROUP

A meeting was held on March 12, in the Smoking Room of the Chemical Industry Club, with Mr. J. A. Reavell in the chair, and Mr. B. Heastie, M.I.C.E., read a paper on "Heat Transmission in Coolers, Heaters and Condensers."

The object of the paper is, briefly, to review our present very incomplete knowledge of the laws governing heat transmission. Heat may flow in three ways; by conduction, convection and radiation. In tubular heaters and coolers in common use, heat flows mainly by conduction and convection. The law governing the flow of heat by conduction and convection may be compared with Ohm's law for the flow of electricity: the potential difference causing the current to flow against the resistances in an electric circuit may be likened to the differences of temperature in a heat circuit. Three resistances will be met in transferring heat from saturated steam to a liquid through a metal plate, viz., (1) the film of condensed steam on the face of the plate, (2) the metal plate, and (3) a stationary film of water on the face of the plate in contact with the water. The total temperature drop is due chiefly to the resistance of the two films, the drop across the metal plate often being negligible in practice. Heat can be transmitted through the relatively stationary film of liquid adhering to the plate (or other solid) by conduction only. Since most gases and liquids are very poor conductors of heat there is usually a very great resistance to heat-flow in the boundary surface of a liquid or gas and a solid, accompanied by a large drop in temperature at that point. Incrustations or deposits from the liquid or gas also increase the resistance to heat flow. The lecturer then went on to discuss formulæ for calculating the coefficient of heat transfer from vapour to a metal wall. It was stated that the calculation of wall resistance was usually neglected in practice unless the film resistances were very small, as in high-velocity heaters. Further formulæ for deducing the liquor-film coefficient were discussed, and in connexion with the flow of gases through tubes, illustrations were adduced to show the fallacy of using superheated steam for heating or evaporation. Discussing heat transfer between liquids, it was shown that the transmission coefficient is higher when working at a higher range of temperature, but with the same temperature difference, probably owing to the lower viscosity and higher conductivity with increase of temperature. With gases, however, the viscosity increases with increasing temperatures. After discussing the transfer of heat between air and metal, a subject on which few data are available, viscous and turbulent flow was considered, and it was indicated that the production of turbulent flow in economisers and other water heaters was advisable to reduce corrosion. In conclusion, various methods of heating were considered.

THE UNIVERSITY OF LIVERPOOL

NEW CHEMICAL LABORATORIES

On Saturday, March 3, the new Chemical Laboratories of the University of Liverpool were formally opened by Viscount Haldane of Cloan. The speeches at this function were delivered in St. George's Hall, before a large audience. Vice-Chancellor Adami presided, and on the platform were Lord Haldane, the Lord Mayor of Liverpool, the Bishop of Liverpool, the Mayors of Birkenhead and Bootle, Pro-Chancellor Rathbone, Sir Max Muspratt, and a good many of the University professors and members of the Council. Viscount Haldane, in declaring the new buildings open, delivered a really eloquent address.

He contrasted the older Universities, which were secluded in situation and in other respects from the great manufacturing centres, with the modern Universities, which originated as colleges in great industrial cities. He traced the history of the movement which led to the dissociation of the Victoria University and the creation of the University of Liverpool, followed very shortly by the creation of the Northern Universities, and explained how essential it was that these new Universities should continue in close co-operation with the municipal and industrial activities of our modern centres of population. In Liverpool, which adjoins a great area of chemical manufacture, it was inevitable that chemistry should be a prominent subject, and it was proper and fortunate that the chemical manufacturers had done so much to support an institution the discoveries of which were essential to their progress and prosperity. It seemed to him that out of the misfortunes of the war had come a new profusion of ideas, a new prescience of spiritual activity. This was in accordance with the conclusions of Renan, who pointed out in "L'Avenir de la Science" that the greatest advances in science and poetry, in art and spiritual development, came not when nations were prosperous, but when they were under great misfortunes.

Lord Haldane alluded to the evidence that mass and energy were but different forms of the same identity, and said we were face to face with a state of things in which chemical knowledge was going to be, as far as could be foreseen, the very foundation of industry. Great advances had been made in physics, chemistry and mathematics, and the principles of these would be applied to industry with tremendous and revolutionary results. In this development the new Universities had an important part to play. Liverpool had done much and was now doing more, and he was sure that the scope of its activities had not yet reached its limits.

On the conclusion of the address Mr. Thornely, of the firm of Messrs. Briggs and Thornely, the architects of the new buildings, presented to Lord Haldane a ceremonial key and the laboratories were visited by both hosts and guests. The buildings are light and airy, spacious and well supplied with the apparatus, power and devices which are necessary for modern analysis and research. Naturally they are as up-to-date as possible and include the most modern forms of equipment. Several of the speakers alluded to the important work that has already been carried out in the chemical department of Liverpool, and the new buildings will give Professors Baly and Heilbron and their colleagues those greater facilities for research of which they have been in need. The position of students who have no immediate certainty of posts in academic or industrial positions has not been forgotten, and Sir Max Muspratt announced that, in addition to the other gifts made by him and his firm, the United Alkali Company had offered to post-graduate students two scholarships for research work. It is to be hoped that other firms will follow this excellent example. Some help of this sort is particularly valuable at Liverpool, because its reputation has already attracted a considerable influx of students to the chemical department.

In the evening the University Association entertained a large gathering to dinner at the Midland Adelphi Hotel. Vice-Chancellor Adami took the chair, and in proposing the health of Viscount Haldane, mentioned the great services he had rendered to the University during the struggle to obtain the status of a University and to the nation in many other capacities. In his reply Lord Haldane gave a very pleasant set of recollections of his activities in the law, in politics, at the War Office and in the work of education, and explained the necessity which compelled him in these different spheres to limit his work to very few problems. At the War Office he concentrated on the organisation of the Expeditionary Force; in education he had only time for one problem—the future of our Universities and in particular the newer Universities, now in number and importance nearly adequate to the needs of the country. He called attention to the fact that the fees paid by the students did not nearly cover the cost of their education, and that about two-thirds of this was provided by taxes, rates and endowments. It was important that the Universities should realise that the Labour Party would urge that educational advantages so largely maintained by the State should be available for all classes of the community. The Universities should set up in industrial areas minor University centres, where that thorough teaching which was their tradition could be made accessible to all those who were capable of profiting by it. Prof. Baly, responding to the toast of the "New Chemical Laboratories," said it was vital to the prosperity and security of the Empire that we should progress in science and claimed, what is probably now universally admitted, that there were as good chemists in England as in any other country.

MEETINGS OF OTHER SOCIETIES

INSTITUTE OF CHEMISTRY

A meeting of the Bristol and S.W. Counties Section was held on February 16, Mr. E. Russell, B.Sc., presiding. Dr. David Hooper, late quinine expert to the Madras Government, gave an interesting lecture on "Cinchona and Quinine in India," or the "Romance of Peruvian Bark," illustrated by the history of the introduction of cinchona and the manufacture of quinine in British India. The characteristics of the red bark, crown bark, and hedgers yellow bark were enumerated, and the features given of the districts in the Nilgiri Hills and Sikkim where they are grown. Praise was bestowed on the pioneers who overcame the difficulties of cultivation and manufacture and brought the alkaloid quinine within the reach of the people of India. Reference was made to the methods of harvesting the bark and the numerous experiments made in manuring the trees in order to increase the amount of alkaloid in the bark. The process was described of manufacturing "febrifuge," a mixture of alkaloids, and also that of the manufacture of sulphate of quinine by the oil process, the product being just as good as that turned out by the British and Continental factories. Quinine was still acknowledged to be the most effective remedy for malarial fever, one of the greatest scourges of the East. The vital need of possessing within the Empire our own cinchona plantations was strikingly brought home to us during the war.

The Chairman opened a discussion on the paper, in which Messrs. Storey, Littler, Andrews, Wintle, Barke and Wallace took part.

At the meeting of the Leeds Area Section on March 7, Capt. J. A. Foster read a paper on "Chemical Jurisprudence," in which he observed that chemical jurisprudence or forensic chemistry signifies the application of chemistry and chemical knowledge to the elucidation of questions in a Court of Justice. Forensic chemistry therefore includes all those branches of chemistry which help to solve questions arising during judicial proceedings. The branches of legal procedure in which a knowledge of chemistry is required are many. These branches may be divided into: (I) The Police Court: (*a*) Criminal; (*b*) Food and Drugs Acts, 1875, 1912; (*c*) Fertilisers and Feeding Stuffs Acts, 1906; (*d*) Rag Flock Acts, 1911; (*e*) Rivers Pollution, and Actions under Fisheries Board (Sea and Rivers); (*f*) Building Regulations. (II) County Court Proceedings, where claims for damages of and under 100*l*. are brought. These cases may arise from different sources, amongst which may be mentioned claims for selling goods not up to guarantee such as foods, fertilisers, feeding stuffs, oils, oilcakes, and deaths of livestock from causes on which the analyst has to give his opinion. (III) High Court cases.

Thus, the administration of the Foods and Drugs Acts depends wholly or almost entirely on the results of analyses. The same remark applies with almost equal force to many criminal actions. In many civil cases chemistry plays an important part and in some of these cases the chemistry of manufacturing processes is examined exhaustively.

Nature of Evidence.—In all legal proceedings the first essential is that the facts shall be brought before the Court in the most authentic form possible. This is done by giving evidence in the proper way—*i.e.*, facts are proved by either actual eye-witness or personal knowledge, and not by hearsay. It is specially enacted by the Food and Drugs Acts, and the Fertilisers and Feeding Stuffs Act that a certificate of analysis given by "a Public Analyst" or "An Official Agricultural Analyst" may be produced in Court and used as evidence without the appearance of the person who signed it.

Burden of Proof.—It is the duty of prosecutor or plaintiff to prove his case. Thus, if food or drugs are adulterated the prosecutor must prove adulteration. At times the burden of proof shifts from one party to the other. It may be taken as a rule that the evidence must be complete and conclusive. A very general defence is that the evidence is incomplete and inconclusive.

Chemical Evidence.—Chemical evidence deals with chemical facts and deductions. Such evidence is usually governed by the same rules as apply to other evidence, but there is one important exception. The ordinary witness as to fact is not allowed to give his opinion. The expert witness, a class which includes the chemist, is permitted a somewhat wider latitude. The chemist may, therefore, state not merely his facts, but also the deductions he has drawn from them, and the opinions he has formed thereon.

Functions of Chemist and Lawyer.—Although chemist and lawyer are both concerned in the preparation and formulation of chemical evidence, they are not necessarily familiar with each other's methods and requirements. Therefore, the chemist should know sufficient of the rules of evidence to make his analyses or experiments as useful as possible to the lawyer. Chemico-legal knowledge does not consist only in the acquisition of facts, but in the power of arranging them and in applying the conclusions to which they lead to the purposes of the law. A man may be a most skilful analyst or a most experienced chemist: his mind may be well stored with professional information; yet if he is unable by the use of simple language to make his information known to others, his knowledge will be of no avail. The first duty, therefore, of a chemical expert is to cultivate a faculty of minute observation combined with a general knowledge of what the law requires as evidence. In preparing evidence all the facts known to the expert should be clearly set down. An expert should remember that copies of his report and depositions, either before a Magistrate or Coroner, are usually placed in the hands of Counsel as well as of the Judge, and that his evidence, as given at the trial, is compared word for word with that which has already been recorded. Any serious deviations from what is on record will, of course, tell unfavourably against the witness, supply materials for a severe cross-examination and form an excellent ground of defence for the opposing side.

SOCIETY OF PUBLIC ANALYSTS

Three papers were read at the meeting held in Burlington House on March 7, Mr. P. A. Ellis Richards in the chair, members of the Medical Legal Society being present by special invitation to hear a paper on "The Examination of Firearms and Projectiles," by Mr. A. Lucas, O.B.E., Director of the Egyptian Government Laboratory, Cairo. This paper, which was read by Mr. C. Ainsworth Mitchell, discussed the scientific methods used for the identification of firearms and projectiles in cases of wounds or deaths from shooting. A particular weapon may sometimes be recognised by the rifling marks imprinted on a bullet, and the nature of the fouling left in the barrel after the weapon has been fired may also afford valuable information, both as to the nature of the original powder and also, in some cases, the period that has elapsed since the last discharge. The composition, dimensions and markings on bullets, slugs, etc., were described, and directions were given for the reproduction of rifling marks on bullets, and for the chemical analysis of projectiles of all kinds.

"The Interpretation of the Results Obtained in the Analysis of Potable Waters" was the title of a paper presented by Mr. R. C. Frederick, who gave an account of an extended investigation into the chemical changes which occur in samples of water polluted with excreta. The findings were considered in conjunction with the results obtained by the author in analysing a very large number of samples from every kind of supply throughout the British Isles. The orthodox ideas in regard to the interpretation of the analytical results of such examinations were criticised and the author's own views detailed.

Mr. S. B. Phillips read a paper on "The Determination of the Purity of Vanillin." After reviewing the various methods proposed from time to time, the author described (1) a volumetric method, and (2) a gravimetric method for estimating vanillin :—(1) One g. of vanillin is dissolved in 20 c.c. of neutral alcohol and acid impurities are neutralised ; 1·2 g. of *p*-toluidine is added and 20 c.c. of semi-normal sodium-hydroxide solution measured in, followed by 100 c.c. of cold water. The solution at 15° C. is titrated with semi-normal sulphuric acid until the permanent precipitate of the condensation product of vanillin and *p*-toluidine is formed. The difference between the volumes of alkali and acid represents the volume of alkali required to combine with the vanillin. (2) One g. of vanillin is dissolved in 13·6 c.c. of semi-normal sodium hydroxide, and a solution added of 2·4 g. semicarbazide hydrochloride plus 3 g. anhydrous sodium acetate (or 5 grams of the crystalline salt) in 30 c.c. of water. The mixture is heated on a boiling water bath for ten minutes, allowed to stand in the cold for four hours ; the semicarbazone is filtered off, washed, dried and weighed, treated with ammonium-hydroxide solution, and the insoluble portion filtered off, washed, dried and weighed. This weight is deducted from the original weight of semicarbazone and the remainder calculated to vanillin.

OPTICAL SOCIETY

At the Annual General Meeting held at the Imperial College on February 8, Emeritus Prof. A. Barr, D.Sc., was elected President, Major E. O. Henrici was elected Hon. Treasurer, and Prof. A. Pollard and F. F. S. Bryson, M.B.E., M.A., were elected Hon. Secretaries for 1923-24.

After the Annual Meeting Sir Frank Dyson delivered his Presidential Address on "Large Telescopes," in which he detailed the contribution made by them towards the progressive advance of astronomy. By means of the large reflectors of Lord Rosse and Lassell the heat from the moon was measured and new satellites of Uranus and Neptune were discovered. In 1868 a refractor of 26 inches aperture was made by Cooke for H. S. Newall, of Newcastle. This was soon followed by large telescopes in America by Alvan Clark, by Grubb in England, and the brothers Henry in France. In 1892, a 36-inch refractor was made for the Lick Observatory by Alvan Clark and a 40-inch one for the Yerkes Observatory in 1897. These large telescopes led to the discovery of new satellites and double stars, and to a very satisfactory knowledge of the masses of stars as well as of their velocities.

Mr. F. W. Preston, B.Sc., read a paper on "The Properties of Pitch Used in Working Optical Glass." Pitch as a material for mounting lenses for polishing possesses many remarkable advantages. Its colour is valuable ; the dull black surface in contact with the lens prevents reflection of light at the second face of the glass, and nothing better could be devised for the purpose of examining figure in a block. More than most similar materials in the "solid" state its co-efficient of expansion approximates to that of glass, it melts at a relatively low temperature, and remains plastic through a considerable range. A material with a definite melting point would be much more difficult to handle, and in the solid phase would need a co-efficient of expansion almost identical with that of the glass to be worked, or figure would always be bad. Even if this condition were satisfied, the material would be at a disadvantage as compared with pitch, since identity of expansion would preclude the use of refrigeration for parting. Pitch, being an undercooled liquid, may be made sufficiently solid to resist deformation by external pressures during the polishing operation, and yet left sufficiently plastic to yield to internal stresses, so as to be self-annealing at ordinary temperatures. The alteration of properties on prolonged heating is its most serious disadvantage, but methods of conservation and testing are available which obviate this, so that its unique properties can be utilised advantageously.

Instructor Commander T. Y. Baker showed a prismatic astrolabe designed and made at the Admiralty Research Laboratory, Teddington.

PHYSICAL SOCIETY

At the meeting held on March 9, Sir William Bragg read a paper on "The Crystalline Structure of Anthracene." X-ray measurements have now been made on crystals of anthracene more perfect in shape than those employed in previous work on this subject (*cf.* J., 1921, 429 R). The results obtained indicate that the lengths of the axes of the crystal unit of anthracene are $a=8{\cdot}58$ Å.U., $b=6{\cdot}02$ Å.U., and $c=11{\cdot}18$ Å.U. The data previously available gave $c=11{\cdot}6$ Å.U. The corresponding data for naphthalene are $a=8{\cdot}34$ Å.U., $b=5{\cdot}98$ Å.U. and $c=8{\cdot}68$ Å.U. The difference of length of the c axes of anthracene and naphthalene is therefore 2·50 Å.U., corresponding exactly with the width of the benzene ring as determined from the crystal structure of the diamond. The crystal molecule of anthracene possesses a centre of symmetry, and the molecular structure is such that if one set of identical molecules be placed at the corners of the unit cell, the centres of the other molecules lie at the centres of the *ab* faces. The specific gravity of a perfect crystal of anthracene, deduced from X-ray data, is 1·255, a value differing considerably from the commonly accepted value of 1·15.

In a paper on "A Radio-Acoustic Method of Locating Positions at Sea," Dr. A. B. Wood and Capt. H. E. Browne showed how the position of a ship at sea could be determined from the difference of the times taken by a radio-signal and an explosive wave produced by detonating a 9-oz. charge of guncotton under water to reach two or more stations of known position, equipped with radio-signal receivers and hydrophones of the microphone type.

A paper was submitted by Mr. J. H. Powell and Dr. J. H. T. Roberts on "The Frequency of Vibration of Circular Diaphragms."

INSTITUTION OF RUBBER INDUSTRY

A paper entitled "A Review of Solvent Recovery Processes" was read by Mr. T. W. Wild at the meeting of the Manchester Section on February 19.

As most of the solvents used in manufacturing processes are comparatively expensive, the prevention of waste is an insistent problem, particularly in the rubber industry, in which many thousands of gallons of solvents are lost annually. After describing the experiments which led to the use of cresol as an absorbent for ether and alcohol employed in manufacturing cordite, the lecturer outlined various processes used to recover solvents in the rubber industry.

All previous methods for the recovery of solvents used in rubber manufacture have relied upon the direct condensation of the vapours, but a large firm is utilising the absorption and redistillation system for recovering solvent naphtha. In a recent American process flue gas flows in contact with the fabric, and takes up the vaporised solvent, the resultant mixture of the flue gas and solvent vapour being separated. This method has been chiefly applied to the preparation of material for tyre manufacture. The flue gas, generated by burning any suitable fuel in special burners to remove the free oxygen from the air, is first scrubbed, then sprayed with water to remove dirt and soot, and dried. The flue gas then enters the drying chamber, which is a large compartment in the top and bottom of which there is a series of rollers. The cloth, first dried by passing it over hot cylinders, is passed into the chamber through a very narrow opening. Just inside the chamber are two dip tanks containing rubber solution. The cloth travels in a zig-zag path from top to bottom of the chamber between heating pipes or coils to evaporate the solvent. The flue gas enters the chamber where the fabric leaves it, and therefore flows in a direction opposite to the moving fabric. The solvent-laden flue gas then passes through a series of separators, condensers and compressors whereby the solvent is separated from the flue gas and conveyed by a common main to a receiving tank. The flue gas may be used again in the chamber. A register is attached to the apparatus to record the percentage of oxygen mixed with the flue gas, as it is vitally necessary to keep the proportion within safe limits from the danger of fire and explosion; 10 or 12 per cent. of oxygen in the flue gas is not objectionable, but usually the content is much lower. Flue gas coming directly from the fire for the drying of solvents cannot be used, as it is too hot (over 1000° F.), and contains moisture and sulphur dioxide that would damage the fabric. The waste of heat involved in cooling and purifying these gases is justified because of the protection it affords against fire and explosion. It is claimed that this apparatus will recover all but a very small percentage of the solvent used in treating the fabric.

This fascinating problem of solvent recovery has challenged man's ingenuity for many years; at least, this was true as regards the recovery of solvent from over-spreading machines until quite recently. The fundamental requirements of an ideal apparatus are as follows:—(1) Sufficient solvent must be recovered to show a substantial and constant profit after all expenses against the apparatus have been deducted; (2) the output of the spreading machine must not be reduced; (3) the possibility of fire must be no greater than on an uncovered machine and there should be no danger of an explosion; (4) the quality of the manufactures must be maintained. These essential features of a reliable apparatus were used as standards of efficiency in designing the "Voliq" apparatus, manufactured by the Solvents Recovery Co., Ltd. In this apparatus the drying chests of the spreading machine are covered with a close-fitting hood, made accessible at any part by hinged doors. About the centre of this hood is an exhaust box containing a fire screen which can be easily withdrawn for cleaning. The exhaust box is connected by means of a pipe to an air circulator mounted on a condenser, the base of which is connected to a re-heater placed under the spreading machine. At the other end of the re-heater a connecting duct is provided to convey the recirculated air to each end of the hood. The recovered solvent is separated from the air and deposited in the base of the condenser, from whence it is removed through a pipe to a storage tank and is ready for use again. The apparatus has been tested under ordinary working conditions during four years and it was found that 6 to 12 gallons of naphtha were recovered per day by each apparatus when fully employed during a working week of 48 hours. The quantity of solvent recovered varies, of course, with the class of work passing over the spreading machine. Taking an average recovery of 9 gallons per day, the yield per year of 273 working days would be 2457 gallons of coal-tar naphtha, which at to-day's price equals £215, whereas charges, including costs of maintenance and running, condenser water, power, oil, and an allowance of 15 per cent. for depreciation, etc., amount to about £80.

The output and quality of the product was the same as that obtained from an uncovered spreading machine and the danger of fire is no greater, the material damage done to the fabric being spread being less, because any fire is immediately choked underneath the hood by the products of combustion formed and by an insufficiency of oxygen. As there are so many loose, light doors and openings at the ends, etc., there is no likelihood of an explosion. Other advantages are that the drying of the fabric is improved, the hood protects the piece from falling dust, etc.—an important advantage when white or delicate shades are being spread—and the atmospheric conditions in the workroom are better.

SOCIETY OF DYERS AND COLOURISTS

A paper on "The Valuation of Dyestuffs by Titration Methods" was read by Reginald B. Brown and H. Jordan, at the meeting of the London Section held in the Dyers' Hall on March 8.

The rapid valuation of a number of commercial dyestuffs is carried out by the authors by titration methods based on the mutual precipitation of acid and basic colouring matters. They review the methods based on this principle which have already been proposed, commencing with Rawson's paper (1888) on the estimation of Naphthol Yellow by means of Night Blue, and including the systematic examination by Baenziger and Vlies in 1899 and Seyewetz in 1901 of a series of precipitates produced by the interaction of acid and basic dyestuffs.

Owing to the extraordinary conditions of the dyestuff industry in the years 1915-17, when it was frequently necessary to come to a decision regarding the purchase of a parcel of colour within an hour or so, the authors attempted to devise a method which could be carried out more rapidly than the usual dyeing tests and would yet afford a sufficiently exact indication of the colour value. For several of the more widely used dyestuffs, which are offered in many brands of varying strength, they have worked out titration methods allowing of an estimation of differences of 2 to 2·5 per cent., a nearer valuation than is possible by any dyeing or staining test.

The following principles are laid down:—(1) The dyestuff to be estimated and the volumetric reagent selected must be of quite different colour in solution, *e.g.*, blue with red, green or blue with yellow. (2) The acid colour should be run into the solution of the basic dyestuff; the reverse method is seldom useful. (3) In determining the end point a quick judgment must be formed. The strength of the dyestuff solutions employed is 1 g. in 500 cc., and the end point is recognised by the appearance in a spot made on filter paper of a ring of the colour of the precipitant solution.

Useful methods of valuation have been established for Auramine, by direct titration with Indigo Carmine, Methyl Violet with Naphthol Yellow S; and Victoria Blue B with Tartrazine. With most other basic dyestuffs, titration with an acid colour alone does not give a definite end point. In several cases a useful modification consists in titration with a solution containing tannic acid and sodium acetate in addition to the acid colour. Brilliant Green and Malachite Green are titrated with a solution containing 1 g. Orange II, 2 g. tannic. acid, and 2·5 g. sodium acetate per litre. Magenta and Saffranine are estimated by a similar method with Indigo Carmine in place of Orange II, and Rhodamine with Metanil

Yellow and the tannin addition. For Methylene Blue, Tartrazine or Crystal Scarlet, in either case with Tannin, may be employed.

For acid colours the process is the same, the volume of solution of acid dyestuff required to precipitate a given weight of basic colour being an index of the colour strength. Up to the present, trustworthy valuations are only possible of Orange I, Orange II, Tartrazine, and Naphthol Yellow S, and for all these dyestuffs the re-acting basic colour is Victoria Blue or Night Blue. Eosine can be estimated by running a solution of the dyestuff into a Malachite Green solution.

With direct cotton colours much less progress has been made. The method suggested by Baenziger and Vlies for the estimation of Benzopurpurine 4 B with Methylene Blue does not give a satisfactory end point whichever dyestuff is employed as precipitant. A better result is obtained by adding to the Benzopurpurine solution an excess of Victoria Blue B and titrating back with Orange II. An alternative is to add excess of Auramine and titrate back with Indigo Carmine, a method which serves also for the valuation of Chrysophonine.

It is found that concordant results are only obtained by working within certain limits of concentration ; if it is desired to value products which are very much stronger or weaker than the standard taken for comparison it is well to prepare a solution approximating to the usual colour strength. Another question which naturally arises is the effect of slight differences in the shade and therefore in the constitution of the products tested on the results of titration; such effect will depend on the molecular weights of the colouring matters and can only be investigated with precision with purified dyestuffs. The authors' personal experience has proved the method to be of considerable value ; several of the methods described have been in regular use in their laboratory for four or five years and have never yet led them astray. They hope to undertake later on a more scientific investigation of the laws governing the facts observed.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held on March 5, Sir Max Muspratt, Bart., presiding. Dr. Clayton, M.P., received a hearty welcome on taking his seat for the first time as a member of the Council. The United Indigo and Chemical Co., Ltd., and the United Water Softeners, Ltd., were elected as members of the Association.

In connexion with the chemical regulations under the Factory and Workshop Acts, it was reported that manufacturers of bleaching powder were not opposed to the form of register suggested by the Chief Inspector of Factories, and that the Home Office had been advised accordingly.

As the result of negotiations the promoters of the Oakham Gas and Electricity Bill had agreed at the request of the Association to abandon Sub-Clause (3) of Clause 13 and to modify Clause 6, which enabled the undertaking to have unrestricted powers in chemical manufacture.

A conference has been held with the Medical Research Council with the view to closer co-operation between the medical profession and the chemical manufacturers, and further conferences with this object in view are likely to be held.

The British Industries Fair was more successful than ever last year, but in view of the British Empire Exhibition it was decided that the Association would not organise a Chemical Section of the Fair next year. A report from the general manager showed that great progress is being made on both the commercial and scientific sides of the British Empire Exhibition, 1924.

Certain points arising out of the administration of the Dyestuffs Act were considered.

It was agreed to give a donation of £250 towards the Chemical Society's Library.

A report from the transport manager stated that concessions had been obtained from the original proposals of the railway companies regarding the forms of schedule to be used in compiling the new standard rates.

PERSONALIA

The Meldola Medal of the Institute of Chemistry has been awarded for the second time to Dr. C. K. Ingold.

Mr. A. C. Nelson has succeeded Mr. H. Rook as chief chemist to the Clifton Coke Ovens, Cumberland.

Mr. T. J. Keenan, who has long been associated with the Technical Association of the Pulp and Paper Industry, has resigned the editorship of *Paper.*

Prof. F. Zambonini has been appointed professor of chemistry in the University of Naples, and Prof. E. Mameli has been nominated to a similar chair in the University of Perugia.

* * *

From Italy the deaths are announced of Dr. A. Castoldi, a well-known toxicologist and editor of the *Bolletino Chimico Farmaceutico,* and of Dr. Luigi Marino, lecturer in Applied Chemistry in the Engineering School, Pisa.

The death is announced of Dr. E. A. Merck, at the age of sixty-eight. Dr. Merck was the oldest member of the family which owns the well-known chemical works of E. Merck, and owned the Angel Pharmacy, founded in 1868, in the laboratory of which the production for the first time of alkaloids on a large scale, undertaken a century ago, marked the beginnings of the present factory.

CORRESPONDENCE

THE TITLE "CHEMIST"

Sir,—The Annual Meeting of the Institute of Chemistry affords the younger chemists an opportunity of expressing opinions at a public meeting, but the time available does not always permit their indiscretions to be commented on or corrected. At the recent meeting the younger members were supported in their aspersions of the pharmacist as a "chemist," and perhaps a few words of comment may correct their attitude, which seems to amount to jealousy.

The Authorities of the Pharmaceutical Society and the Institute of Chemistry both appreciate their rights in the matter, and the younger members of the latter body ought to be prepared to wait for the changes which time alone will effect without calling into question the rights conferred on pharmacists at a time when they were the only competent trained exponents of the chemical arts.

At the time the Pharmaceutical Society opened its laboratories in Bloomsbury Square, about the middle of last century, I believe the revered Fellow of the Institute of Chemistry, Dr. Tilden, was one of the students there, and it needs but little searching through the lists of Fellows of the Institute to find that some of the most prominent ones were trained as pharmacists.

The names Attfield, Redwood, Dunstan, Wynne and Collie are some of those who were for years Professors of Chemistry at the Pharmaceutical Society's School of Chemistry, and the men they trained had no option regarding their legal cognomen, "Chemist and Druggist" or "Pharmaceutical Chemist."

Yet we have this ever recurring quibble about the word or title "Chemist." The pharmacist is as proud of that title as a D.Sc. is of his degree, but the "law of the land" gave the pharmacist his right to the name "chemist" before B.Sc. degrees were granted all over the country and before even the modern chemical laboratory came into existence.

Who bothers about the title Apothecary now? Who ever sends for a Barber Surgeon or calls in the Leech? And as these titles have gradually lapsed, so the title "Chemist" will find the position it deserves, and be attached to the right man at the right time. Meanwhile, the newer members of the Institute of Chemistry would be wise to remember the debt they owe to the Pharmaceutical Society as one of the institutions which fostered and helped the Institute of Chemistry in its early days, when the science of chemistry was a novelty in this country.—I am, Sir, etc.,

C. Edward Sage

London
March 2, 1923

COLLOID CHEMISTRY

Sir,—With the assistance of prominent specialists the world over, I am preparing a comprehensive book on Colloid Chemistry, Theoretical and Applied. The extensive and international character of the book is evidenced by the subjoined list of some of those who have already promised contributions:—

U.S.A.:—E. G. Acheson, W. D. Bancroft, Carl Barus, M. H. Fischer, W. D. Harkins, H. N. Holmes, G. A. Hulett, D. D. Jackson, F. G. Kunz, R. S. Lillie, D. T. MacDougal, S. E. Sheppard, A. Silverman, E. B. Spear, E. W. Washburn, A. W. Thomas, H. A. Gardner. *England*:—E. F. Armstrong, Henry Bassett, W. M. Bayliss, E. F. Burton, W. B. Hardy, F. G. Donnan, F. E. Lloyd, A. E. Dunstan. *Austria*:—C. Doelter, W. Pauli. *Yugoslavia*:—M. Samec. *Sweden*:—Sven Oden. *Holland*:—H. R. Kruyt. *Mexico*:—A. L. Herrera. *Germany*:—H. Bechhold, G. Bredig, A. Fodor, H. Handovsky, A. Lottermoser, Lüppo-Cramer, R. Höber, W. Ostwald, H. Plauson, E. Stiasny, G. Tammann, H. Schade.

Many unusual experimental facts and practical applications of colloid chemical principles are unpublished, and the object of this letter is to ask anyone in any field of science or experience, who may have information of interest to send me a brief statement for inclusion in the book.

Contributions may consist of a paragraph, a page, or several pages, and will (unless contrary request is made) be duly acknowledged. If possible they should be submitted in English and duplicate copies will be appreciated. Authors should state their full names and titles.

The editors of scientific, technical, and cultural publications in all countries are asked to disseminate this appeal.—I am, Sir, etc.,

Jerome Alexander

50, East 41st Street,
New York City.
February 10, 1923.

MARKET PRICES

Sir,—In your recent issue dated March 2, 1923, your publication of a letter from Mr. P. E. Aldred expressing his inability to obtain the quoted market price for Wood Creosote suggests another aspect of the matter.

From a buyer's point of view the position appears to be different as will be apparent from the appended figures:—

		Magnesium turnings for Grignard's Reagent per lb.	Nickel pellets per lb.	Aluminium Sheet (1/16") per lb.
Manufacturer		5/3	1/6	1/6 (7–14 lb. lots)
Retailer	A	12/–	4/6	3/– (1 mm. thick)
	B	15/–	—	5/–
	C	16/–	5/–	7/6

These figures speak for themselves; no printable comment would be adequate.—I am Sir, etc.,

R. C. Gale

Woolwich
March 2, 1923

INDUSTRIAL HYGIENE AND THE LONDON SECTION

Sir,—As an example of unconscious inconsistency, I think that the meeting of the London Section of the Society of Chemical Industry on March 5 would be hard to beat. A hot crowded room, no apparent means of ventilation and nearly everyone present engaged in adding to the atmosphere the combustion products of vegetable matter—tobacco. I may say that I was not the only one obliged to make an early departure in search of a cleaner and more oxygenated atmosphere. And yet that meeting was solemnly discussing carbon monoxide poisoning, poisoning due to defective ventilation, the ignorance and apathy of workmen, and so on. "O wad some power the giftie gie us . . . ." —I am, Sir, etc.,

"Gassed."

St. Margarets-on-Thames
March 7, 1923

BAYBERRY OIL

Sir,—Your correspondent who inquires for this oil would have received a more satisfactory reply if he had explained the purpose for which the oil was required. There are two essential oils which own the name "Bayberry":—

1. The first is obtained from the leaves of the North American bayberry shrub, *Myrica cerifera*, and, relatively, is of very little importance.

2. The second is the essential oil obtained from bay berries, the fruits of *Pimenta acris* (Wight). This is the tree whose leaves yield us the well-known bay oil for making bay rum. The oil is similar in character to ordinary bay oil, but is richer in eugenol than, and consequently different in flavour from, the commercial oils.

I have not seen any of the berry oil in this country, but in New York I have heard of oil which was supposed to have been distilled from the berries. Either the old-established essential oil distillers in New York or their London agents would be able to supply or procure the oil from the bay berries.—I am, Sir, etc.,

C. Edward Sage

London
March 10, 1923

Sir,—Referring to your correspondent's inquiry on p. 241 of your current issue, the *essential* oil of bay berries is not an article of commerce. The bayberry oil of commerce, which is sold by wholesale druggists under the name "Oleum Bacc. Lauri," is the oil expressed from the ripe fruits of the bay laurel, *Laurus nobilis*, a small evergreen tree extensively cultivated in Europe. The oil is produced chiefly in Northern Italy by pressing the fruits after steaming or boiling with water. The berries yield about 30 per cent. of fatty oil, which is semi-solid in consistence, somewhat granular in appearance and greenish in colour. It consists mainly of glyceryl laurate, and has a pleasant aromatic odour. It is used as an outward application for rheumatism.

The essential oil of *Laurus nobilis* is obtained from the leaves and contains cineol. It is seldom used in this country. This must be distinguished from the essential oil of West Indian bay leaves. obtained from the leaves of *Pimenta acris* (*Myrcia acris*), which is the "oil of bay" of commerce. This contains eugenol and is the oil employed for making "bay rum."

Another tree known as "bayberry" is the Wax Myrtle (*Myrica cerifera*), the leaves of which also yield an essential oil of no commercial importance. Bayberry bark, obtained from a species of *Myrica*, is employed in pharmacy.

Trusting this information will be of service.
—I am, Sir, etc.,
C. T. Bennett
(Lecturer on Essential Oils at the Borough Polytechnic Institute)

London, S.E. 1
March 9, 1923

[We have also received a letter from Mr. Donald McDonald, stating that the bay berry is a N. American shrub known botanically as *Myrica cerifera* and referring to Sauer's "Odographia," Vol. 2, for further details.—Editor.]

NEWS AND NOTES

FRANCE

The National Fuel Problem

The problem of developing a national fuel, especially one based on home-made alcohol, is much to the fore in France. Recently, Monsieur Pineau, director of the Petroleum Section of the Ministry of Commerce, published a report setting forth the arguments in favour of the "national fuel" consisting of a mixture of alcohol and petrol. According to this report, the French State has stocks of alcohol exceeding one million hectolitres, and alcohol is produced in France, whereas all the petrol has to be imported; if beet cultivation were developed with a view to producing fuel alcohol, agriculture generally would benefit. The subject is arousing great interest and criticisms have been published of the national formula prescribing the addition of 40 to 50 per cent. of alcohol to petrol. Some consider that as alcohol costs more than petrol and has a lower calorific value, three litres of alcohol will be consumed where two of petrol would suffice. This is true, but the stocks of alcohol held by the State are sold at a price below that of petrol, and it is admitted that the price of petrol is too high. It is also suggested that certain by-products of coal should be added to petrol, and investigations on these lines are being carried out. In fact the recent discovery that it is possible catalytically to hydrogenate coal and its distillation products to produce liquid compounds related to petroleum suggests that a solution of the question lies in this direction. The utilisation of ethyl alcohol produced from cellulose is proposed by those who consider that an increased cultivation of sugar-beet would harm agriculture and reduce the area available for wheat. A difficulty is the production of stable mixtures of alcohol and petrol, for even traces of water render the mixture unstable. This question has been resolved by the industrial manufacture of practically absolute alcohol (99·70) by the process of Loriette. A further solution would be to add a third compound which would act as a " binder " between alcohol and petrol, but practical difficulties prevent this from being done. In 1922, 141,000 hectolitres of alcohol containing 50 per cent. of benzol were used by the Parisien motor-buses and many public carriers have also used this " National Fuel."

SOUTH AFRICA

Developments in the Coal Industry

A correspondent writing in *The Times* states that a London syndicate has secured options over areas of coal-bearing land in the Carolina district of the Transvaal. The syndicate, it is stated, proposes to develop coalmines on a large scale, and to build an electric railway to Kosi Bay or another Zululand port, which it would also develop. The estimated cost of the scheme is £25,000,000, but the actual capital mentioned is £50,000,000, and the Government is to be asked to guarantee £10,000,000. The coal is said to be of the highest quality and a scheme has been formulated to deliver it at the coast for 4s. 2d. per ton ; it is intended to grind the coal finely and transport it in steel pipes with water. The district in question has long been known as a promising mineral area, containing both gold and coal, but hitherto has not been exploited.

UNITED STATES

The Arsenic Industry

A Report issued by the United States Geological Survey states that the use of arsenic in weed-killing compounds has greatly increased during the past year, especially as calcium arsenate required in controlling the cotton-boll weevil, 8000 tons being used for this purpose in 1922. In addition arsenic is used in controlling mosquitos in the malarial regions in the south. The general shortage of arsenic resulted partly through the large increase in demand but also owing to the reduced supplies obtainable from copper and lead works and from abroad. At present the consumption of arsenic amounts to 12,000 short tons per annum, whereas in 1921 the supply from both domestic production and imports totalled only 6455 tons. Arsenic plants in the United States have an annual capacity of 18,300 tons of white arsenic, but their output depends largely upon the plants of two companies that intend to reduce ores directly for their content of arsenic.

GENERAL

Notes on New Zealand Ironsand

The isolation of a new element from Dominion sources is a matter of great interest to chemists of the British Empire. Large supplies should be obtainable on account of the abundance of the material and its freedom from zirconium.

Ironsands in New Zealand chiefly occur along the west coasts of both islands, where denudation and wave action are greatest. The deposits in the South Island, where the west coast is closely approached by the Southern Alps or their continuations, have yielded, and still yield, payable quantities of gold by skilful concentration. Most of the sands, however, are not auriferous, but consist essentially of titaniferous iron oxide associated with varying amounts of ferro-magnesian minerals. The sands are disposed in thick lenticular beds on the beaches and often extend inland for a mile or more. Enormous amounts are present, as these beaches often run for many miles. Near Patea, in the North Island, for example, there are over 5,000,000 tons. The pure sand is perfectly black, and to walk over it barefoot after it has been exposed to the hot summer sun of those latitudes is almost as good a test of innocence (or natural-leather soles) as the red-hot ploughshares of the Middle Ages.

The sand has been formed largely by the disintegration of andesitic and basaltic rocks which form a large part of the country behind the coast. It is an intimate mixture of magnetite, with varying proportions of hæmatite, and ilmenite, but some samples contain none of the last-named constituent. Usually between 60 and 70 per cent. of iron is present. The recent analyses quoted show that titania is often lower than in the sample analysed by Dr. Scott :—

	From Patea	From New Plymouth beach
Ferrous oxide	27·60	40·68
Ferric oxide	51·32	36·05
Manganous oxide	0·48	0·35
Titanium dioxide	9·60	9·20
Alumina	1·04	4·00
Lime	1·25	1·80
Magnesia	2·60	2·77
Silica	5·30	3·90
Phosphoric anhydride	0·25	0·09
Sulphuric anhydride	0·04	0·01
Vanadium pentoxide	0·32	n.d.
Water lost at 100° C.	0·20	0·25
	100·00	99·10

Numerous experiments have been carried out in order to determine the best conditions under which this sand may be smelted for iron. It has been found that the titanium content is not greatly altered either by mechanical or by magnetic separation. The sand when made into briquettes with a local clay has been successfully smelted with the production of a grey pig iron containing in one instance 0·245 per cent. of titanium.

Safety in Mines Research Board

The Explosives in Mines Research Committee (*cf. Chem. & Ind.*, p. 182) has prepared a memorandum outlining the history of the introduction and development of the special class of explosives known as "Permitted Explosives," used in coalmines in this and other countries, and the methods adopted for examining and testing them for this purpose. An indication is also given of the programme of research which the Committee proposes to undertake. Copies of the memorandum may be obtained, price 3d., from H.M. Stationery Office.

Sugar Beet Crop in Czechoslovakia

The 1922-23 crop of sugar beets in Czechoslovakia is estimated by the Central Association of Czechoslovak Sugar Manufacturers at 4,200,341 metric tons, and the yield of raw sugar at 717,240 m. t. These figures represent increases over the crop of 1921-22 of 23·65 per cent. for beets and 42·4 per cent. for sugar. Exports during the last four seasons have been roughly as follows (in metric tons):—1918–19, 160,604; 1910-20, 340,516; 1920-21, 414,376; 1921-22, 376,328. Almost one-half of the export was directed to Austria and France. During the season 1921-22 Czechoslovakia exported approximately 38,000 tons of sugar less than during the preceding year because it produced less. The big decrease in sugar exported to France was due chiefly to the reconstruction by that country of its sugar factories in the devastated areas.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for March* 8)

TARIFF CUSTOMS EXCISE

Australia.—The "dumping" duty on Portland cement of United Kingdom origin has been removed.

British India.—It is proposed to reduce the export duty on hides and skins by 5 per cent., and to increase the duty on salt from Rs. 1¼ to Rs. 2½ per maund.

Germany.—The export of pitch, tar and tar oils is prohibited.

Irish Free State.—Regulations have been issued controlling trade with the Irish Free State.

Italy.—By recent modifications in the customs tariff, mineral-oil distillation residues not for use as fuel, concentrated ammoniacal liquor, superphosphates, and sodium nitrate are admitted free of duty.

Mauritius.—Increased customs duties are leviable on kinematograph films, glassware (not sheet glass or laboratory appliances), perfumery, fireworks, and indigo.

Mexico.—Modified import duties have been applied to starch, rubber tyres and inner tubes, sheet zinc, and paper.

Poland.—An export tax, amounting to 50 per cent. of the profit derived from the export, is payable on sugar.

Russia.—The issue of March 8 contains a list of articles the import of which is prohibited. Many chemicals, minerals and metallurgical products are affected.

South Africa.—A "dumping" duty equal to the difference between the home and export prices but not exceeding 15 per cent. *ad valorem* has been applied to imports of Portland cement.

Switzerland.—General licences have been granted for the import of paper-making materials, and certain iron products.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Hardware, hollow-ware, galvanised sheets, tinned and lead-coated sheets, metal tubes, carbon steel ..	*
British India	Cresol, quinine hydrochloride	†
Canada ..	Steel strip and wire ..	10691/E.D./ E.C.2.
Egypt ..	Palm-oil soap (tender for)	**
France ..	Oilseeds, fibre	322
Italy ..	Lighting glassware, aluminium and tin ware	323
Netherlands	Pharmaceutical chemicals	325
New Zealand	Celluloid goods, paper, thermometers ..	314
,, ,,	Glassware, crockery, rubber goods ..	315, 316
,, ,,	Chemicals, soap, aniline dyes, sulphur, caustic soda, alkalis, tin foil, edible oils	317
South Africa	Pharmaceutical preparations	318
,, ,,	Creosote (tender for) ..	10710/E.D./ C.C.2
United States	Iron and steel	18677/F.W./ E.C./A.2
,, ,,	Calcium arsenate, white arsenic	5411/A./ T.C./C.C.2
Yugoslavia	Tinplate	335

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* Official Secretary, Commercial Bureau, Australia House, Strand, W.C.2.

† Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E.1.

** Inspecting Engineer, Egyptian and Sudan Governments, Queen Anne's Chambers, London, S.W.1. Ref. Muh. 1923/58.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Metallurgical Coke

Viscount Wolmer informed Mr. C. Lloyd that in 1922 the estimated production of metallurgical coke was 9,400,000 tons from 10,500 ovens, and the consumption in blast furnaces was between 5,750,000 and 6,000,000 t., compared with a production of 12,798,996 t. from 21,006 ovens, and a consumption of 11,760,000 t. in 1913.—(March 5.)

New Bills Introduced

On March 5, Mr. Lunn presented a Bill to nationalise the mines and minerals of Great Britain, and to provide for the national winning, distribution, and sale of coal and other minerals.

A Bill to amend the Safeguarding of Industries Act, 1921, in respect of agricultural produce was introduced by Capt. W. Benn on March 5.

The Pharmacy Bill, to regularise the position of all persons trading as chemists, druggists or pharmacists or proprietors in the sale of drugs, the transcribing of doctors' prescriptions and sale of patent medicines, was presented by Capt. O'Grady on March 8.

Sugar Duty

Capt. King, replying to Mr. A. V. Alexander, said that the revenue collected in the United Kingdom from the duty on sugar, molasses, glucose and saccharin during the current financial year up to the end of January last, amounted to £35,600,000.—(March 5.)

The Dyeing Industry

Answering Lieut.-Col. Hilder, Sir P. Lloyd-Greame said that he had no power to supervise the regulations of the associations of dyers in this country, even though they enforce regulations imposing a handicap on textile manufacturers.—(March 6.)

Excise Duty on Alcohol

In a written answer to Major Waring, Mr. Baldwin stated that relief from taxation was granted to manufacturers in respect of the bulk of commercial alcohol used by them for other than purely medicinal purposes. The amount of relief and consequent loss of revenue for the year ended March 21, 1922, was estimated at £24,000,000.—(March 6.)

Unemployment of China-clay Workers and Tin Miners

Replying to various questions, Sir M. Barlow said that the numbers of china-clay workers and tin miners registered as unemployed in February were 140 and 1834, respectively.—(March 7.)

Shortage of Coke and Pig Iron

Answering Mr. Jowett, Sir W. Joynson-Hicks, said he was aware that the demand for metallurgical coke for export had increased, and that there was a shortage of pig iron in some districts. The home output of both coke and pig iron was, however, being increased and there were indications that the demand for coke for export would not be maintained. The situation was being carefully watched.—(March 7.)

Supplies of Rubber

Sir Ormsby-Gore, replying to Mr. A. T. Davies, said that representations had been received from manufacturers of rubber goods regarding the effect of the policy for restricting the exports of rubber adopted by the late Government. The policy was intended to secure a stabilised price for crude rubber at a level at which it would return a reasonable profit to the growers. The policy was approved by the Colonial Governments concerned.—(March 7.)

LEGAL INTELLIGENCE

CLAIM FOR LOST AMMONIUM SULPHATE

The British Sulphate of Ammonia Federation *v.* the Clan Line Steamers, Ltd.

On February 20, Mr. Justice Rowlatt, in the King's Bench Division, heard an action by the British Sulphate of Ammonia Federation, Ltd., against the Clan Line Steamers, Ltd., to recover £147, the value of 40 bags of ammonium sulphate delivered to the defendant company at Birkenhead in 1920, for shipment to Mauritius.

For the defendant company it was denied that the bags were delivered and that the plaintiffs had suffered any loss. The plaintiff company claimed that the defendant company lost 40 bags out of a total of 1,000 bags delivered. The arrival of a consignment of 400 bags was not disputed. The other 600 bags was sent by one colliery on the London and North Western Railway, and documents showed that the bags were delivered. The records of the defendant company, however, did not agree. The point at issue was what deliveries had actually been made. Evidence was called to prove that the whole of the 1000 bags had been delivered, although receipt was only given by the defendant company for 960 bags. Evidence was submitted by the defendant company to show that there were no records of receipt of the bags, and it was argued that delivery of the bags had not been established in such a way as to rebut the evidence that rested on the wharfingers' receipts.

Mr. Justice Rowlatt said that the question was really whether 410 bags were received as the plaintiff company said, or only 370 as the defendant company claimed. The method of business was for bags to be sent by the London and North Western Railway Co., and for the company to send carts to deliver the goods to the docks. He had concluded from the evidence that the delivery of the bags was established and that there had been some mistake in regard to the checkings. Judgment was given for the plaintiff company for the sum claimed and costs.

REVIEWS

A Method for the Identification of pure Organic Compounds by a Systematic Analytical Procedure based on Physical Properties and Chemical Reactions. *By* S. P. Mulliken, Ph.D. *Vol. IV. Pp. vii*+238. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.*, 1922. *Price* $6.

To attempt to do justice to a publication, of which the fourth and last volume only, and also probably the shortest, is accessible to the reviewer would, as a rule, be to court failure. In the present instance, however, the book is of such a character that a fairly clear impression of the whole may, no doubt, be gathered from an examination of a part.

Dr. Mulliken has classified all the compounds mentioned in the first three volumes of the last complete edition of Beilstein's *Handbuch* (the edition now in progress of publication) and in more recent periodical literature, which, in his opinion, are of evident interest. The classification is based fundamentally on the nature and number of the elements contained in the compound, and the sequence in which elements other than carbon, hydrogen and oxygen are taken is that used in Richter's *Lexikon der Kohlenstoff Verbindungen.*

Thus Vol. I contains classified descriptions of about 2300 of the more important compounds of carbon with hydrogen and with hydrogen and oxygen. Vol. II deals similarly with the compounds containing carbon, hydrogen, oxygen and nitrogen, exclusive of the dyestuffs. Vol. III, which contained descriptions of the pre-war brands of commercial dyestuffs, is no longer on sale.

The present volume (IV) opens with some admirable general directions on the procedure to be followed in the indentification of an unknown compound belonging to one of the "higher orders" with which this volume deals. The compounds of "Order 3," containing chlorine as an "additional element" are then given. These are numbered consecutively for indexing purposes and are classed into Division A, Solid Species, and Division B, Liquid Species; in Division A, the compounds are arranged in the order of their melting points and in Division B, according to their boiling points, with a subsidiary classification into two groups based on the specific gravity of the liquid. These tables are followed by similar ones of those compounds in which the "additional element" is (*a*) bromine and then (*b*) iodine, and the description of the halogen derivatives occupies about one half of the book; then follow similar lists of substances containing as an "additional element," sulphur, nitrogen and chlorine, nitrogen and bromine, and so on; altogether about 3900 compounds are thus classified in Vol. IV.

In addition to the name and formula (usually structural), the melting point, or the boiling point and specific gravity, the table gives very briefly the odour, taste, behaviour towards solvents, simple reactions, and any other properties recorded in the literature which might serve for the identification of the compound. One noteworthy series of omissions, which it is difficult to account for, is that of halogen compounds of the terpene and camphor series, such as pinene hydrochloride, isobornyl chloride, chloro- and bromo-camphor.

The object of the whole book, it appears, is to assist a chemist to identify as rapidly as possible any organic compound, pure or impure, which he may come across in the course of his practice. For such a purpose Dr. Mulliken's tables would be of the utmost use and, obviously as regards those of Vol. III at any rate, it is already proved that they are in great demand. It is, perhaps, unlikely that Vol. IV will appeal to so large a number of chemists, but in any case the author may be complimented on the general excellence of his work.

F. Stanley Kipping

Farben-und Lackkalender. Taschenbuch für die Farben- und Lack-Industrie. *By* H. Wolff and W. Schlich. *Pp.* 177. *Stuttgart: Wissenschaftliche Verlagsgesellschaft*, 1923.

This little volume, of pocket size, contains a number of important data of service to those interested in the paint and varnish industries, whether as chemists, manufacturers, or merchants. The sections dealing with varnish are a masterpiece of condensation; the oils, resins —including artificial resins—and other raw materials of varnish-making are fully described and the methods of examining these products are given in sufficient detail. The properties and constants of the various solvents employed are shown in useful tabular form. Other sections deal with driers, coloured varnishes, cellulose varnishes ("Zaponlacke"), and with the testing and analysis of the finished products.

The treatment of pigment colours, apart from their use in opaque varnishes, is restricted to a tabular survey of the more important mineral colours and bases and a brief description of the usual tests for fineness, covering power, fastness, etc. The lakes produced from coal-tar dyestuffs do not come within the scope of the volume and rather more might have been said with advantage of such useful bases as blanc fixe and alumina hydrate.

The book concludes with information concerning the prevention of accidents in varnish works, German employment laws and German trade customs. The purchaser also secures a diary and note-book in a side pocket of the volume.

Reginald B. Brown

Handbook of Chemical Engineering. *Edited by* D. M. Liddell, A.I.M.E. *Vol. I. Pp. xi+517. Vol. II. Pp.* 519–1008. *New York and London: McGraw-Hill Book Co., Inc.,* 1922. *Price* 40*s.*

The appearance of this book is particularly welcome owing to the growing interest in this country in chemical engineering. It is produced under the editorship of Mr. Donald M. Liddell, assisted by a staff of 30 specialists. The book is divided into 31 sections, viz. :—

I—Generation and transmission of power. II—Material handling: the transportation of solids. III—The transportation of liquids. IV—The transportation of gases. V—Crushing and grinding. VI—Grading (sizing and screening). VII—Mechanical separation. VIII—Concentration. IX—Leaching and dissolving. X—Evaporation and drying. XI—Crystallisation. XII—Thermometry and pyrometry. XIII—Refractories. XIV—High-temperature production. XV—Mixing and kneading. XVI—Sampling. XVII—Fermentation. XVIII—Distillation: fractional; destructive. XIX—Refrigeration. XX—Oxidation. XXI—Electrochemistry. XXII—Catalysis. XXIII—Colloidal chemistry. XXIV—Smelting: Zinc—lead—copper—iron; roasting. XXV—Lutes and cements. XXVI—Radioactive elements. XXVII—Rare metals. XXVIII—Rare gases. XXIX—Materials of construction. XXX—Plant design. XXXI—Methods of financing.

The book is written by Americans and the descriptions of plant and processes are mainly confined to American practice. There is the advantage, however, that the English reader is introduced to a greater variety of labour-saving and automatic devices than he has known hitherto. The editor has allowed his contributors a very free hand in the treatment of their subjects. This has led to lack of continuity or coherence in the presentation of the theme and sometimes to overlapping and even contradiction. It comes as a shock to hear it doubted in one section whether hydrogen has ever been liquefied, or if xenon and neon really exist, whereas in a later section this scepticism has vanished. On the other hand, the treatment of such widely different branches by specialists is probably more serviceable than an attempt by one man to deal with so extensive a subject.

In no spirit of carping criticism, it is suggested that many of the sections cannot be properly called chemical engineering, although the subject matter is of great importance and assistance to the chemical engineer in carrying out his work. To those whose technical training has been chiefly chemical, the editor has presented in convenient form a mass of information which will prove of the greatest value in studying and carrying out industrial chemical operations. There is a great desire to produce good chemical engineers, and this book will simplify the task of the professors, and help those who have to teach themselves.

The book is strongest on the engineering side. One would have liked to see prominence given to the importance of thermochemistry and the necessity for reckoning with its teachings when carrying out chemical processes. The editor, in his preface, has largely disarmed criticism of omission, but one may hope that in a future edition the thermochemical side of the subject will receive attention.

In the section on Transportation of Liquids, a very complete list is given of substances which may be handled by pumps, and the materials of which the pump parts should be constructed. Also, in the section on Evaporation, the materials which can be used in constructing plant for use with specified solutions are stated.

The importance of the section on Sampling should not be overlooked as it too often is in general practice. The author says, "The utmost care is ordinarily given to all the operations of a chemical laboratory. Large sums are spent on its proper equipment and high salaries are paid to the chemists employed without regard to the fact that the accuracy of the analytical work is primarily limited by the accuracy of the samples furnished to the laboratories. It appears to be the customary assumption that any $3 a day man can prepare samples for a $20,000 staff of chemists."

The Editor says: "With much misgiving this book is sent forth in the hope that Chemical Engineers in all lines may find something of profit in the general principles laid down. . . ." He may rest assured that, however much one would have desired information on other matters not touched on in the book, cordial thanks are due for presenting so much that should prove of great value to all who are desirous of bringing more scientific knowledge to bear on the development and carrying on of chemical industry.

Wm. Macnab

REPORT

Report on the Trade and Commerce of East Africa, revised to September, 1922. *By* C. Kemp, *Officer-in-Charge, Nairobi. Department of Overseas Trade. Pp.* 44. *H.M. Stationery Office,* 1923. *Price* 1*s.* 6*d.*

With a view to fostering an export trade, railway rates on export produce have been cut in E. Africa, and ocean freights are, in many cases, quoted at losing figures. Lack of transport has prevented development of most of the area declared to contain coal, but trade is increasing generally. Money will have to be spent on transport (the railway to the Uasin Gishu Plateau is under construction), medical service, and education before trade can develop properly. Great Britain, controlling the bulk of the trade in East Africa, will benefit most from such developments.

The rubber situation, both in Uganda and Tanganyika, cannot improve until the home market shows a definite advance. The cost of delivering East African rubber to the London market is from 1s. 2d. to 1s. 6d. per lb. There has been a comparatively large increase in the amount of carbonate of soda exported by the Magadi Co. from Kenya, about 90 per cent. of the export going to Japan. Mica from an outcrop in the Uluguru Mountains, in Tanganyika, has been exported by Greek prospectors. The exploitation of minerals in general is in the prospecting stage only, and, apart from coal and oil, it is doubtful whether the local minerals could be exploited on a large scale. The Victoria Nyanza Sugar Co. expects to place its sugar on the market shortly, and later to develop an export trade in sugar. The electric power and light interests of Mombasa and Nairobi have been amalgamated, and the new company claims to have sufficient water power to supply all needs for many years. In Zanzibar and Tanganyika, soap manufacture is already carried on. Developments in the production of power alcohol are anticipated.

In East African trade, the initial cost of goods is the important point; quality is a secondary consideration. The United Kingdom's share of the trade with Kenya and Uganda has decreased. At present exports to Germany are financed through London, and imports are generally financed direct. The table below gives the values of the total imports and of the imports from the United Kingdom in respect of various materials for the years ending, respectively, March 31, 1920 and 1921 :—

	Total imports		Imports from United Kingdom	
	Year ending Mar. 31, 1920	Year ending Mar. 31, 1921	Year ending Mar. 31, 1920	Year ending Mar. 31, 1921
	£	£	£	£
Candles	668	2,706	203	846
Cement	20,085	67,036	19,721	60,360
Chemicals, etc.	10,843	20,426	6,868	15,757
Coal	2,731	23,829	—	14,424
Coal products	4,868	8,664	4,124	5,806
Drugs and medicines	22,883	30,522	18,840	25,597
Glass	16,540	37,547	7,857	17,850
Manures and insecticides	724	1,461	508	1,313
Matches	19,658	6,409	—	728
Brass and copper wire	3,318	20,632	669	10,883
Iron and steel, building materials	42,037	147,944	27,787	127,011
Kerosene, petroleum, liquid fuel	56,287	123,617	—	—
Turpentine	920	1,737	532	1,604
Oils, fats and greases	22,598	53,980	8,448	31,510
Perfumery	6,731	8,465	4,335	4,675
Salt	10,374	16,454	8	2,395
Soap	15,666	68,705	6,840	38,285
Sugar	128,375	205,551	—	—

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acid Acetic, 40% tech.	£22 10s. per ton. Firm tone still maintained. Advance expected.
Acid Hydrochloric	4s. per carboy.
Acid Nitric, 80° Tw.	£24 10s. per ton. Not in much demand on the open market.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Fair request for home consumers with a firmer tone for export.
Arsenic (White)	£70 per ton. Prices nominal and very few parcels available.
Bisulphite of Lime	£7 per ton, packages extra and returnable.
Bleaching Powder	£10 10s.-£11 10s. per ton. No change in position.
Calcium Chloride	£6 per ton. No change.
Copper Sulphate	£26 10s. per ton f.o.b.
Potash Caustic, 88/90%	£29-£30 per ton. No change.
Potass. Bichromate	6¼d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton. Price unaltered and manufacturers are offering more freely than of late, but business has not reached very large dimensions.
Soda Caustic, 76%	£20-£21 per ton. Not in very brisk demand at present.
Soda Crystals	£5 5s. carr. paid. Manufacturers have reduced their prices 5s. per ton.
Sod. Acetate	£24 per ton. In better demand with very small quantities available.
Sod. Bicarbonate	£10 10s. per ton.
Sod. Bisulphite Powder, 60/62%	£19-£20 10s. per ton f.o.b. or f.o.r. London.
Sod. Chlorate	Market dull with spot parcels offering at 2⅞d. per lb.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, solid 60/62	£15 per ton. No change.
Sod. Sulphite Pea Cryst.	£17-£17 10s., 1-cwt. wooden kegs included.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£10 per ton d/d.
Grey	£20 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. „ „ 24° Tw.

Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 6d. ,, ,, Unrefined. Somewhat lower prices, however, are reported in some quarters.
Wood Naphtha—	
Miscible	6s. 6d. per gall. 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead	£39 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 8d. per lb. Very strong market.
Crude 60's	3s. 9d.-4s. per gall. Good demand, price steady.
Acid Cresylic—	
97/99	1s. 11d.-2s. 3d. per gall. Very fair inquiries.
Pale 95%	1s. 11d.-2s. 2d. per gall.
Dark	1s. 9d.-2s. per gall. Fair demand at steady prices.
Anthracene Paste, 40%	4d. per unit per cwt. Price nominal, market stagnant.
Anthracene Oil—	
Strained	9d.-11d. per gall. Fair demand for small lots.
Unstrained	8½d. per gall.
Benzole—	
Crude 65's	1s. 1d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall.
Pure	2s.-2s. 6d. per gall. Not many inquiries.
Toluole—90%	1s. 9d.-2s. per gall. Fair inquiry.
Pure	1s. 11d.-2s. 3d. per gall. Market better.
Xylol	2s. 9d.-3s. 3d. per gall.
Creosote—	
Cresylic 20/24%	1s.-1s. 1d. Fair business.
Middle Oil	8d.-10d. per gall. Market active.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d.-9¼d. per gall.
Solvent 90/160	1s. 6d.-1s. 9d. per gall. Market dull.
Solvent 90/190	1s. 6d.-1s. 7d. per gall. Fair business.
Naphthalene Crude—	
Drained Creosote Salts	£6-£9 per ton. Market steady, but supply short.
Whizzed or hot pressed	£9-£12 per ton. Fair inquiry for forward delivery.
Naphthalene Crystals	£17 per ton.
Naphthalene Flaked	£16 per ton.
Pitch, Medium Soft	£8 17s. 6d.-£9 5s. per ton. Plenty of business.
Pyridine—90/140	11s.-12s. Little demand.
Heavy	8s.-9s. Price still nominal. No inquiries.

INTERMEDIATES AND DYES

Acetic Anhydride	1s. 5d. 100% basis.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 7½d. lb.100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb.100% basis d/d.
Aluminium Chloride—	
Anhyd.	1s. per lb. d/d.
Aniline Oil and Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. 1d. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
Dinitrobenzene	11d.-1s. lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene—48/50	8d.-9d. naked at works.
66/68	1s. 2d.-1s. 3d. naked at works.
Diphenylamine	3s. 2d. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d, packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Meta Phenylene Diamine	5s. 6d. per lb. d/d.
Meta Toluylene Diamine	5s. per lb. d/d.
Monochlorbenzol	£70 per ton.
a-Naphthol	2s. 9d. per lb.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d.-8d. per lb.
Nitronaphthalene	1s. per lb. d/d.
Naphthionate Soda	2s. 8½d. lb. 100% basis d/d.
Orthonitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Chlorphenol	4s. 6d. per lb.
Paradichlorbenzol	£55 per ton.
Paranitrophenol	1s. 9d. per lb. 100% basis.
Parachloraniline	3s. per lb. 100% basis.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
Para Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
Para Toluidine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

In view of the uncertain position with regard to deliveries from Continental manufacturers, prices for all pharmaceutical chemicals are much firmer, and as supplies on the spot are none too large higher prices are expected in face of any material demand.

Acid Acetic, 80%	£46 10s. to £47. Market very firm.
Acid Acetyl Salicylic	3s. 1d. per lb. Advanced. A very firm market. The price of Phenol justifies higher figures.
Acid Benzoic	2s. 3d. per lb.
Acid Boric, B.P.	£61 per ton Crystals, £65 per ton Powder, packages in 2-cwt. bags.
Acid Citric	1s. 8½d. per lb. Market firm.
Acid Gallic	3s. per lb.
Acid Pyrogallic, cryst.	5s. 6d. per lb.
Acid Salicylic	2s. per lb. Very firm. Price advancing. Only small supplies of foreign product available. Some prices quoted as high as 2s. 3d.-2s. 6d. per lb.
Acid Tannic	3s. 3d. per lb. Little demand.
Acid Tartaric	1s. 2¾d. per lb., less 5%. Raw material still very firm. Price tendency upward. Demand expected to improve.
Amidol	9s. per lb.
Acetanilide	1s. 6d. per lb. Steady.
Amidopyrin	13s. per lb., with little demand.
Ammon. Benzoate	3s. per lb. for good makes.
Ammon. Carbonate, B.P.	£37 10s. per ton nett.
Barbitone	14s. per lb.
Benzonaphthol	5s. per lb. Unchanged.
Bismuth Salts	Steady demand at previous rates.

Bromides	In view of possible shortage on the Continent prices are much steadier and are likely to go higher. A few second-hand parcels still available on spot.
Chloral Hydrate	4s. 3d. per lb. Firm.
Formaldehyde, 40%	£90-£92 10s. per ton.
Guaiacol Carbonate	8s. per lb. Unchanged.
Hexamine	4s. 3d. per lb. Very firm and likely to go higher.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate	B.P. 2s. 5d. lb. Green 3s. 1d. lb. Market quiet.
Magnesium Carbonate—	
Light Commercial	£38 per ton.
Magnesium Oxide—	
Light Commercial	£85 per ton.
Heavy Commercial	£28 per ton.
Menthol	32s. to 33s. per lb. Poor demand. Prices lower.
Methyl Salicylate	2s. 4d. per lb. in bulk. Very firm in common with other phenol derivatives.
Methyl Sulphonal	13s. per lb.
Mercurials	Very firm. Quicksilver has advanced to previous price of £10 10s.-£11.
Paraformaldehyde	3s. 6d. per lb.
Paraldehyde	1s. 6d. per lb. Steady.
Phenacetin	5s. 3d. per lb.
Phenazone	7s. per lb.
Phenolphthalein	5s. per lb.
Potass. Bitartrate, 99/100% (Cream of Tartar)	95s.-100s. per cwt. less 2½%. Higher prices expected.
Potass. Iodide	15s. 8d. per lb. for cwt. lots. Cases free, good market.
Potass. Permanganate	9d. per lb. Very firm and a further advance is likely in the near future.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. Steady market.
Salol	2s. 4d. per lb. In steady demand.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 3d. per lb.
Sod. Citrate	U.S.P. quality, 2s. 2d. per lb. B.P.C., 2s. for quantity.
Sod. Hyposulphite— Photographic	£15-£17 per ton, according to quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s.-85s. Upward tendency.
Sod. Salicylate	2s. 4d. for Powder, 2s. 6d. for Crystal are the present rates, and with any large inquiry these prices would probably be advanced.
Tartar Emetic	1s. 4d.-1s. 6d. per lb.
Thymol	19s. per ib. Much firmer.

ESSENTIAL OILS

Anise Oil, Red Ship Brand	2s. 1d.
Cananga Oil, Java	9s.
Cinnamon Oil, Leaf	4d. per oz.
Cassia Oil, 80/85%	8s. 3d.
Citronella Oil—	
Java, 85/90%	4s.
Ceylon	3s. 6d.
Clove Oil	8s.-8s. 6d.
Eucalyptus Oil, 70/75%	1s. 8d.
Lavender Oil, Mont Blanc, 38/40%	12s. 6d.
Lemon Oil, spot	3s. New crop for shipment 2s. 11d.
Orange Oil, Sweet, Spot	10s. New crop for shipment 10s. 6d.
Otto of Rose Oil—	
Anatolian	24s.
Bulgarian	26s.
Palma Rosa Oil	17s.
Peppermint Oil—	
English, Mitcham	80s.
Wayne County	13s.
Japanese	6s. 6d.

PERFUMERY CHEMICALS

Amyl Acetate	2s. 3d.	per lb.
Amyl Butyrate	8s.	,,
Amyl Salicylate	3s. 3d.	,,
Anethol (melting point 21/22° C.)	4s. 6d.	,,
Benzyl Acetate from chlorine-free Benzyl Alcohol	3s.	,,
Benzyl Alcohol free from chlorine	3s.	,,
Benzaldehyde free from chlorine	3s.	,,
Benzyl Benzoate, 19.5° C.	3s.	
Cinnamic Aldehyde, 98/100%, Natural	14s. 9d.	,,
Coumarin	12s. 6d.	,,
Citronellol	22s. 6d.	,,
Citral, 100%	9s. 6d.	,,
Ethyl Phthalate	4s. 3d.	,,
Eugenol	11s.	,,
Geraniol (from Palma Rosa)	30s.	,,
Geraniol	6s. 6d.-12s. 6d.	per lb.
Iso Eugenol	18s. 6d.	per lb.
Linalol ex Bois de Rose	21s.	,,
Linalyl Acetate	22s. 6d.	,,
Methyl Benzoate	8s. 6d.	,,
Musk Xylol	9s.	,,
Phenyl Ethyl Acetate	10s.	,,
Phenyl Ethyl Alcohol	17s. 6d.	,,
Rhodinol	45s.	,,

TRADE NOTES

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications for licences under the above Act made during the month of February, 1923, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 646, of which 514 were from merchants and dealers. To these should be added 56 applications outstanding on February 1, making a total of 702 for the month. These were dealt with as follows:—

Granted, 463 (of which 441 were dealt with within seven days from receipt).

Referred to British makers of similar products, 121 (of which 116 were dealt with within seven days from receipt).

Referred to Reparation supplies available, 88 (all of which were dealt with within 48 hours of receipt).

Outstanding on February 28, 30 (mostly applications received on February 28).

Of the total number, 702, of applications received, 553, or 79 per cent. were dealt with within three days of receipt.

The French Chemical Market during February

The general tendency of the chemical market is towards increased prices, due chiefly to the cost of coal and fluctuations of certain foreign currencies.

Fertilisers were in active demand during the month. Orders for superphosphates are numerous and deliveries, to some extent, slow, owing to small stocks. The price may be expected to rise. Mineral superphosphate (14%) is quoted at 18 fr. at Nantes, 19 fr. at Rouen, Bordeaux and Marseilles, and 19·50 fr. at Brest; 16% superphosphate is quoted at 22 fr. at Marseilles and bone superphosphate (0·5% nitrogen and 10% phosphoric acid) at 34·50 fr. at Paris and 33·50 fr. at Somme. High prices of bone fertilisers are keeping back the demand. Basic slag is in short supply and manufacturers are only filling previous orders, so that a rise in price is anticipated. Quotations for basic slag at Thionville are:—17%, 14·45 fr.; 19%, 16·15 fr.; 21%, 17·25 fr. The nitrate of soda market is dull owing to fluctuations in the pound sterling. Stocks are normal, but insufficient to meet any sudden demand. French ammonium-sulphate manufacturers have fixed prices for March at 125 fr. per 100 kg. for common grade and 130 fr. for extra dry at works. French production is small. German deliveries have ceased and, despite the unfavourable exchange, buyers will probably have to turn to the English market to obtain stocks. Nitrate of lime is in great demand, but in short supply. Granulated cyanamide is no longer available, and the powder sells at 3·75 fr. per unit of nitrogen for samples averaging 18 to 21% of nitrogen. Among potash fertilisers, sylvinite is in good demand, but deliveries are slow and there are many inquiries for sulphate of potash. The sales of organic fertilisers except compound manures such as phosphatose and nitragine, continue active.

General Chemicals.—The demand for copper sulphate has caused the price to rise to 179 fr. at Marseilles (crystals); supplies of ferrous sulphate do not meet the demand.

Prices of petroleum products have risen generally. The *National Fuel* is quoted at 95 fr. per hectolitre on rail.

Prices of wood-distillation products have also risen generally, except turpentine, which is now quoted at 750 fr. the hectolitre. Prices of resin have risen still more rapidly and there is difficulty in obtaining supplies. A further rise of 15 to 20% in the price of wood-distillation products is probable.

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JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

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EDITORIAL

EVER since the dry photographic plate was introduced by R. L. Maddox in 1871, the history of the photographic industry—founded on the discovery by Thomas Wedgwood in 1802 of a method of producing "sun-pictures"—has been one of constant progress. Starting with extremely slow plates, inefficient lenses, and few chemical reagents, the photographer now has a choice of reliable materials suitable for all, even the most unreasonable, conditions, and but rarely has he reason to complain. The Photographic Fair, an account of which is to be found elsewhere in this issue, bears striking testimony to the amount of scientific research and control which has gone to build up so large an industry, utilising such delicate reactions and materials. After Dr. Herbert Levinstein's speech in Manchester, detailing the progress of the British fine-chemical industry, the wide range of photographic chemicals exhibited by Messrs. Johnson & Sons came not as a surprise but as a pleasure, and we can only hope that the public will give this branch of the chemical industry the support it so surely deserves. To those accustomed to handling the older types of dry plate, the quality combined with the enormous speed attributed to the ultra-rapid plates of Ilford, Ltd., and of the Imperial Dry Plate Company, would seem exaggerated. But experience goes to show that the claim of speeds of 700 to 650 respectively, measured by the Hurter and Driffield system, for these plates is amply justified. Performance such as this well illustrates the perfection of modern plate making, and holds out hope of still further, undreamed improvements. The importance of this latest step in plate-making can be appreciated when it is remembered that, thirty years ago, the fastest plate available had a speed of 200 H. & D., and even then required the most careful handling, a disadvantage from which these modern ultra-rapid plates are free. It is also gratifying to learn that British base paper is now being largely used in the manufacture of photographic papers, and this and other advances indicate the progress made by what can not unreasonably be claimed as a branch of the fine-chemical industry.

* * *

It is a fortunate circumstance that in the year in which we celebrate the work of Pasteur we should be favoured by visits from some of our distinguished French colleagues. A number of these are in London this week and a larger number we hope to welcome at Cambridge in June. The work of Pasteur, perhaps not the greatest French chemist, but certainly the greatest man among French chemists, was developed from the earlier work on crystals to which his compatriots so largely contributed. It was Romé de l'Isle and Haüy in the eighteenth century who made crystallography a science, Malus, Arago and Biot in the first fifteen years of the nineteenth century who made the fundamental discoveries of polarization and optical activity. Charles Kestner, the great-uncle of our very good friend the President of the Société de Chimie Industrielle, discovered para-tartaric acid and de la Provostaye studied the crystalline forms of the tartrates and paratartrates. We ought not to forget the valuable work in some of these subjects of Gay-Lussac, but it is already evident that the genius of Pasteur was applied to a science which was as French then as the benefits conferred upon mankind are now international. Pasteur's work took him out of the domain of pure science, but others continued the investigation of crystals, and the light they throw on the constitution of chemical compounds.

* * *

Pasteur had some clear conception, founded on rather unreliable reasoning, as to the existence of asymmetric carbon atoms in optically active organic acids, but it was Professor Le

Bel, another visitor whose presence honours us this week, who worked out, simultaneously with but independently of van't Hoff, a complete theory of molecular asymmetry. His theory, published now nearly fifty years ago, has been tested in a great number of instances and is universally accepted, not even the disciples of Kolbe dissenting. We are proud to welcome the representatives of a nation which has advanced human knowledge to such a remarkable extent and glad that some of our own men of science, whose names are obvious, are worthily following in the paths, but dimly imagined by those of an early date, now identified as optical activity and crystal structure, including in this its application to tautomerism in organic compounds, co-ordination and the benzene ring.

* * *

It was only last week that we published some news about Hafnium; now whether this has or has not some disputed atomic number will be definitely known in a few weeks, and Professor Urbain, another of our distinguished guests, has so many pieces of first-class work to his credit that he will neither be unduly exalted if celtium turns out to have the atomic number 72 nor unduly depressed by disappointment if this turns out otherwise. His contributions to our knowledge of the rare earths and to spectroscopy have been so immense that his glory will be little affected either way. Professor Le Chatelier has worked out the general principles of resistance to change. We confess that our knowledge of thermo-dynamics is inadequate for a popular exposition of Le Chatelier's law, but it seems to us from a recollection of the correspondence which reached us after one or two innovations we attempted in the Journal that some of our readers have the principles thoroughly implanted in them.

* * *

The Abbé Senderens has for more than a score of years worked at catalysis, and he and Sabatier laid the foundations for the present processes of hydrogenation of oils; their work on nickel as a catalyst is of the utmost importance and is well known to all who are familiar with the use of catalysts in industrial operations. We alluded recently in our columns to the clergymen who, as a hobby, read and write on various branches of science, and without wishing in any way to slight the importance of their contributions, we may say that in its industrial applications the work of the Abbé Senderens exceeds all those we remember. Messieurs Kestner, Deschiens and Gérard have an enduring sign of their tact, skill and industry in the prosperity of the Société de Chimie Industrielle, and we are grateful to them, and particularly to Monsieur Kestner, for the extraordinary zeal they have shown in promoting a good feeling between French and English chemists.

THE PRODUCTION OF LEAD IN BRITAIN

By PROF. H. LOUIS, M.A., D.Sc.

(Continued)

Although smelting by natural draught was thus in use as late as the seventeenth century, it by no means follows that other furnaces worked by blast had not been introduced, and we have indeed evidence that such was the case. The fuel was, of course, either wood or charcoal. It is interesting to note that in "A Just and True Remonstrance of His Majestie's Mines Royal to His Majestie," addressed to King Charles the First, in 1641, by a Mr. Bushell, who was interested in the lead mines of Cardiganshire, the author states that he had had experiments made in order to "try whether fuel of turfe would separate the oare, extract the silver and reduce litharge" as well as charcoal, and found that he could do so by the use of charred peat. It is difficult to conceive that this experiment could have been a success unless the furnace had been worked by blast. The earliest account of this form of lead smelting appears to be contained in two notes from Joseph Glanvil, published in the *Philosophical Transactions*, for 1667[18] and 1668,[19] respectively. These were written in answer to a series of inquiries concerning mines, published in the above *Transactions* (Vol. II., No. 19, p. 331), and are stated to refer specifically to the operations as conducted in the lead mines of the Mendip Hills. The following are the two passages which refer to the smelting operations :—

"They beat the Ore small, then wash it clean in a running stream; then sift it in Iron Rudders[20]; then make of Clay or Firestone a Hearth or Furnace which they set in the Ground, and upon it build their Fire which is lighted with Charcoal and continued with young Oaken Gads[21], blown with bellows by Mens treading on them; and after a fire is lighted and the fireplace hot, they throw their Lead Ore upon the Wood which melts down into the Furnace; and then with an Iron-Ladle they take it out, and upon sand cast it into what forme they please."

"There is much difference in the goodness of the Ore; 36 hundred of Ore may yield a tun of lead. . . . They beat the Ore with an Iron flat piece; cleanse it in water from the dirt; sift it through a Wire-sive. The Ore tends to the bottom and the Refuse lies at top. And these are the Preparations they make use of before 'tis fit for fusion. Then they have a hearth about 5 foot high, set upon timber to be turn'd as a Wind-mill to avoid the inconvenience of Smoak upon a shifting Wind. The Hearth contains half a bushel of Ore and Coal, with bellowes on the top. The charcoale is put upon the Hearth where the Ore is; laying dry Gads upon the top, which they call their White coales. There is a sink upon the side of the Hearth, into which the lead runs, that holds about an hundred and an half. Then it is cast into Sand, and runs into those Sowes (as they call them) which they sell. They have a barr to stir the Fire; a shovel to throw it up; and a Ladle heated red-hot to cast out the Metal."

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[18] Vol. II., No. 26, p. 525.

[19] Vol. III., No. 39, p. 767.

[20] *i.e.*, riddles or sieves (H.L.).

[21] *i.e.*, sticks or branches (H.L.).

It is interesting to note that this writer also refers to the use of the "Slagg-Hearth," although he does not seem to be very clear as to its exact purpose. The description is evidently written at second-hand, but gives upon the whole a fairly good idea of the method of smelting in use at the time. Apparently there was no great change in the process for some considerable time, as may be gathered by the description of lead smelting in Derbyshire, by John Martyn, F.R.S., written in 1729[22]:—

"When the Ore is brought up from the Mine it is broken to Pieces so that the Spar, Cawk, or other Bodies which adher'd to it may be the more easily separated. It is then thrown into a large Sieve and washed, and so farther purified from extraneous Bodies. After this it is carried to the Furnace in order to be smelted. The Furnace which I saw near Warksworth was very rude and simple, consisting only of some large rough stones placed in such a manner as to form a square Cavity, into which the Ore and Coals are thrown *stratum super stratum*; two great Bellows continually blowing the fire being moved alternately by Water. I saw no other Fuel used on this Occasion but dried sticks which they call white Coal. Mr. Ray informs us that they use both white and black Coal or Charcoal in Cardiganshire. . . . When the Ore is melted it runs out at an opening in the bottom part of the Front of the Furnace, through a small Channel made for the Purpose, into a cylindrical Vessel out of which it is laded into the Mould. The Dross of the Ore on smelting is called Slag. This Slag is afterwards smelted again with Coke only and the lead obtained from it is called *Slag-lead*."

The most detailed and accurate information that we possess concerning the history of lead smelting is to be found in the accounts of the Bishopric of Durham, which have been kept carefully for many centuries and which owe their value to the fact that the See of Durham owned the lead mines of Weardale from a very early period. Roman remains have been found in Weardale, notably the Roman altar dating from about A.D. 240, which was discovered close to the village of Eastgate in 1869, but there is no evidence at all that the lead mines of this region were worked by the Romans. The first definite reference is the well-known Charter of Stephen, in which he grants absolutely the "minariam de Werdela" to his nephew Bishop Hugh Pudsey, whilst the latter in his turn granted a lead mine for roofing certain of the churches in Durham.[23] All through the twelfth and thirteenth centuries there are references to these mines. In 1426 there are detailed accounts of the smelting of the lead at "Les Bolehill" at Wolsingham. Payments were made to certain specified "bolers," whilst it is definitely stated that a certain amount of lead was smelted by the use of a wheel and by the feet of men, referring apparently to bellows worked by water-power and by foot.[24] It may be assumed that the wind furnace would be used whenever the wind was suitable, but that under other conditions mechanically produced blast would be employed. The type of hearth was probably very much the same as it was in Derbyshire in 1729, as described by Martyn. This furnace was obviously the prototype of the ore hearth, or Scotch hearth, as we know it to-day. Although this furnace is and has long been built of cast-iron blocks, these are still known as "stones"—*e.g.*, the pipe stone or cast-iron block through which the tuyere passes, the work-stone or sloping plate of cast iron which forms the front of the furnace, etc. These terms make it appear highly probable that the ore hearth is a direct descendant of the crude furnaces above referred to. For another century these methods of smelting continued, though it appears that slag hearths were already in use in the latter part of the fifteenth century, as there are several records in the Durham accounts of payments for carting "blackwerk" (in all probability black slag) from the "boilisted" to the "smelting place."[25] Probably about this time the shortage of fuel began to make itself felt, and this would have induced Cardinal Wolsey, who at that period held the Bishopric of Durham, to attempt to smelt lead with pit coal, which attempt was made at a "great furnace" at Gateshead. Though we have no record of the construction of this furnace, or of how it was intended to carry out the process, it is quite evident that the experiment was a failure. In 1527 Cardinal Wolsey leased his furnace at Gateshead and all mines within the Bishopric for a term of thirty years at a rent of £5 per annum, and for another century nothing further is heard of any attempt to use mineral fuel. In 1678 the patent right was granted to George Lord Viscount Grandison, "to melt and refine lead oare in close or reverberatory furnaces with pitt coale or sea coale," etc; and 1690, John Hodges obtained a patent for "a way of melting and refincing lead ore in close or reverberatory furnaces with pitt coal," etc."[26] It is highly probable that one or both of these patents formed the basis upon which was founded the important Company generally spoken of as the London Lead Company, the full title of which is the Governor and Company for Smelting down Lead with Pit Coal and Sea Coal, founded in London in the year 1692, under a Charter of William and Mary. From a modest beginning this Company extended its operations all over the kingdom, and for over two centuries it exercised a most important influence upon the progress of lead smelting in Great Britain. This Company appears to have been originally formed to apply this process of lead smelting to works at Bownham, near Bristol. It soon acquired lead mines in Wales, some of which were in full work during the Middle Ages. The first notice of the lead mines of Cardiganshire dates back to 1485, when Henry VII. appointed Jasper Duke of Bedford and certain others to be the Commissioners and Governors of all his Mines of gold, silver, tin, lead and copper in England and Wales. The Society of the Mines Royal was formed under patent granted by Queen Elizabeth in 1568, and several of the Cardiganshire lead mines worked under this corporation. It is recorded that in 1667 these mines had four great wheels which worked the bellows and the stampers.[27] In 1704 the London Lead Company acquired mines in Alston Moor, and about twenty years later various others in Durham. Again in 1745 the Company leased a number of mines in the Teesdale district, with which it remained closely connected up to the end of its career. It also extended its operations into Scotland. The mines of Wanlockhead and Leadhills appear to have been worked in the thirteenth century. Sir James Stampfield worked them from 1680 to 1691, and apparently in 1721 they were leased to the London Lead Company, but it appears that this tenure terminated in 1755.[28] In 1792 the Company concentrated its operations in the dales of Durham and the northern portion of Yorkshire, and their holdings must have been considerable, seeing that in 1809 they paid to the Bishop of Durham royalties of over £5000 in respect of the Weardale mines.

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[22] Phil. Trans., 1729, No. 407, Vol. XXXVI., p. 27. "An Account of some Observations relating to Natural History made in a Journey to the Peak of Derbyshire, 1729."

[23] Victoria History of England: Durham: Mining, p. 349.

[24] Ibid., p. 349.

[25] Loc. cit., p. 351. The above spelling suggests that possibly a bole-hill or bole-stead was a place where lead was "boiled," *i.e.*, smelted out of the ore.

[26] Percy's Metallurgy of Lead, p. 218.

The Company appears to have prospered exceedingly up till about the middle of the nineteenth century, when its production began to fall off. Some of the mines in Teesdale and the smelting works at Eggleston continued in operation on a very reduced scale until this famous old company was finally wound up in 1905.[29]

The reverberatory furnace was apparently introduced in Flintshire about the beginning of the seventeenth century, and within the next fifty years these furnaces, or cupola furnaces as they were then called, had spread to the other lead smelting districts of England, and both the reverberatory furnace and the ore hearth have continued in use up to our time. The successive modifications in the smelting process are well shown in a chapter on the "Smelting of Lead Ore," by John Farey.[30] The following are some of the more important extracts from this writer :—

"In the early periods of the Mining in Derbyshire, the Ore was smelted on the tops or western brows of high Hills, by fires made of Wood, and blown by the Wind only, as is supposed, piles of stones being made round the fire, and perhaps arches were formed underneath them, to favour and increase the effect of the wind on the fire : these ancient hearths were called Boles, and whence many of the highest Hills in and near to the Lead Districts obtained their names.

"These very ancient Boles or Wind Hearths were succeeded by Slag-mills or Hearths almost like a Blacksmith's forge on a large scale, blown by large bellows worked by Men or by Water, one of which is still to be seen attached to each of the Cupolas that can command a stream of water, for re-melting the black or drawn Slag of their Cupolas.

"The Cupolas or low-arched Reverberatory Furnaces, now exclusively used for the smelting of Lead-Ore in Derbyshire, were introduced from Wales by a company of Quakers, about the year 1747, the first of which was erected at Kelstedge, in Ashover."

A full description is given of the method of smelting in a reverberatory furnace of the then most modern type, the furnace being 10 ft. long and 6 ft. wide in the middle inside, connected by flue with a stack 50 ft. in height with doors or openings on either side. The usual charge is stated to be 16 cwt. of 120 lb. each, and the charge is said to take from seven to eight hours to work, the produce being about 66 per cent. of metal. The author states, however, that "The quality of the Ore has become so much worse, owing to the low state of the Mines, that a charge of 16 cwt. of Ore, produces more Slag now than 20 cwt. did about twenty years ago, and is still increasing." Incidentally, it is interesting to note that the writer voices the complaint which we constantly hear in our time as to the number of different units of weight in use :—

"The Pieces or half Pigs of Lead are not of any certain weight, though the Smelter here endeavours, in filling the Mould, to approach as near to 176¼ Avoirdupois as he can, this being the 16th part of the Mill-fodder in use here, consisting of 23½ long cwt. (of 120 lb.) or 2820 lb., which is the largest of twelve Fodders used in different places, to the no small inconvenience and disgrace of this Trade."

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[27] Memoirs of the Geological Survey, Vol. II., Part 2, 1848, p. 636.

[28] The Wanlock Head Lead Mines. By John Mitchell. The Mining Magazine, July, 1919, Vol. XXI., p. 11.

[29] Victoria History of England: Durham: Mining, p. 352.

[30] General View of the Agriculture and Minerals of Derbyshire, by John Farey, Senr., Mineral Surveyor, 1811, Vol. 1, p. 380, 383, 385, 390.

The process appears to have undergone but little modification since the beginning of last century. Thus, Dr. John Percy, in his Classical work on Lead, gives an account of lead smelting in the reverberatory furnace, or the Flintshire furnace as he calls it, from which it would appear that in 1859 the hearth was about 10 ft. long and 9 ft. wide; that it received a charge of 21 cwt. of ore, which was worked in six hours with a consumption of 12 to 16 cwt. of coal, yielding about 63 per cent. of lead direct from the furnace and producing about 4 cwt. of slag. Apparently the view of most smelters appears to be that this type of reverberatory furnace had better be replaced than improved, more recent practice running entirely in the direction of oxidising the ore in a reverberatory furnace and smelting it in a blast furnace or water jacket.

It may well be conjectured that the ore hearth would still be holding its own to-day, seeing that it is admirably adapted for the smelting of pure, finely crushed lead ores, if workmen could be got to give the same care and attention to the smelting operations that they used to do, but it has been noteworthy that this is far from being the case. The men got into the habit of working their fires at longer and longer intervals, the make of lead decreased, and the proportion of fume produced increased, so that, by such practice, taken in conjunction with the steadily rising price of wages, the ore hearth is being gradually driven out of existence.

It need hardly be said that all improvements in general mining practice naturally helped the operations of lead mining also, and the same is true of dressing. It is probable that for many years but little improvement took place beyond the methods described by Agricola in Germany, and which no doubt in due course became known in this country, and which are about the same as those described by Glamil. It is on record that in Queen Elizabeth's time German miners were brought over to this country in order to instruct British miners in the more advanced methods then used on the Continent, and there is no reason to doubt that they brought with them such improvements as there were in dressing also. It is probable that until the eighteenth century the ore was crushed and hotched by hand; the only form of mechanical crushing in use up to that time—namely, that of stamping—is somewhat unsuitable to soft, highly cleavable ores like galena, and was never extensively applied to them. Crushing rolls were first devised in the North of England, probably in connexion with the lead mines, about 1800. The old round sieve jerked up and down in a tub of water was replaced by a larger rectangular sieve, worked by a compound lever or breakstaff, and in the early part of the nineteenth century these levers were worked mechanically. The modern jig, with moving piston and fixed sieve, appears to have been introduced in the Cornish Mines by Petherick about 1830, and it, too, was soon adapted to lead mining purposes. The importance of these various improvements in the methods of dressing are due to the fact that both the smelting hearth and the English reverberatory furnaces are only suited to the treatment of tolerably pure ore broken small, such as is produced by dressing operations.

All modern improvements in the production of lead, such as blast-roasting and smelting in huge water-jackets, like those which are in use in America to-day, are only intended for operations on a very large scale, and are quite unsuited to small mines. Mines of the former type do not in fact exist in Britain, and hence it is that British lead-smelting practice may be said to have become more or less stationary. A few works have adopted the modern methods above referred to, but without any conspicuous measure of success, owing to the fact that even if they purchase and import ores they are nevertheless restricted to a relatively moderate scale of operations.

Reference may perhaps be here made to the great improvements effected in this country in the process of desilverisation of lead. The first of these was due to Mr. Hugh Lee Pattinson, whose patent is dated 1833, depending upon the fact that when molten argentiferous lead is cooled slowly until a portion crystallises, the crystals contain much less silver than the portion which still remains liquid. This process was extensively employed until the introduction of Parke's process, patented by Mr. Parke in 1850, which is based upon the fact that if molten zinc is mixed with argentiferous lead, the zinc, solidifying first, abstracts the greater part of the silver, leaving the lead comparatively free from silver. This process is cheaper in its execution than the previous one, and therefore gradually displaced it.

An account of this subject would be incomplete without some reference to the output of lead in Britain. About 1830 the production was between 45,000 and 50,000 tons per annum, and there is reason to suppose that this was about 50 per cent. of the world's total output; in that year the United States was producing only on a small scale, its production being well under 10,000 tons. British production continued to increase pretty steadily, reaching its general maximum about the year 1855, after which it receded somewhat, rising again to about the same level in the year 1870, with an output of over 74,000 tons, and since that date it has been continuously declining. The following table shows the production of lead in Great Britain, the figures given being the quinquennial average output. Wherever known, the percentage which this output forms of the world's total production is also indicated:—

Period	Production of lead in Britain. Quinquennial average Tons	Percentage of world's production
1845/9	54,127	—
50/4	64,837	—
55/9	67,528	—
60/4	66,697	about 30
65/9	69,458	—
70/74	63,385	—
75/79	56,432	—
80/84	47,026	13·6
85/89	37,648	7·6
90/94	30,944	5·1
95/99	26,820	3·7
1900/04	27,507	3·1
05/09	22,339	2·2
10/14	18,890	1·7
15/19	12,099	1·2

The main fact that emerges from the study of these statistics is that Britain, which once exercised control over the lead market of the world, has now become a negligible factor. This is due not only to the rapid strides made by other nations, notably by the United States, but even more to the exhaustion of the British lead deposits, and there is no reason to suppose that Britain will ever again become a producer to be reckoned with in estimating the world's supply of lead. We have had our day!

SYNTHETIC ORGANIC CHEMICALS

We have received the ninth list of synthetic organic chemicals manufactured by the Eastman Kodak Co. of the United States. The present list contains the names of over 1500 chemicals which are in stock. Three qualities are supplied: "Eastman" chemicals, of the highest possible purity; "Practical" chemicals, not of the highest purity, but suitable for laboratory work; and "Technical" products as obtained from large-scale manufacturers and supplied in small quantities for experimental work. New chemicals are continually being added to the list, and it is worthy of note that many of the prices have been reduced owing, it is stated, to the increased demand and consequent lower cost of production. The practice of incorporating specifications of melting and boiling point ranges has been continued, and these data, obtained from actual laboratory observations, can be regarded as standards of quality below which these chemicals do not fall. The quality of certain chemicals has actually been improved, and directions are being prepared for some special reagents mentioned in an appendix to the list. The Eastman Kodak Co. will be glad to learn of new organic compounds available for purchase, of new sources of supply, or new chemicals required, as the company hopes not only to prepare materials, but to assist organic chemists. Copies of this list can be obtained on application to the Eastman Kodak Company, Rochester, United States.

THE ESTIMATION OF SODIUM HYDROSULPHITE

By R. W. MERRIMAN, M.A., D.Sc.

The manufacture of stable sodium hydrosulphite, $Na_2S_2O_4$, illustrates the characteristic energy of the German technical chemist in working at a problem for many years until final success is reached. Bernthsen and his collaborators, among others, continued the attack for over a quarter of a century, with the result that stable sodium hydrosulphite has been in general use for the past 18 years.

Many methods have been devised for the estimation of sodium hydrosulphite, but the only one which has survived critical examination for technical purposes is the Indigo-Carmine method. Synthetic "Indigo Pure" is constantly above 98 per cent. strength, and is readily purified by extraction with hot 90 per cent. phenol, the 100 per cent. indigo so obtained forming the standard upon which the strength of sodium hydrosulphite is based. An elaborate apparatus is necessary for the exclusion of air during the analysis, but the method offers no difficulties when a large batch of pure indigo has been prepared.

The Indigo-Carmine method satisfied all requirements so long as the use of sodium hydrosulphite was confined to vat dyers who found it necessary to do daily estimations. At the present time, however, sodium hydrosulphite is used for a large variety of purposes, *e.g.*, the estimation of oxygen in gases and the removal of oxygen from technical gases, the estimation of nitro-compounds and dyestuffs, the manufacture of dyestuff intermediates and drugs such as salvarsan, the bleaching of textile fabrics, straw, leather, glue, gelatin, sugar, glucose, soap, oils, fats, grain, flour, and asbestos. The chemist controlling such processes only requires to make an occasional estimation of sodium hydrosulphite, and a simple method of analysis has been searched for during many years. The following new method is based on standard iodine solution and no apparatus is necessary for the exclusion of air:—It has been known for a long time* that sodium hydrosulphite, in the presence of excess of formaldehyde, breaks up into a mixture of sodium sulphoxylate formaldehyde ($NaHSO_2$, CH_2O, ${}_2H_2O$) and sodium bisulphite formaldehyde ($NaHSO_3$, CH_2O, H_2O) according to the equation:—

$$Na_2S_2O_4+2CH_2O+{}_4H_2O=NaHSO_2,\ CH_2O,{}_2H_2O+NaHSO_3,\ CH_2O,\ H_2O.$$

The following method for estimating sodium hydrosulphite is based on the above fact:—

Sodium bisulphite formaldehyde is not acted upon by iodine in neutral or acid solution. Sodium sulphoxylate formaldehyde reacts with iodine in neutral or acid, solution according to the following equation :—

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* (1) Baumann, Thesmer and Frossard, *Bull. Soc. Ind. Mulhouse*, 1904, **74**, 348; 2 *Z.f. Farb. and Textilind*, 1905, **4**, 292.

(2) Bazlen, *Berichte*, 1905, **38**, 1064.

$$NaHSO_2,CH_2O,2H_2O+4I=NaHSO_4+CH_2O+4HI.$$

It is clear, therefore, that the action of iodine on a solution of sodium hydrosulphite in excess of formaldehyde is to be represented by the equation :—

$$Na_2S_2O_4+2CH_2O+4I+3H_2O=NaHSO_4+4HI+CH_2O+NaHSO_3,CH_2O,H_2O.$$

That is, one molecular weight of $Na_2S_2O_4$ reacts with 4 atoms of iodine or 40 litres of N/10 iodine solution.

40,000 c.c. N/10 iodine=174·1 g. $Na_2S_2O_4$.

1 c.c. N/10 iodine=0·004352 g. $Na_2S_2O_4$.

The application of this method of estimation is described below.

Preparation of solution of hydrosulphite in formaldehyde—As the contents of a keg of hydros are apt to be shaken into layers of different strengths during transit, a proper sampler should be used in taking an average sample of the keg. The contents of the sample bottle should be shaken before weighing out the 10 grams required for the analysis. The 10 grams may be weighed out on an open watch glass if done rapidly. After some experience in weighing out this quantity of hydros, it can be performed accurately in a few seconds. The neck of a standard litre flask is cut off to within one inch of the graduation mark and is provided with a well-fitting rubber stopper; 20 c.c. of 40 per cent. formaldehyde is placed in the flask and distilled water is added, leaving room for another 50 c.c. of water. The flask is shaken to mix the formaldehyde uniformly with the water. The liquid in the flask is given a whirling motion by rotating the flask and 10 grams of the sample of hydrosulphite is poured into the flask down a dry funnel with a short stem. The funnel and watch glass are washed down rapidly with water, the volume is made up to the mark, the stopper inserted and the flask shaken vigorously. The whirling motion given to the liquid prevents the hydrosulphite sinking to the bottom and forming a cake. To obtain a uniform solution, it is necessary to shake the flask by inverting it repeatedly for five minutes, because of the small air space available.

Titration—About 100 c.c. of water followed by 20 c.c. of the hydrosulphite solution are placed in a beaker, using a standard pipette; 50 c.c. of N/10 iodine solution is at once added by a standard pipette. The light brown liquor is left for two minutes and the excess of iodine is back-titrated with N/10 thiosulphate solution with starch as indicator. No precautions are necessary to exclude air.

Examples—In each case 10 g. of the hydrosulphite and 20 c.c. of 40 per cent. formaldehyde were placed in the litre standard flask, 20 c.c. of this solution was taken for the titration and 50 c.c. N/10 iodine added as described above.

(1) *Works batch of sodium hydrosulphite testing* 99·5 *per cent. by the Indigo-Carmine method*

Thiosulphate required for the back-titration :

(*a*) 4.·55 c.c. N/10. (*b*) 4·60 c.c. N/10.
(*c*) 4·50 c.c. N/10.

Volume of iodine used=50−4·55=45·45 c.c., *i.e.*, equivalent to 45·45×0·004352 g. hydrosulphite. This is contained in 20 c.c. of the solution, in which 0·20 g. of the hydrosulphite was dissolved. The percentage content of sodium hydrosulphite$=\frac{45{\cdot}45\times4{\cdot}352}{2}=$98·9 per cent.

(2) *Mixing which has been reduced to standard strength with pure NaCl testing* 90 *per cent. by the Indigo-Carmine method*

Thiosulphate required :

(*a*) 9·15 c.c. N/10. (*b*) 9·00 c.c. N/10.
(*c*) 9·05 c.c. N/10. Mean 9·07 c.c.

∴ N/10 iodine used=40·93 c.c. Therefore, the percentage content of sodium hydrosulphite$=\frac{40{\cdot}93\times4{\cdot}352}{2}=$89·1 per cent.

It has been found, during an extended use of this method, that the action of formaldehyde on sodium hydrosulphite is an interesting "time reaction" and takes 15 minutes for completion with the quantities specified above. The solution of sodium hydrosulphite in formaldehyde should be left for 15 minutes before analysis. With 50 c.c. of formaldehyde (40 per cent.), the reaction is finished in about 5 minutes. A correction should be applied for the loss of hydrosulphite due to oxidation by dissolved air and by the small quantity of air in the flask below the cork, before the formaldehyde has had time to combine completely with the sodium hydrosulphite.

It is evident that this simple method is available for the testing of fresh commercial hydrosulphite which contains only sodium chloride in addition to the sodium hydrosulphite; but a technically useful method of analysis must have wider possibilities.

Sometimes the works chemist finds a partly used keg of "hydros" with the lid off and the contents smelling very strongly of sulphur dioxide and he requires to know how far the decomposition has proceeded. The alteration in weight of decomposed "hydros" is very small as the absorption of oxygen and moisture counterbalances the loss of sulphur dioxide. The following investigations, which are typical of a large number, prove that the products of decomposition do not interfere with the new method of estimation :—

(*a*)—320 g. of sodium hydrosulphite was spread out on a large dish and exposed to the atmosphere of a laboratory kept at about 60° F. From time to time the contents of the dish were mixed with a spatula and two separate 10-g. samples were removed for estimation by the Indigo-Carmine and iodine methods. The results obtained are tabulated below :—

Date	Weight of hydros	Removed for analysis	Indigo-Carmine method Per cent.	Iodine method Per cent.
Jan. 22	320	20	98·5	98·0
„ 26	298·8	20	90·0	89·1
„ 30	279·5	20	69·1	68·0
Feb. 2	259·3	20	51·8	52·2
„ 6	238·4	20	46·4	46·9
„ 9	217·8	20	41·5	42·0
„ 13	197·4	20	36·0	36·2
„ 16	176·9	20	33·2	33·5
„ 20	156·4	20	29·7	30·2

(*b*)—A sample of "hydros" received from Germany in a broken cardboard box had lost its power of decolorising Indigo-Carmine. 10 g. dissolved in dilute formaldehyde solution only absorbed 4 c.c. of N/10 iodine, corresponding to 0·17 per cent. of sodium hydrosulphite. 1 g. dissolved in water absorbed 23·1 c.c. N/10 iodine, corresponding to 12% $NaHSO_3$. 1 g. boiled with dilute HCl and $BaCl_2$ gave 1·0330 g. of $BaSO_4$, corresponding to 62·9% Na_2SO_4.

These results indicate that the iodine method may be applied to sodium hydrosulphite in any stage of decomposition. The solutions of decomposed hydrosulphite are perfectly colourless and clear, showing that free sulphur is absent. The agreement between the results obtained by the two methods proves the substantial absence of sodium thiosulphate.

SOME PROPERTIES OF MERCURIC IODIDE

By Dr. T. SLATER PRICE, O.B.E.

The enantiotropic forms of mercuric iodide, distinguished as they are by a marked difference in colour, have been the subject of extended investigations by many chemists, who have given their attention not only to the change of one form into the other, but have also extended their observations to the photosensitiveness of the two forms. As is well known the red modification, which consists of tetragonal crystals, is stable at ordinary temperatures, and the yellow modification, consisting of rhombic crystals, at higher temperatures, the temperature at which the one form changes into the other, the transition temperature, being somewhere about 127° (Rodwell *Phil. Trans.* 1882, **173**, 1125, and Gernez, *Comptes rend.*, 1895, **120**, 921, give 126°, as also Kastle and Reed, *Amer. Chem. J.*, 1902, **27**, 209. Reinders, *Zeitschr. physikal. Chem.*, 1900, **32**, 507, gives 129·5°, and Schwarz, *Preisschrift, Göttingen*, 1892, 129·3°).

Although the red modification is the stable form at ordinary temperatures and below 127°, the yellow form is readily obtained at these temperatures, it then changing more or less gradually into the red enantiotrope. It is a matter of common observation, for example, that when mercuric iodide is precipitated from a solution of mercuric chloride by the addition of potassium iodide the first formed precipitate is yellow. Bancroft (*J. Phys. Chem.*, 1896, **1**, 142) showed that when a solution of mercuric iodide in methyl alcohol (ethyl alcohol may also be used) is poured into water the yellow iodide is precipitated, and Gernez (*Comptes rend.*, 1899, **128**, 1516) found that if the red iodide is sublimed it condenses as the yellow form. The crystals which separate from a solution of the iodide in various organic solvents, *e.g.*, phenol, naphthalene, salol, vaseline, and many others, are yellow (Kastle and Clark, *Amer. Chem. J.*, 1899, **22**, 473; Kastle and Reed, *ibid.*, 1902, **27**, 209). The effect of gelatin in favouring the formation of the yellow modification has been known since Lüppo-Cramer (*Zeitschr. wiss. Phot.*, 1903, **1**, 50) first investigated the preparation and properties of photographic emulsions of the yellow variety. Ostwald, in a book notice (*Zeitschr. physikal. Chem.*, 1912, **79**, 253) makes a statement which indicates that when precipitated from alcoholic solution in the presence of a colloid, the yellow form can be preserved for a long time; presumably the colloid referred to was gelatin, since the emulsion was used to make a paper sensitive to light. Newton Friend (*Nature*, 1922, **109**, 341) has recently called attention once more to the effect of gelatin in stabilising the yellow form.

These effects are examples of Ostwald's rule that when a substance is formed which is capable of existing in more than one modification the least stable modification is formed first; this may then change, sooner or later, into the stable modification.

The yellow mercuric iodide which results when the alcoholic solution is poured into water may remain unchanged for days; when exposed to light, however, the change to the red modification is very much accelerated (Ostwald, *Zeitschr. physikal. Chem.*, 1897, **22**, 308). Ostwald again refers to the accelerating action of exposure to light in *Zeitschr. physikal. Chem.*, 1912, **79**, 253, as also does Newton Friend (*loc. cit.*), but these were not the first observations of this kind, since the change is mentioned by Weber (*Pogg. Ann.*, 1857, **100**, 131), Schiff (*Ann. d. Chem. und Pharm.*, 1859, **111**, 371), Reynoso (*Comptes rend.*, 1854, **39**, 696), and Selmi (*Cimento*, 1855, **1**, 183).

As distinct from the change of the yellow into the red modification, it has long been known that mercuric iodide is photosensitive. The earliest observations are probably those of Hunt (*Researches in Light*, 1844; compare Lüppo-Cramer, *Zeitschr. wiss. Phot.*, 1903, **1**, 50), who found that a film of mercuric iodide on paper became brown on exposure to light. Slater (*Chem. Gaz.*, 1852, **10**, 325) showed that the brown coloration was especially favoured by the use of blue light. Sulc (*Zeitschr. anorg. Chem.*, 1900, **25**, 399) observed that when mercuric iodide is dissolved in alcohol, chloroform, or ethyl bromide, and the solutions exposed to light, free iodine and mercurous iodide are formed. Naturally, the fact that mercuric iodide is photosensitive led to its investigation as a possible substitute for the silver haloids in photographic emulsions, and in this connexion a number of papers have been published by Lüppo-Cramer (*Zeitschr. wiss. Phot.*, 1903, **1**, 50; *Koll. Zeitschr.*, 1911, **9**, 22; 1912, **13**, 151; 1913, **13**, 151; 1915, **16**, 11; 1917, **22**, 77; *Phot. Korr.*, 1904, 403; 1907, 130; 1909, 191; 1914, 112) and by Kropf (*Phot. Rund.*, 1910, **24**, 185; *Phot. Chronik*, 1910, 436; *Phot. Korr.*, 1914, 640). A fine-grained emulsion of the yellow iodide is obtained by adding a solution of mercuric iodide to a solution of potassium iodide containing gelatin, the temperature being 50°. After the addition of more gelatin the whole may be set to a gel on cooling, and then shredded and washed to remove soluble salts, after which it may be coated on plates as with an ordinary photographic emulsion. If the emulsion obtained on mixing the salts is boiled, it gradually turns red and the precipitate readily settles on standing, showing that the grain has become less disperse.

If a concentrated solution of gum arabic is added to a liquid emulsion in gelatin of the yellow mercuric iodide, rapid settling takes place, the deposit consisting of larger particles of the red iodide. Gum arabic thus appears to act differently from gelatin, and, in accordance with this, if an emulsion is made from mercuric chloride and potassium iodide as above, but using gum arabic instead of gelatin, the red iodide is obtained; this may then be "set" by the addition of gelatin, shredded, washed, etc. The effect of the gum arabic depends, however, on the temperature. If the emulsification takes place at 80° yellow mercuric iodide is produced, but the crystals are much larger than those obtained with gelatin at 50°; gelatin also gives the large yellow crystals at 80°.

These emulsions are not nearly so sensitive photochemically as those of the silver haloids. The red emulsion is more sensitive than the fine-grained yellow emulsion, whilst the yellow emulsion made at 80° is not very sensitive in comparison with the others.

It has already been mentioned that the change from red to yellow mercuric iodide is accelerated by exposure to light, and Ostwald states that when he precipitated mercuric iodide from an alcoholic solution in the presence of a colloid he was able to make a sensitive paper with the product, which, exposed under a negative, gave a red print on a light background. When, however, plates coated with yellow emulsion made according to the method given above are exposed to the light until a print-out effect is produced, a brown colour due to loss of iodine is obtained, and not a red colour. The following experiments of Lüppo-Cramer throw some light on this apparent discrepancy. If the yellow-white emulsion produced when a saturated alcoholic solution of mercuric iodide is poured into water is exposed to direct sunlight, it changes colour in a few minutes and the red mercuric iodide formed rapidly sinks to the bottom, showing that it is of a much less dispersity than the yellow iodide. If some of the freshly-prepared emulsion is allowed spontaneously to evaporate in a Petri dish and then examined when dry, it is found that if it was exposed to the light during evaporation there is a number of red crystals among the yellow. These red crystals are much larger than the yellow ones and each one is surrounded by a clear space, showing that it has been formed as the result of Ostwald ripening.* If the evaporation takes place in the dark only the smaller yellow crystals remain, there being only an occasional red crystal. If the dry yellow deposit is then exposed to light there is no increase in the size of the particles and no change to red, the ordinary photochemical brown colour appearing.

Ostwald ripening such as that indicated above can only have taken place as long as there was some of the solution containing mercuric iodide present; since the yellow emulsion coated on plates has been well washed and dried, Lüppo-Cramer says that the explanation as to why it does not turn red on exposure to light is obvious.† If the plates are exposed to light while under water they turn red in one to two hours, and then fix out glass-clear with thiosulphate.

The complex (or double) salt formed between mercuric and silver iodides is only very little sensitive to light (Lüppo-Cramer, *Eder's Jahrb.*, 1904, 12); this is remarkable, since each of the components is fairly photosensitive.

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* Strictly speaking this is not a simple Ostwald ripening, since it is not merely the growth of a large crystal at the expense of a smaller one, but the growth of a stable at the expense of an unstable modification. At ordinary temperatures the red iodide, being the stable form, will have a lesser solubility than the yellow iodide and therefore, once the crystal of the red iodide is formed, it will grow at the expense of the yellow iodide crystals surrounding it, the growth taking place through the agency of the surrounding solvent medium (compare also Sheppard and Trivelli, *The Silver Bromide Grain of Photographic Emulsions*, p. 62). The effect of the solvent can be shown by the following experiment, due to Lüppo-Cramer. A microscope slide is coated with a 10 per cent. solution of gelatin containing 1 per cent. potassium iodide. When the film is set, a drop of 4 per cent. mercuric chloride solution is placed in the centre. In the dark a ring of yellow mercuric iodide is first formed, but after several hours the outer zone turns red, the width of the zone gradually increasing. This is because of the diffusion towards the ring of the potassium iodide in the surrounding film of gelatin. If the experiment is done in the daylight, the change from yellow to red takes place much more quickly than in the dark.

† An explanation as to why growth of the crystals does not take place may be obvious, since there is insufficient solvent left in the dry plate for ripening to proceed, but this does not explain why a red colour is not produced. An explanation is still wanting as to why light accelerates the change from the yellow into the red iodide.

THE PROGRESS OF THE BRITISH CHEMICAL INDUSTRY SINCE 1914

By HERBERT LEVINSTEIN, M.Sc., Ph.D.

(*Continued*)

There are two striking developments of the war years which do not directly affect production, but which throw a vivid light on the greater importance attached to chemical industry and to research by the public. The chemical industry has grown strong enough, and big enough, and wise enough to form an Association which Mr. Woolcock has made a power in the land. The chemical industry is no longer deaf and dumb. The Association of British Chemical Manufacturers can speak with authority on behalf of the whole industry, and has in fact rendered in all respects remarkable service to its members. Affiliated to the A.B.C.M. is the Association of British Chemical Plant Manufacturers. To-day the plant manufacturers, through their Association, are standardising plant, and can render services to chemical manufacturers which would have been impossible before the war. I suppose that before the war the demand for the chemical industry, at least the organic chemical industry, was too small to interest many of the large engineering concerns. Certainly we had the greatest difficulty in getting even autoclaves.

The second striking feature is the creation of the Department for Scientific and Industrial Research. Who could have dreamt that Whitehall, before the war, would subsidise research and do it not without insight? Under the auspices of this Department no less than twenty-four Industrial Research Associations have been formed, of which twenty-two are licensed by the Department and received over £86,000 in grants during last year. The wielder of the ruthless axe refrained from striking here.

Broadly speaking, the work of the Department and of the Research Associations with which they collaborate is to ensure the best utilisation of our natural resources and of the raw materials which we buy from abroad for our staple industries with a view to increasing the efficiency of those industries and enlarging the demand for their products in customer countries.

This work does not replace that of private firms, but is complementary to and ought to stimulate it. There is a radical difference between industrial research carried out by a company and that by a Research Association or by a Department of State. Practically the question of patents is the fundamental distinction. Patents taken out by chemists who receive part of their emoluments from the Department belong, if I understand the position rightly, to the Government. Patents which may be taken out by a Research Association would, I presume, be available for all subscribers, and could not easily become a profitable monopoly for any one member. For this reason it appears likely that in the future, as in the past, the Dyestuffs Industries and the allied Fine Chemical Industries will be the main source from which chemical discoveries will be transferred from the laboratory to the factory. The Dye Industry will remain the key industry to chemical inventions.

Most of us in this Section take a very considerable interest in the work of the Fuel Research Board, which is maintained by the Department for Scientific Research. Any invention which would enable us more economically to utilise our coal would be of great benefit, particularly if it could be introduced widely and quickly and at a reasonable cost. There is one obvious weakness which could be remedied without research. I refer to our practice of fetching coal from the pit to the mills by road or by rail, instead of generating our power at the pit mouth and delivering power to the mills through high-tension wires. The amount of useless hauling of full and empty waggons is wasteful and a blot on our industrial system. The absence of a network of wires carrying high tension current in this country is surprising when you have seen the practice abroad. Research should surely be preceded by utilisation of known improvements. To search for the sublime in the unknown and miss the obvious is not an uncommon practice. Industrial research is not much good, unless you propose to find the means of carrying discoveries into effect, and here you have an obvious weakness well enough known but quite neglected.

THE DYESTUFF INDUSTRY, 1914

I have left the Dyestuff Industry till the end. The last statement issued by the A.B.C.M. deals in a very lucid manner with the present position. I should like to qualify one remark picked out of this admirable publication. I am quite sure that Mr. Woolcock will not mind my commenting on the statement that 10 per cent. of the dyestuffs required by the various consuming industries were of British origin in 1914, and that of this 10 per cent. many were merely *foreign dyestuffs mixed in British works.* It does not give a just impression of the pre-war British Dyestuff Industry.

Prior to the war about 80 per cent. of the dyes consumed in this country came from Germany, about 10 per cent. from other countries, and 10 per cent. were manufactured (I do not mean mixed) in Great Britain. My own company had a considerable share of the British production and, *pace* the A.B.C.M., the dyes they sold were made in their own factory, many of them their own inventions. They did not purchase dyes to mix them, they sold their dyes wherever they could find a purchaser. America, Italy and the East took about as much as Great Britain. The 10 per cent. supplied to Great Britain did not include the whole British production. Nor was the range of dyes contemptible. At our own factory we made about 160 chemically different dyes. Our range of azo colours and sulphur colours compared favourably with those of foreign firms. On the other hand, there were great gaps. Why had we these gaps ? Surely because it was difficult to introduce and sell a new range of dyes and make any money out of it. As the Fine Chemical Industry, so in the Dyestuffs Industry, the whole war development, with very little qualification, is due to those who carried on the industry before the war. They were not mushroom firms. Surely any thinking person must know that the rapid extension is solely due to the existence of these firms and their experience. We have not created these industries, but those who were in them have expanded. If you see what kept the industry back before the war, you will see that it can develop in this country now that these inhibiting conditions no longer exist. The prices at which British dyestuffs were sold on the whole were lower than those at which the Germans sold their dyes ; the quality of the corresponding product was equal to that of the Germans, otherwise the dyes could not have been sold at all. The greater range of the German Dyestuffs Factories and the great prestige which they enjoyed enabled them to dominate the markets. Their commercial organisation and commercial propaganda which greatly impressed the consumer made it extremely difficult to find a sale for the British-made product. The main pre-war difficulty in this industry was not on the manufacturing side but on the sales side. Owing to the large number of new products which were constantly appearing from German works, consumers felt that they must keep in touch with the German firms. Many of them did not think that they would miss new products if they did not trouble to have an account with a British house. There was almost up to the war severe price cutting between the two big German groups, and these prices had to be accepted by the British makers.

My own firm had been since 1907 an object of very special dislike on account of the active part taken by my father in bringing about a change in our patent law with a view to compelling the Germans to manufacture in this country. When the Act of 1907 was passed, the Germans erected plant at Ellesmere Port and Bromborough Port, and to this we owe our present indigo factory (much enlarged) and the Mersey Chemical Works owned by Messrs. Brothertons.

In 1907 a great proportion of our business consisted in the manufacture of intermediates which were supplied to the German dyestuffs factories. We did not manufacture these intermediates into dyestuffs. Why ? The simple truth was that the sales organisation of the German factories rendered it impossible to find a market for the dyes, and this fact made it possible for us to find a market in Germany for our British intermediates.

It will perhaps surprise some of you to know that such products as Gamma Acid, H. Acid, and Cleves Acid were made in England over twenty years ago and sold to German dyestuff factories, and were afterwards re-exported to England as components of German dyes. Naphthylamine and Naphthionate were very important products to us. Their purity was acknowledged. Most German Congo Red, Benzopurpurine and Wool Black, for instance, were made from these intermediates. If Yorkshire buyers wanted only German Wool Black, or if Indian buyers wanted only German Congo, the intermediates came largely from Blackley. The Germans cut off all orders we got with a view to punishing us for the action taken in the reform of our patent laws. This action threw large plants out of commission and caused heavy losses. The undercutting, "according to plan," by the Germans in all staple products made it difficult to retain, and more difficult still to expand business in dyestuffs. You will see, therefore, that the position of the comparatively small firm opposed by the German Collosus was not easy. Yet what was the result ? In a few years the loss was made good and considerable profits were earned. How was this done ? The answer is by successful research, carried out, it is true, on a most economical basis. No combine, however willing to crush you, can prevent you if you know how to discover a new product, and if it is new and useful the public can be persuaded to buy it at a good price.

I have not such detailed information with regard to other companies—Read Holliday and Sons, the British Alizarine Co., and the Clayton Aniline Co. To me, quite frankly, the description of their pre-war work seems inadequate. One may easily form an erroneous judgment from the sentence I have just quoted. It seems important to me to remember that these firms enjoyed no kind of protection, and yet they succeeded in holding their own. The contemptuous way in which the pre-war British Dyestuffs industry was regarded by many people was the result of German propaganda, and I am afraid this opinion had become firmly embedded in the public mind.

The Germans were very successful in two distinct pieces of propaganda. First, they impressed all Europe with the idea of the invincibility of the German Army. This was an axiom, and profoundly and favourably affected German diplomacy before and during the war. Secondly, they succeeded in impressing all the world, and not least England, with the idea of the utter futility of attempting to compete with the German dyestuffs factories. They succeeded in getting the consumer to believe that it was an absurdity to get supplies from British sources. Both of these axioms have been shown to be false, but I believe that both were so firmly fixed in the minds of the people that nothing but the defeat of the German Army would have shaken either. The war has broken the continuity of German supplies. Every consumer has been forced to buy elsewhere, and the German goodwill is therefore diminished. That in itself is a powerful help to those outside the German I.G., and encouraging to those now carrying on our dyestuff industries.

THE DYESTUFF INDUSTRY, 1923

The A.B.C.M. statement tells us that 80 per cent. of the dyes now used in the country are of British make, and that they are wholly British uncontaminated by any made-in-Germany organs in their anatomy. That is excellent. We may add to this the reflection that the dyers of Great Britain are able to give the same guarantees of fastness to their customers, now that they use 80 per cent. of British made dyes, as they were able to give prior to the war when they used a predominating proportion of foreign dyes.

I would also point out that if I may judge from the share values or from the dividends paid by the large textile combines which use dyes, that the substitution of British dyes for German dyes has not produced such financial disaster as was predicted by some of the opponents of the Dyestuffs Act.

The first person in public life to recognise the importance of the dyestuffs industry, both in peace time and in war time, was Mr. Runciman. If we examine what did happen exactly after the war, we shall see what progress was made at two critical periods—1919-20 and in 1923 :—

"No one can tell" (said Mr. Runciman) "what exactly will be the position after the war is over. Of this I am certain, if we go on being dependent in a large portion of our textile trade, whether wool or cotton, upon supplies which Germany has the power to cut off whenever she pleases we leave these cotton and wool industries in a state of peril."

What did happen after the war ? Were our textile industries left dependent upon Germany ? Were they in a state of peril ? Let us see. In 1913 the Dyestuffs Industry in England supplied about 10 per cent. of the British consumption, which amounted in round figures to rather over 20,000 tons. The factories were comparatively small, and the number of chemists proportionately few. By Armistice Day the two principal companies, already loosely united, employed some 7000 persons, nearly 300 academically trained chemists—an unheard of number in this country. During the two years following the Armistice over 25,000 tons of dyestuffs manufactured by this British company alone went into consumption in Great Britain. I am not talking of the production, nor of the sales, but of just the quantity actually consumed in Great Britain.

The extraordinary prosperity in the textile trades at that period had its aftermath in the slump. But in 1919 the employment provided by these trades, and the money brought into this country as payment for exports, were factors without which this country would not have readily recovered from the paralysis of war. I do not know the total value of these exports, but the exports of printed and cotton dyed piece goods alone during 1919-20 amounted to 270 million pounds in value. What would have been these exports had the 25,000 tons of British made dyestuffs not been available ?

In October, 1920, the British Dyestuffs Corporation (and remember there are other important dyestuff makers in this country to carry out this work) employed some 8000 people with a yearly wage roll of £1,600,000. This company used 4000 tons of coal per week, 1000 tons of pyrites and corresponding quantities of heavy chemicals and raw materials. These figures will, I think, be considered large in this country, where we are not so familiar with very large plants, but of course they are small compared with the aggregate of the German I.G. Suddenly in October, 1920, the slump fell upon the country. The position was made much worse by four factors. The German production revived, considerable quantities of German dyes were imported as reparations, the Sankey judgment temporarily removed all protection from the home producer, and the rapid external depreciation of the mark temporarily made it difficult to compete with Germany in neutral markets. Stocks fell in value, large sums of money were lost, and the production of British companies fell down almost to prewar figures.

THE RUHR

I cannot imagine a more delicate political situation than that arising out of the French action on the Ruhr. Fortunately our negotiators were free from anxiety as to the effect any action taken by the French on the Ruhr might have in restricting a supply of dyestuffs. You know exports from the German dye factories are prohibited by the French, except under licence, while the German Government forbids these firms to make application for licences. What will be the outcome no one can tell, but this I do know, that there will be no operatives thrown out of employment here if Germany fails to maintain her production of chemicals.

It seems clear that if our position in the Dyestuffs and Fine Chemical Industries to-day were no better than it was in 1914 we should have to consider what would happen to the textile trade of this country *if* the supply of German dyes were cut off in Germany by troubles on the Ruhr. If we do not have to consider this we have a measure of the progress made. I am careful to express no political opinions. I do not wish to be misunderstood. I am making the one comment on the Ruhr situation as it presents itself to me, viz.: That in fact any restrictions in the output of German dyes is a matter of no political importance, whereas had we not established this industry to the extent which we have done, the possible effect of French action on German chemical industry would have been a factor of first-class political importance. I do say that our textile trade is not to-day left in a "state of peril."

The British Dyestuffs Corporation

I sometimes think that nothing could more clearly show the extraordinary change in the views held on the British Dyestuff Industries since 1914 than the formation of the British Dyestuffs Corporation. For sixty years you carry on; for years you point out the menace which in threatening you, threatens the textile trades. Nobody takes the least interest in your work. Suddenly in 1914 it is found to be a fundamental part of the national fabric. Who would have thought it possible in 1914, that in March 1918, you would be pressed at a crucial point in our history to amalgamate your business on the ground that it was vital to our peace negotiations?

The B.D.C. was formed entirely on national grounds, so far as we were concerned, solely owing to the pressure put upon us by Ministers. The initiative was taken by the President of the Board of Trade. That initiative would not, I may say, have been taken by ourselves, nor would it have been acceded to on any other grounds save those put forward by the President. It is, I think, rare in our industrial history that Governments have practically compelled an old-established manufacturing company to join a concern in which the Government were interested, because they felt that such co-operation was vital to the State. That, however, was the case in the dyestuff industry at the critical ending period of the war. The terms of the merger are described in an official publication, "Report on Dyes and Dyestuffs," dated May 18, 1921. Perhaps someone can tell a fairer way than the method therein described. We knew of none. We were making no commercial bargain. We did desire that the distasteful course we took would give the results the Government desired. It was necessary to spend large sums of money in construction when everything was dear. That was the essence of the job. We were definitely promised a prohibition of German imports into this country for a period of ten years after the war, to say nothing of a similar protection which it was expected would be afforded by India and some other countries. Without this definite pledge there would have been no amalgamation. As you know, the Government endeavoured to carry out their pledge, but, as you also know, the imposition of an Order in Council was shown to be illegal by the Sankey judgment. As the Government did not venture to appeal against this judgment, we may conclude that their method of carrying out their promise had not been examined by their legal advisers with the care we might reasonably expect. On the other hand, we took upon ourselves the gigantic burden only on the clearest understanding that the pledge would be kept. We carried out our contract. There was no difficulty at the Peace Conference. The textile trades were not "left in peril" in the boom years owing to dependence on a non-existent supply of German dyes.

The Sankey judgment in the peculiar circumstances of the time involved us in heavy losses at a critical period of the development of this industry. You must remember that the British Dyestuffs Corporation manufactured not less than 75 per cent. of the dyestuffs used in this country. Clearly the passing of the Dyestuffs Act in 1920 did not re-establish the status quo. You will see the extraordinary importance attained by this industry in Germany not merely in war but politically, for in this and in many other ways we know of, the German supremacy was a strong weapon wielded by German diplomacy. The Government desired the formation of the British Dyestuff Corporation, when they took on their own initiative steps to form it, because they desired to strengthen the hands of our diplomatists when the time came to discuss the terms of Peace.

I do not think that many people are aware of how this Corporation came to be, how definitely the pledge was made, and how inadequately the Dyestuff Act fulfilled it. I have always found the opponents of the Dyestuff Act to be as fair-minded men as any I know, and I cannot, therefore, imagine that people advocating a repeal of the Act are aware of the circumstances.

Conclusion

Now, we have not the slightest interest in industries which can only live in this country under Protection. Our dyestuffs industries, our organic chemical industries cannot be static. They live by research and this implies two things:—

1. Constant growth, because they make inventions which require to be translated into manufacturing processes.
2. World markets, because new inventions must be exploited and sold wherever a consumer exists.

It follows clearly that this industry cannot live as we wish it to live on a protected home market, and that we do not require permanent protection. If I have shown you that we have created something vital, that we may help to prise open the door of the unknown, I am satisfied. The world is searching for new industries. We have created chemical industries since 1914, but not *new* chemical industries, for they already exist in Germany. These are dependent on, and fruitful of, inventions. As parent industries we regard them hopefully. It is to their children that we look for the real benefits from our 1914 industrial effort in applied chemistry.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

THE OLD CITY COMPANIES with their centuries of tradition behind them form a never-failing source of interest to an old journalist. I have been renewing my acquaintance with some of them recently, and the more I see of them the more I feel they have a part to play in connexion with industry to-day. Whether there is any such desire among the liverymen I know not, or whether there is a sufficient sprinkling left in the Companies of persons connected with the craft they represent may be doubtful, but I believe there is still a desire to do something useful. They have been and still are extraordinarily liberal with the funds at their disposal. The Goldsmiths' Company is one of the twelve "great" companies which still has a close connexion with the trade. To dine in their very fine hall is still one of the desirable functions, an invitation to which is never refused. The Armourers and Brasiers, who also keep a good table, are quite naturally, owing to changes in the method of warfare, not as much in evidence as formerly, but I believe they still have the right to confiscate any piece of armour which is found not to bear the mark of the Company.

THE TWO COMPANIES most closely connected with Chemical Industry are the Salters and the Dyers. The former is also one of the twelve "great" companies and has for many years contributed most generously to the higher education of chemists, years ago in the form of scholarships and more recently by the foundation of the Salters' Research Institute of which our old friend Dr. M. O. Forster was the first Director. It is a very ancient company and dates back I think to the fourteenth century. I remember once seeing there a bill for a dinner for fifty persons given so many years ago that the total amount came to £1 13s. 2½d. and it was a very fine dinner. I believe the Company keeps in touch with the Industry through a Committee of the Council of the Association of British Chemical Manufacturers. I was once told that the Company never seeks the advice of that Committee, except on an afternoon and always invites the Committee to lunch first.

THE DYERS' COMPANY is not one of the "great" twelve, but it is the next best thing to it being the thirteenth in order of precedence of the City Companies. One of the things which has always struck me when I have dined with this Company was the devotion of its liverymen to the old guild. Of course all liverymen are proud of the company to which they belong, but in the case of the Dyers, this devotion amounts almost to a religion. The Company does not contain more than the average number of those now connected with the art of dyeing, but there is nevertheless a keenness to follow all that is going on in the colour-using and colour-making industries, which makes me wonder why this ancient guild has not hitherto taken a part in helping this country to develop these industries in recent years. There is still an important function for the City Companies to perform if they can only be kept in touch with the industries, which have developed out of the arts and crafts which formerly they fostered and controlled.

THE DINNER of the Society of Dyers and Colourists held at Bradford last week was a much more enjoyable affair than is usual with public dinners. I think this was largely due to the fact that a time-table had been carefully prepared and was rigidly adhered to by the speakers. Sir William Alexander in a speech from which all surplusage was eliminated set a good example and Mr. Woolcock managed to say all he had to say in just under ten minutes. The presentation of the Perkin Medal to Mr. Charles F. Cross was made by the President (Mr. S. J. Pentecost). The medallist's health was proposed by Mr. Sutcliffe Smith in whose speech and that of Mr. Cross we had one more example of the amount of pleasure a speaker can give his audience if he only knows what he wants to say before he gets up to say it. All of which contributed largely to our enjoyment.

A JOURNALIST who has to attend a large number of dinners in the year gets ample time for studying the methods of after-dinner speakers. Indeed, were it not for the fact that there is always some amusement to be got out of this the business of attending so many dinners would be intolerable. I suppose Dr. Forster when at his best was one of the wittiest after-dinner speakers we have had and I could rarely detect any signs of previous preparation. Our President also seldom uses a note and manages to introduce a lot of dry humour into his speeches. Mr. Cross's speech, after receiving the Perkin Medal, seemed to me to be a model for such occasions. A half sheet of notepaper with just the pencilled outline of the main theme—the discovery of viscose. A reference to the presence of the son of the man whose name is commemorated in the medal, a modest word of thanks and the result—a well-satisfied audience. Mr. Sutcliffe Smith is the type of speaker who carefully prepares his speech *in extenso* and brings it with him to the dinner. This is a habit, and quite unnecessary, as he speaks equally well if you give him anything else to hold in his hand.

FORTHCOMING EVENTS

Mar. 23. Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 9 p.m. "Life History of an Alpha Particle from Radium," by Sir E. Rutherford.

Mar. 23. University College, Nottingham, at 8 p.m. *Sir Jesse Boot Foundation Lecture.* "Evolution in Chemical Industry," by Prof. F. S. Kipping, Ph.D.

Mar. 24. Royal Institution of Great Britain, 21, Albemarle Street, W. 1, at 3 p.m. "Atomic Projectiles," by Sir E. Rutherford.

Mar. 27. Society of Chemical Industry, *Birmingham and Midland Section*, at the University, Edmund Street, Birmingham, at 7 p.m. (1) "The Reaction Between Ammonia and Sodium Hypobromite," by D. R. Nanji, M.Sc., and W. F. Shaw, M.Sc. (2) "Some Studies in Catalytic Hydrogenation," by E. J. Lush, M.A.

Apr. 9. The Institution of Rubber Industry, Engineers' Club, Coventry Street, Piccadilly, W. 1. "Rubber Pigments," by Dr. D. F. Twiss.

Apr. 10. Society of Chemical Industry, *Birmingham and Midland Section*, the University Buildings, Edmund Street, Birmingham, at 7 p.m. "Some Observations on the Activated Sludge Process," by F. R. O'Shaughnessy, A.R.C.Sc. "Some Studies in Catalytic Hydrogenation," by E. J. Lush, M.A.

Apr. 10. Institute of Metals, *Birmingham Local Section*, the Chamber of Commerce, New Street, Birmingham, at 7 p.m. Annual General Meeting.

Apr. 10. Institute of Metals, *North-East Coast Local Section*, Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. Annual General Meeting.

Apr. 11. The Institution of Electrical Engineers, *Wireless Section*, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "Magnetic Drum High-Speed Recorder and Key Transmitter," by Dr. N. W. McLachlan.

Apr. 12. The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "The X-Ray Examination of Materials," by A. G. Warren.

Apr. 12. Society of Chemical Industry, *Ottawa Section*, University Club, Elgin Street, Ottawa, at 8 p.m. "Electrolytic Iron," by R. J. Trail.

Apr. 12. Institute of Metals, *London Local Section*, Institute of Marine Engineers, 85-88, The Minories, Tower Hill, E. 1., at 8 p.m. Annual General Meeting, followed by a paper on "The Surface Tension of Metals," by S. W. Smith, D.Sc.

Apr. 13. Society of Chemical Industry, *Liverpool Section*, Muspratt Lecture Theatre, the University, Liverpool, at 6 p.m. Meeting of the Chemical Engineering Group.

Apr. 26. West of Scotland Iron and Steel Institute. Annual General Meeting.

SOCIETY OF CHEMICAL INDUSTRY

CORRESPONDENCE BETWEEN THE PRESIDENT AND THE CHAIRMAN OF THE AMERICAN SECTION

The Chairman and Committee,
American Section of the Society of Chemical Industry

Gentlemen,—In wishing you the compliments of the season I trust that you will allow me to add the hope that 1923 will see the American Section of our Society more prosperous than ever before.

We, on this side, appreciate to the full the loyalty which you have shown to the Parent Society, and assure you that at no time has our interest in your Section been greater. The interchange of visits by individuals, the official visit paid to you during 1921, and the hospitality offered by the Chemists' Club and the Chemical Industry Club, have all helped to cement that alliance between the two great Anglo-Saxon nations which is essential for the well-being, indeed, for the very existence of civilisation. Chemists have a very special part to play in the re-establishment of peace and prosperity and high ideals of social service among mankind, and it is only by the chemists of America and Britain standing shoulder to shoulder that we can hope to achieve our ideals.

I trust that many members of the Society will be interchanging visits during 1923 to our mutual advantage, and remain, Yours fraternally, (Signed) E. F. Armstrong,
President

My dear Dr. Armstrong,—I took pleasure in presenting to the Executive Committee of the American Section at its last meeting your letter of good wishes for 1923. The Committee and I wish to express best wishes for the coming year to you personally and to the Society.

We want, also, to express our appreciation of the changes in publications which are now taking place, and which promise so much for the future of chemical industries in the English-speaking countries.—Very sincerely yours,

Ralph H. McKee

NEWS FROM THE SECTIONS

BIRMINGHAM AND MIDLAND SECTION

Dr. E. B. Maxted presided at the meeting held on March 6, when Dr. J. Newton Friend read a paper on "The Influence of Emulsoids upon the Velocity of Chemical Reactions."

Dr. Friend said that the study of colloids and emulsoids, particularly in relation to adsorption, was very fascinating, and although some advance had been made in recent years, we had as yet only begun to touch the fringe of the subject. An emulsion was a system of two liquid phases, the first of which was continuous, and the other discontinuous or disperse. If the disperse phase consisted of very minute particles of diameter, say, of one-millionth to one ten-thousandth of a millimetre, the system was termed emulsoid. Emulsoids could be prepared directly by adding a suitable continuous phase to a gel and then applying heat, *e.g.*, as in the preparation of glue. An indirect method was to dissolve a suitable gel in a solvent and then pour it into another liquid in which the original gel was not very soluble. For instance, gamboge was dissolved in alcohol and a few drops of the solution poured into excess of water. Emulsoids prepared in that way were used by Perrin in his classical researches on the Brownian movement. Freundlich's adsorption law was explained, and it was pointed out that it was really a special case of the better-known partition law. If X was the amount of emulsoid adsorbed and C the final concentration of emulsoid, $X=K\sqrt[n]{c}$ where K and N are constants; then $\log X=\log K+\frac{1}{n}\log C$, and if a graph was drawn with log X plotted vertically and log C horizontally, the data should lie on a straight line if the law was obeyed. It was often not easy to determine the value for X because it is so small. Langmuir had suggested that the adsorbed layer on a given surface was only one molecule thick; but if it was assumed that the retardation of chemical reaction was proportional to the amount adsorbed, relative values for X could be obtained. This explained why the setting of plaster of Paris was retarded by the addition of gum arabic, a fact well known to modellers. The rates of solution of salts in water and the rates of crystallisation of salts from aqueous solution were similarly retarded. The characteristic feature of emulsoids was their power of being adsorbed; and illustrations were given showing the influence of emulsoids on the course of some familiar chemical reactions. Although emulsoids and gels generally retarded chemical action, one interesting case was that in which the gels acted as catalysts—namely, in accelerating the setting of linseed oil. This was effected by the presence of such gels as size, glue, etc., and was probably due to their power of handing over moisture to the unsaturated acid radicals in the oil, the drying of linseed oil in that case being really a wetting.

The chairman commented upon the big advance that had been made in recent years in the study of colloids, and on their employment in electrolysis. Mr. G. King said that greater stress should be laid upon the study of the degree of dispersion of the colloid. Much research lost its value because the degree of dispersion was not stated in the published results. Dr. Parker pointed out that emulsoids were a source of much trouble in the manufacture of carburetted water-gas. A high-boiling petroleum oil was used, and part of the oil was converted into tar, much of it being obtained in the form of an emulsion in water, which had generally to be thrown away, though it was sometimes mixed with coke dust and used for firing boilers. The trouble was how to get rid of the emulsion. Mr. F. R. O'Shaughnessy said that contributions such as that of Dr. Friend were most important because they enabled one to get a better general view of the laws governing the colloidal state. Dr. Maxted had suggested that men were living colloids, but recent work suggested that the living organism was a non-colloid, although containing an immense number of colloids in practically every condition. Mr. Carter observed that colloids could accelerate reaction velocities; the addition of a colloid in the electrolysis of metals, particularly of zinc, had a useful effect.

BRISTOL SECTION

The Annual Dinner was held on March 15 at St. Stephen's Restuarant. Mr. W. Jones presided, and those present included Mr. W. Windus (the guest of the evening), Prof. F. E. Francis, Dr. Rixon, Messrs. R. Robertson, J. Bernard, D. T. H. Blaton, Howard Butler, E. Butler, A. Marsden, and friends, the number present totalling 41.

Few speeches were delivered, the evening being mainly devoted to a musical programme. In proposing the health of Mr. W. Windus, Mr. W. Jones said that since Mr. Windus came to Bristol 50 years ago, the chemical industry had been transformed. Mr. Windus was first associated with the Netham Chemical Works, which was afterwards absorbed by the United Alkali Co. Mr. Windus, in reply, briefly reviewed the period of 55 years during which he had been associated with the industry and said that after the Franco-German war they had labour troubles similar to those of the present day. It took nine years before the high wages then paid were reduced to the normal level. He first came to Bristol in 1878 as manager of the Netham Works, at which the Deacon process was operated. After referring to the formation of the United Alkali Co. in 1892, Mr. Windus said that in 1914, the Germans had more chemists in Mannheim than we had in the whole of Britain. British brains, however, triumphed in the end. It was, perhaps, not generally known that 400 tons of poison gas was made at Avonmouth and that there was a casualty for every ton made. Production was forced to such an extent that towards the end the chemists had to look at the gauges through binoculars, owing to escapes. He hoped that more progress would be made in the next 50 years than in the past half-century.

LONDON SECTION

At the meeting held on March 5, Dr. T. M. Legge, C.B., H.M. Medical Inspector of Factories gave an interesting address on "Industrial Poisoning and the Works Chemist."

He asked for the assistance of the works chemist because he and they both desired the elimination of waste. In smelting works it was now possible to lay down a rule that if lead in the form of dust was present to a less extent than 5 milligrammes per 10 cubic metres of air, then lead poisoning would be rare. About 2 milligrammes of lead was the minimum daily dose that a worker could absorb and escape chronic lead poisoning. As an instance of what a works chemist could do, he cited the methods adopted by Mr. A. Klein at the works of the Brimsdown Lead Co., whose manufacture of lead bi-silicate had eliminated lead poisoning in the potteries. Mr. Klein had also been able to provide the rubber manufacturers with a lead compound which could be incorporated with rubber and avoid lead poisoning in that industry. Dr. Fox, of the Government Laboratory, had investigated poisoning by arseniuretted hydrogen, which came from a galvanised pail containing arsenic as an impurity. A system of exhaust ventilation would prevent many such cases. During the war there were cases of benzol poisoning in the rubber industry, and it was found that 20 parts of benzol per 10,000 parts of air was on the border of the danger line. Dr. Legge said if chemists, during their training, could get systematic information about the toxic properties of the materials they had to handle, it would be of great advantage. He also gave instances of poisoning by Aniline Black and dinitro-benzene derivatives, and in connexion with the doping of aeroplane parts with cellulose acetate.

In the discussion Mr. Potter explained how difficult it was for the works management to maintain a regular output, unless they took due precautions against danger from poisoning. He thought that chemists should understand the early symptoms of industrial poisoning, so as to investigate suspicious cases before the effects were serious. Mr. C. A. Klein called attention to Dr. Legge's investigation of lead poisoning in white lead works, the number of cases being reduced from 400 to 20 per annum in the course of very few years. Co-operation between the medical man and the works chemist would be of the greatest value. Dr. Paterson said the chemist could be effective in dealing with industrial poisoning in many works if he were encouraged by the management to work hand in hand with the medical staff. Dr. Coles dealt with precautions which should be taken to prevent poisoning by carbon monoxide. Mr. Finnemore alluded to the danger from dimethyl-sulphate. This and some other substances were carelessly handled because they were not known to be toxic.

MEETINGS OF OTHER SOCIETIES

CHEMICAL SOCIETY

An ordinary scientific meeting took place on March 15, presided over by Prof. Lowry and later by Prof. Thorpe.

The death was announced of Prof. van der Waals, who had been an honorary Fellow of the Society since 1898.

The President's address at the Annual Meeting, to be held on March 22, is to be on "Symbols and Formulæ."

Five papers were read at the meeting :—

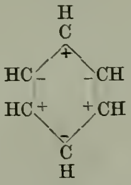
(1) "The oxime of mesoxamide (*iso*nitrosomalonamide) and some allied compounds. Part III. Ring formation in the tetra-substituted series," by E. H. Usherwood and M. A. Whiteley, who described reactions similar to the Thorpe condensation.

(2) "The preparation and stability of cuprous nitrate and other cuprous salts, in the presence of nitriles," by Mr. H. H. Morgan, who dealt with reactions found to occur when silver, in salts, is displaced by copper. Anhydrous substances were used, and the reactions were investigated in nitrile solution. Using aceto-nitrile, on evaporation of the solvent, colourless crystals such as the following were obtained :—$CuCl,CH_3CN$; $CuBr,CH_3CN$; $CuNO_3,4CH_3CN$. These were, however, only colourless in absence of air. Oxidation gave a green colour, a basic salt being formed. The author tried to prepare cuprous nitrate from the above double salt but obtained only cupric nitrate and copper. Using succinonitrile, a more stable double compound with cuprous nitrate was produced, corresponding to the formula $CuNO_3, 2C_2H_4(CN)_2$.

(3) The paper on "The interaction of hydrogen sulphide, thiocyanogen and thiocyanic acid with unsaturated compounds," by F. Challenger, A. L. Smith and F. J. Paton, was read by Dr. Challenger. He mentioned the fact that few instances were recorded in the literature of organic chemistry of interaction with hydrogen sulphide. Water brought about marked change in the products of the terpene series and the superficial similarity of hydrogen sulphide to water suggested that the former might also be very reactive. Few reactions were however found, so thiocyanogen, NCS-SCN, was tried. Addition compounds with unsaturated substances were recorded, and the analogy of the thiocyanate group with the halogens was brought out in these reactions. In reply to Prof. Pickard, Dr. Challenger said the substances were not specially unpleasant to work with ; it was rarely necessary to isolate thiocyanogen. Ethereal solutions were generally employed.

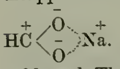
(4) Professor Robinson gave a paper dealing with reactions between formic acid and its derivatives and phloroglucinol which yielded xantho-pyrillium salts. Ketones added were found to take no part in the reaction.

The paper read by Professor T. M. Lowry, F.R.S., on the Polarity of Double Bonds was full of interest. It dealt with the two forms of electrical attraction which may bind together the atoms in a great variety of organic compounds. Of these the sharing of two electrons by two adjacent atoms is called covalency and is equivalent to a single bond. The attraction of a positive ion to a negative ion is called electrovalency and is equivalent sometimes to a single bond, sometimes to a less-defined attraction which, in the past, has been denoted by a pair of dotted lines and many other devices intended to indicate an attraction which is not confined to one single line. According to Lowry a double bond in organic chemistry usually behaves as if it is one covalency and one electrovalency; he writes aldehyde as $CH_3\cdot\overset{+}{C}H—\overset{-}{O}$ and ethylene as $H_2\overset{+}{C}—\overset{-}{C}H_2$; acetylene is $H\overset{-}{C}=\overset{+}{C}H$. Elements linked by electrovalencies are more active than those linked by covalencies. The author discussed the theory of partial valencies introduced by Thiele and the alternate polarities of Lapworth, Kermack and Robinson and the work of Thorpe on ethylidene maleic acid. Benzene, according to Lowry, has the formula:



and this was compared with Bragg's boat-shaped formula for benzene.

In some compounds a new element of symmetry is introduced because the distinction between a single and double bond usually disappears. Sodium formate becomes



$\overset{+}{HC}\left\langle\begin{matrix}\overset{-}{O}\\ -\\ O\end{matrix}\right\rangle\overset{+}{Na}$. The investigations of Goss, Ingold and Thorpe on ethylidene maleic esters were considered and Lowry's method applied to their results.

The introduction of electrovalencies into the structural formulæ of organic compounds provides a satisfactory interpretation of (1) unsaturation, (2) the activity of zinc methyl and the Grignard agent, (3) partial valencies, (4) conjugation, (5) alternate polarities, (6) crossed polarities in conjugated compounds, (7) the structure of benzene, (8) the laws of substitution in benzene, (9) crossed polarities in benzene, (10) the structure of naphthalene and anthracene, (11) the crystal structure of graphite, (12) the structure of carboxylic acids, (13) the structure of the glutaconic acids, (14) tautomeric or bipolar ions and, (16) the relation between tautomerism and co-ordination. The new formula for benzene reminds one of the centric bonds of Armstrong and von Baeyer and the author of the paper seems to be applying the modern discoveries to the elucidation of the problem which his predecessors were struggling to solve in the absence of the exact knowledge now available. The work of Kekulé and Berzelius in old times and of Thorpe, Sidgwick, Robinson, Ingold, Lapworth and many others in modern times may lead up to such an interpretation as Prof. Lowry is now engaged in developing. Had time permitted there would have been a valuable and critical discussion of the paper and there are many features which invite argument, in particular the chlorine derivatives of benzene. On the other hand the models prepared by Bragg enable modern speculators to check some of the important assumptions necessary to their theories and the time is ripe for a consideration of the best way of applying modern views of the structure of the atom to organic compounds as well as inorganic.

INSTITUTE OF METALS

The Annual General Meeting was held at the Institution of Mechanical Engineers on March 7 and 8, 1923, the President, Leonard Sumner, O.B.E., M.Sc., in the chair. An exceptionally large number of papers was presented and discussed. Dr. L. Aitchison, F.I.C., read a paper on "The mechanical properties of some magnesium alloys." Alloys containing 1 per cent. of cadmium, 3 and 13 per cent. of copper, and 6 and 11 per cent. of aluminium were found to be very weak in the cast state; the alloy containing 6 per cent. of aluminium was considerably improved by mechanical work (rolling or extruding). The results obtained were greatly inferior to those that can be obtained with the best alloys of aluminium. A paper entitled "Tests on work-hardened aluminium sheet," by Prof. H. C. H. Carpenter, F.R.S., and C. C. Smith, A.R.S.M., M.Sc., described the effects of annealing, at temperatures below 200° C., on cold-worked aluminium sheet. Work-hardness, as measured by the tensile strength, is not completely lost after two years' storing at 200° C., and it is only slightly removed at 100° C. At temperatures below 100° C. the retention of work-hardness is practically complete. A paper by Dr. A. W. Gray, on "Volume changes accompanying solution, chemical combination, and crystallisation in amalgams," was presented by Prof. Turner, in the author's absence: the work is mainly concerned with amalgams used for dental purposes, and the author discusses the "variable factors" connected with the making of these amalgams, and their effect on the subsequent volume changes. Maurice Cook, M.Sc., presented a paper on "The recrystallisation of cold-worked cadmium." The author finds that cold-worked cadmium recrystallises spontaneously at ordinary temperatures, but that, on annealing at higher temperatures (100° C. and upwards), rapid grain growth occurs. In the discussion on this paper it was pointed out that the author's results were readily explained as a consequence of the allotropic change at 60° C. in cadmium, which the author had ignored. Investigations into the constitution of the alloys of aluminium with copper and nickel formed the subject of two papers by C. R. Austin, M.Sc., and A. J. Murphy, M.Sc., and by Miss Bingham and Dr. J. L. Haughton, who investigated the alloys of this system containing less than 12 per cent. of copper and 10 per cent. of nickel, their research being, naturally, more complete over this limited range of composition than that of Austin and Murphy. Dr. W. Rosenhain, S. L. Archbutt, F.I.C., and S. A. E. Wells presented a paper on "The production and heat-treatment of castings in an aluminium alloy ('Y')." They describe the difficulties experienced in obtaining satisfactory castings; the chief causes of trouble were unsoundness and unsuitable structure. The density of the castings was found to give a very reliable indication of the soundness and approximate strength; success was attained by controlling the ratio of weight of mould to metal; the temperature of the mould; the maximum and pouring temperatures of the metal; and the rate of pouring. By heating the castings for 6 hours at 520° C. and quenching in boiling water, tensile strengths of over 20 tons per sq. in. were regularly obtained. Mr. R. Genders, B.Met., presented a note showing the manner in which the "extrusion defect" is formed in brass rods extruded from a multiple die. Another paper by the same author described a "new form of magnifier hammer" for use with the scleroscope, and made by using a hardened steel ball as the nose of the hammer, the ball being soldered in place with soft solder at the lowest possible temperature. Col. N. Belaiew presented a paper on "The inner structure of the crystal grain as revealed by meterorites and Widmanstätten Figures." Dr. D. Hanson and Miss M. L. V. Gayler, M.Sc., described some experiments on the heat-treatment and mechanical properties of alloys of aluminium with small percentages of copper. They showed how the difference in the solubility of the compound $CuAl_2$ in aluminium, at high and low temperatures, might be utilised to improve the mechanical properties of copper-aluminium alloys. Chill castings containing 4 to 5 per cent. of copper can be heat-treated in a simple manner to give strengths of over 17 tons per sq. in., and elongations of 20 per cent. Wrought alloys of the same composition possessed strengths up to 22 tons per sq. in. A paper by Harold Heape, on "The density and hardness of the cast alloys of copper with tin," compared the author's results with those of other workers; it appears that there is some relation between the density and hardness of these alloys, but chill castings are too unsound to permit reliable information being obtained.

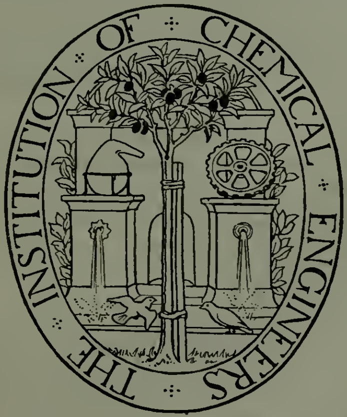
THE INSTITUTION OF CHEMICAL ENGINEERS

It is not often that a scientific society aspires to more than the most obvious emblem of its craft in choosing a badge or other distinguishing device. The Institution of Chemical Engineers, however, has combined plain speaking with happy symbolism in its design, which we here reproduce.

A young and sturdy tree—not yet without support—shows its first fruits between two fountains, bearing the emblems of Chemistry and Engineering. Their waters flow into a common pool, on the bank of which two doves are flirting happily.

It is not clear if there is any special significance in the choice of the tree, which is clearly of the "prunus" variety, but we have heard rumours of "plums of the profession" and it is certain that the apple which caused Man to fall is not appropriate here.

The design has been sketched by Mrs. Hinchley to embody the idea of the Institution as closely as possible and it has decorative charm and interest, which are quite exceptional.


THE INSTITUTION OF CHEMICAL ENGINEERS

The composition, the inspiration and the grace of this sketch have afforded us singular pleasure and we feel sure that the realisation of the artist's fancy will attract to the Institution a large number of members.

Mr. Cecil Thomas is working out the sketch in relief for the Seal and Medal of the Institution.

Sir Arthur Duckham is very kindly presenting the Seal to the Institution as a memento of his office as first President. The design, as a medal, will probably form an award for work of outstanding distinction in connexion with the objects of the Institution.

CORRESPONDENCE

THE TITLE "CHEMIST"

Sir,—The Retail Pharmacists' Union in their recent announcement with regard to the subject of the accurate dispensing of medicines have, I think it will be generally agreed, made a good statement on behalf of the profession of pharmacy.

I would, however, venture to place before your readers a matter, arising from the above, which is one of no small concern to those chemists who are engaged in the practice of *chemistry* as distinct from *pharmacy*—that is to say—who are concerned with the science of chemistry and its applications to the arts and manufactures, and have nothing to do with the dispensing of medicines.

The Retail Pharmacists' Union have headed their announcement with the words "The Chemist," and I would like to make, in the public Press, the suggestion which has so often been made in the scientific Press, that the time has come for the pharmacist to relinquish the use of the term "chemist" in favour of those who definitely practise chemistry.

The war was instrumental in directing the attention of the public more closely to the existence of the profession of chemistry, the profession on which the country found it necessary to rely for the production of explosives and materials of war generally, as well as for the means of protecting our troops against the methods of chemical warfare initiated by the enemy.

During the past half-century the science of chemistry has developed by leaps and bounds, and its practice as a profession has become more and more firmly established. In this country the science is now taught in 1000 or more public and secondary schools, and in nearly 300 technical schools, whilst our University Departments of Chemistry are renowned throughout the world.

The Institute of Chemistry, as the representative chartered professional body of chemists, numbers upwards of 4000 Fellows and Associates, whose qualification demands a four years' University course, or the equivalent, and the majority of whom are engaged in the many branches of industry on which the science has a bearing.

In other countries the strict equivalent of the word "chemist" signifies, as it should, one who professes chemistry, and not in any case the pharmacist, druggist or dispenser of medicines. How the misapplication of the word has arisen in this country is a matter which I need not here pursue. The enormous importance of chemistry is becoming daily more widely recognised, and it is highly desirable in order to avoid confusion that the name "chemist" should be confined to those who practise chemistry in the full sense of the word. It is bad enough when mental confusion is the unfortunate consequence of the poverty of a language, but in this instance the correct and distinctive words are ready to our hand.

I would like to express the hope which I have already expressed on a good many occasions, that our friends the pharmacists—notwithstanding the provision of the Pharmacy Act—will lose no opportunity of referring to their ancient and important calling by the word which more accurately defines and describes it. In addition, I would appeal to the Press, which is so important a factor in the enlightenment of the general public, to assist so far as they can by employing the terms "chemist" and "pharmacist" respectively in their obviously correct significations, so that those practising chemistry may be described as chemists, and those practising pharmacy as pharmacists.—Yours faithfully,

A. Chaston Chapman,
President of the Institute of Chemistry of Great Britain and Ireland
London, March 17, 1923

POLARITY IN ORGANIC COMPOUNDS

Dear Sir,—I hope that the time is not far distant when *Chemistry and Industry* will be read by every Fellow of the Chemical Society as a greatly improved version of the old Proceedings. In the meantime, may I be allowed to anticipate this future development by making use of your columns to reply to some of the points that were raised in the discussion following the reading of my paper on the "Polarity of Double Bonds" at the Chemical Society last night?

May I add that the President of the Faraday Society has authorised me to say that the Council of that Society has arranged to hold a conference at Cambridge on July 13 and 14 to discuss the "Electronic Theory of Valency," as applied both to inorganic and to organic chemistry, and that it is proposed to extend an invitation to members of other societies to attend and to take part in the discussion.—I am, Sir, etc., T. M. Lowry.

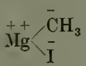
The University, Cambridge.
March 16, 1923.

Reply to Discussion on "The Polarity of Double Bonds"

1. Reactivity

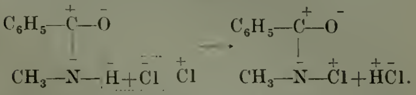
The fact that the reactivity of mixed double bonds varies from compound to compound may I think be interpreted in two ways. In the first place, it is clear that the change of free energy in the formation of the product must influence profoundly the velocity with which chemical change takes place. But in addition to this it is highly probable that (just as the velocity of bromination of acetone depends on the rate at which it can be enolised) the reactivity of a molecule like ethylene may depend on the rate at which the resting form of the molecule becomes reactive by the development of an electrovalency. In the same way the fact that propylene gives normal as well as iso-derivatives may depend on the fact that the resting form of the molecule may become reactive in either of two possible ways. In my paper I have preferred not to lay stress on this aspect of the question, because organic chemists are almost exclusively concerned with the molecule as it actually reacts, *i.e.*, with the appearance of the dog when standing up and barking, rather than when curled up and at rest.

2. Ionisation

The main characteristic of a metal is that it possesses a small surplus of electrons, *e.g.*, as compared with one of the inert gases. In most cases, therefore, it can only enter into chemical action as a kation, *i.e.*, by losing electrons, since the phenomenon of covalency is limited to those cases in which the shortage of electrons is so acute as to compel the atoms to share them. The only way in which the Grignard agent can be represented is, therefore, by some such formula as  $\overset{++}{Mg}\left\langle\begin{matrix}\overset{-}{CH_3}\\ \overset{-}{I}\end{matrix}\right.$; but this does not mean that the compound must give rise to conducting solutions, since the formula set out above corresponds with the "non-ionised" condition of a salt, such as sodium chloride. In order to produce an electrolyte, an ionising solvent must also be found, and this is likely to be a matter of some difficulty in the case of so peculiar a compound. Even if conductivity could be observed, the constituent ions would probably be magnesium monomethyl and iodine rather than a system containing free methyl ions. The idea of testing the electrical conductivity of compounds of this type in various solvents is, however, valuable, and suggests an important line of research. In the meantime it may be noted that Sir Joseph Thomson (*Phil. Mag.*, 1914 [6] 27, 757) has attempted to detect intramolecular ionisation in gases with the help of observations on specific inductive capacity and refractive index, and claims that he has detected ionisation in HCl, CH_3Cl, $CHCl_3$ (weak), H_2O, CH_3OH, C_2H_5OH, NH_3 and SO_2, whilst none could be found in H_2, O_2, N_2, Cl_2, He, CO, CO_2, CS_2, CH_4, CCl_4, C_6H_6 and N_2O.

3. The Mechanism of Chlorination

Most of the reagents that are used to bring about substitution in benzene contain two radicals of opposite types, namely, one radical that is to enter the ring, and a second radical which serves to remove the hydrogen in order to make room for the first radical. In chlorination both *radicals* consist of atoms of the same element, of which opposite functions are required, and to which opposite polarities have been assigned, *e.g.*, by G. N. Lewis and, over a long period of years, by W. A. Noyes. The mechanism of chlorination has not been established clearly in many cases, but it is known that, in the chlorination of acetanilide, the chlorine first attacks the side chain as indicated in the polar equation



$$\begin{matrix}C_6H_5-\overset{+}{C}-\overset{-}{O}\\ |\\ CH_3-\overset{-}{N}-\overset{-}{H}+\overset{-}{Cl}\;\overset{+}{Cl}\end{matrix}\;\longrightarrow\;\begin{matrix}C_6H_5-\overset{+}{C}-\overset{-}{O}\\ |\\ CH_3-\overset{-}{N}-\overset{+}{Cl}+\overset{+}{H}\overset{-}{Cl}.\end{matrix}$$

before swinging down into the *para*-position. The chlorine atom which enters the system is, therefore, positively charged, and behaves like the positively charged nitrogen of a nitro-group. When it has settled down in the benzene ring, the chlorine atom exchanges its electrovalency for a covalency and becomes neutral. It has, however, a latent negative polarity, since when removed from the ring, *e.g.*, by the action of caustic soda, it escapes as the anion of a molecule of salt and is replaced by the negatively charged oxygen of an—$\overset{-}{O}\overset{+}{Na}$ group. It, therefore, directs any further substitutents (including a second chlorine) to the *ortho-para*-positions, in just the same way as a phenol. Other cases of chlorination may be worked out in the same way, and a full consideration shows that there is nothing abnormal in the behaviour of the halogens, except their amphoteric character, which is already displayed in the two-fold function which they serve when used as reagents.

PERSONALIA

The Victoria University of Manchester has conferred the honorary degree of D.Sc. on Prof. Niels Bohr, of Copenhagen, and on Prof. F. Gowland Hopkins, professor of biochemistry in Cambridge University.

Dr. Lüppo-Cramer has been awarded the gold progress medal of the South German Photographic Association.

Monsieur Léon Guillet, the new president of the Société des Ingénieurs Civils, has succeeded the late Monsieur Adrien Bochet as Director of the Central School of Arts and Manufactures.

* * *

David Cochrane, the inventor of the open-feed water heater which bears his name, died on January 24.

The following deaths are announced from Germany :—Richard Fleitmann, General Director of the United German Nickel Works ; Prof. H. Fransen, of the Technical *Hochschule*, Karlsruhe, an active worker in the field of gas analysis, inorganic and bio-chemistry ; and Dr. Framm, director for 20 years of the Laboratory of the Union of German Portland Cement Manufacturers.

NEWS AND NOTES

JAPAN

Forecast of Formosa Sugar Crop, 1922-23

The second official forecast of the sugar crop of Formosa for the season 1922–23 estimates the total production at 6,423,684 piculs, made up of 5,212,503 piculs of centrifugals and 1,211,181 piculs of browns, representing a decrease compared with the previous season of 650,000 piculs. Conditions in the Formosa sugar industry are unfavourable, and the producing companies are effecting all possible economies with a view to reducing the cost of production to from 8 to 12 yen per picul.—(*Bd. of Trade J., Mar.* 8, 1923.)

SOUTH AFRICA

Industrial Progress

According to the industrial census for the year 1920–21, the value of articles produced and work done in factories and workshops (exclusive of railway and other Government workshops) in South Africa was £81,730,652, compared with £81,163,230 in 1919–20. The number of establishments increased from 6,581 to 6,688, and the number of employees from 145,998 to 146,675. Since the first industrial census was taken in 1915–16, the number of establishments has increased by 75 per cent., the value of land and buildings by 59 per cent., the value of machinery, etc., by 62 per cent., the value of raw material used by 160 per cent., the value of the total output by 143 per cent., and the value added to raw materials in manufacturing by 123 per cent.—(*Bd. of Trade J., Mar.* 8, 1923.)

Aluminium, 1919-1921

The Imperial Mineral Resources Bureau has issued a further pamphlet of its series on the Mineral Industry of the British Empire and Foreign Countries. From this pamphlet (pp. 31, price 1s.), devoted to the aluminium industry, including bauxite and cryolite, the following statistics of the world's production of bauxite and of aluminium (estimated) are extracted.

	Bauxite		Aluminium	
	1920	1921	1920	1921
	Long tons			
United Kingdom	11,020	2,269	8,000	5,000
British Guiana	22,084	19,694	—	—
India	3,932	6,652	—	—
Canada	—	—	10,000	3.000
Austria	356	2,596	3,000	3,000
France	183,693	83,577	10,000	6.000
Germany	13,200	—	15.000	14.000
Italy	12,928	48,311	1.218	730
Norway	—	—	7,000	5,000
Spain	531	181	—	—
Switzerland	—	—	10,000	6,000
United States	521,308	139,550	88,000	28,000

Cyrolite is apparently produced solely in Greenland. The exports in 1920 amounted to 13,704 tons, and in 1921 to 11,136 tons, directed chiefly to the United States and the United Kingdom.

The exports of aluminium and manufactures thereof from the various countries are summarised in a series of tables.

GENERAL

German Research Institute for Slag-cement

On December 19 last, the new Research Institute for Slag-cement, formed by the Verein Deutscher Eisenportlandzementwerke and the Verein Deutscher Hochofenzementwerke, was opened in Düsseldorf. The German slag-cement industry has now gained a position of equal importance with the Portland cement industry.

Beet-Sugar Industry in Italy

According to a report quoted in the *Giornale di Chimica Industriale ed Applicata* (Jan., 1923), the past beet-sugar campaign in Italy has been highly successful, the sugar content of the beets being appreciably higher than in previous years. The 39 factories in the country were all working, and the production will, it is estimated, reach 260,000 m.t. of refined sugar valued at 766 million lire. In the previous season, the production from 37 out of the 38 factories then existing, was 203,000 m.t. The output during the past season has only been exceeded in 1913-14, when the production exceeded 300,000 tons. The actual consumption in Italy is estimated at from 270,000 to 280,000 m.t., so that up to 20,000 m.t. of sugar will have to be imported.

An interesting experiment has been carried out by the Union of Sugar Manufacturers and by the Federation of Beet Growers to ascertain the possibility of selling beets by their sugar content. Laboratories have been set up at a cost of 250,000 lire at Rovigo, Bottriga and Mezzano, and the experimental results, which are to be published shortly, are stated to be extremely interesting. It is probable that next season beets will be sold on the basis of their sugar content as a result of the experiment.

The Pharmacology of Phenylenediamines

A recent issue of the *Journal of Industrial Hygiene* (Feb. 23) contains the conclusion of a long experimental study by Prof. P. J. Hanzlik on the pharmacology of certain phenylenediamines. The results indicate that the phenylenediamines are definitely toxic and a list is given of these compounds arranged in order of toxity. Their dimethyl-para- and diethyl-para-compounds are marked irritants to the skin. All the compounds stimulate the circulation and respiration, reduce the body temperature and lead to tremors, convulsions, coma and death. The asthma and respiratory symptoms of workers in the fur-dyeing industry in which para-phenylenediamine is used, are due to direct irritation and bronchial stimulation rather than to anaphylaxis. It is suggested that workmen should be protected against these compounds when used in industry, and that the use of para-phenylenediamine in hair dyes and cosmetics should be prohibited. Therapeutically, the phenylenediamines are of no importance and a scientific basis for the alleged benefits of metaphenylenediamine (lentin) as an anti-diarrheal and anti-dysenteric remedy is stated to be lacking.

REVIEWS

A Dictionary of Applied Chemistry. *By* Sir Edward Thorpe, C.B., F.R.S., *assisted by eminent contributors. Vol. IV. L.-Oxydisilin. Pp.* viii + 740. *Revised and enlarged edition. London: Longmans, Green, and Co.,* 1922. *Price* 60*s. net.*

This volume, a part of the new edition of "Thorpe," is a testimony alike to the diplomacy and tact of Sir Edward, and to the activity and courage of the publisher. It must have been no easy task for the Editor to handle the 120 odd contributors who are concerned in the writing of the various articles in the whole dictionary, and in these strenuous times it requires some optimism for the publishers to venture on such a work. The hard times alike affect the production and sale of a large work. Unfortunately, many manufacturers regard chemists as a luxury, an excrescence, an unprofitable "dead charge" on the works, which can be eliminated when times are bad. This, of course, just now prevents many a chemist from buying the work for his wife as a birthday present. Each edition, as might be anticipated, means the addition of another volume or two; and it is possible that in time the work will approach in magnitude the yet incomplete and cumbrous Muspratt's *Theoretische, praktische, und analytische Chemie in Anwendung auf Künste und Gewerbe.* It is to be hoped not, because the portability and handiness of the dictionary will then cease to be a merit.

The fourth volume, just published, covers subjects between L and Oxydisilin. The reviewer has read most of the longer articles, and has been impressed by their high order of merit. It would be invidious to make a special selection; and that would also illustrate more the temperament of the reviewer than the characteristics of the articles. The silicates are represented by a number of pithy notes on the minerals.

The need for inorganic chemists to come to an agreement on a system of nomenclature is very acute, and the arrangement of the names of compounds in the dictionary-form still further emphasises the attendant difficulties. For example, in the present volume, the last item, "Oxydisilin," would to some inorganic chemists appear like a card misplaced in a card-index.

As a kind of test, the reviewer wrote out a dozen names which occurred to him at random, but within the scope of this volume, and found all but one were treated satisfactorily within the limits imposed by the dictionary: he did not find "leukonin" mentioned. This seems a very good percentage of "hits." The earlier editions have established the utility of this work of reference, and there can be no doubt that the new edition will prove of even greater service.

J. W. Mellor

Manuel Pratique de la Fabrication des Encres. *By* L. Desmarest *and* S. Lehner. *Pp.* 372. *Paris: Gauthier-Villars et Cie.,* 1923. *Price* 12 *fr.*

Essentially this book is a combination of two books, the first portion on writing, copying, marking and miscellaneous inks, being in the main a French version of Lehner's well-known Austrian work, whilst the second portion, on printing inks, appears to be almost entirely French in its origin.

Part I is undoubtedly a valuable storehouse of recipes for the preparation of all kinds of ink, and the descriptive matter is clearly written and, on the whole, fairly accurate. In the chapters on the manufacture of writing and copying inks the writer is obviously speaking largely from his own experience, whereas the chapters on lithographic, marking and stamping inks appear to be mainly compilations, for they do not convey an impression of first-hand knowledge and are not quite up to date.

The section on writing inks is the work of the practical man rather than that of the chemist, for although an outline of the chemical theory underlying the formation of iron-gall inks is given, the methods recommended are based upon rough practical tests rather than upon the results of chemical examination. It is not unreasonable to infer that if the writer were in the habit of estimating the tannin in his raw materials, he would never have committed himself to the statement (p. 27) that good nut galls contain up to 27 per cent. of tannic acid. Even our despised English oak-apple can do better than that, whilst an average sample of Aleppo galls should yield well over 60 per cent. of gallotannin.

It is interesting to note that spent tan liquor and catechu are mentioned as being used in the manufacture of ink, which, so far as the reviewer is aware, is not the case in this country. On the other hand, there is no reference to myrobalans, which are commonly used in the preparation of certain English inks.

The section on marking inks gives most of the older formulæ, but there is no reference to the modern development of "one-solution" aniline inks. The use of concentrated sulphuric acid as a permanent marking ink for fabrics seems unlikely to become popular, even among those who by "much practice" have learned to use it without producing holes in the material (p. 211).

Chapters are also devoted to the methods of preparing inks for writing on different kinds of metals, on leather, ivory, glass, etc., and to sympathetic inks; and lithographic chalks and stamping inks are also dealt with in a useful manner.

Part II, which is concerned with the preparation and properties of printing inks, gives a good outline of the nature of the pigments used, the preparation of the varnish and the incorporation of the various ingredients. There are numerous useful formulæ for making printing inks for various purposes, and a valuable summary of Keghel's work on the manufacture of artificial lake pigments is included as a separate chapter (V). Here, again, the writer is obviously speaking from his own experience, but as in Part I, one misses any real correlation between the work of the chemist and that of the ink-mixer. For instance, no attempt is made to show the chemical reasons underlying the various faults to which printing inks are liable; in fact only two pages are given to the discussion of the qualities of a good preparation. The whole book would be of much greater value as a scientific guide to the manufacture of inks if it had been written upon the lines of Chapter V, to which reference has been made.

C. Ainsworth Mitchell

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Exports of Coal

Replying to Mr. Gilbert, Lieut.-Col. Lane-Fox said that in February the export of coal from the United Kingdom totalled 5,902,630 tons, of which 1,000,097 tons was directed to Germany, compared with 4,014,344 and 359,889 tons, respectively, in February, 1922.—(Mar. 12.

British Empire Exhibition

Viscount Wolmer informed Mr. Darbishire that the British Empire Exhibition would open in April, 1924, and close about the end of October in that year. It was intended that the whole of the cost should be met out of receipts.—(Mar. 12.)

Imperial Institute

Mr. Ormsby-Gore stated, in reply to Sir J. Leigh, that the Grant-in-Aid of the Imperial Institute for the current year was £10,000. The contribution from Australia had ceased and that from India would cease after the current financial year. It was not known whether the contributions of the other Dominions would be continued or not. The report of the Committee now inquiring into the financial position of the Institute would not be available for some time.—(Mar. 12.)

Pitch

Answering Mr. M. Jones, Viscount Wolmer said that in 1922, the total production of pitch in the United Kingdom was 514,236 tons, of which 16,248 tons was produced in South Wales. Exports in the same year amounted to 428,317 tons. It would not be in the interests of industry to restrict the exports of pitch, nor could that be done without authority from Parliament.—(Mar. 13.)

Imports of Aluminium Hollow-ware and Glassware

In reply to Mr. Simpson, Viscount Wolmer said that during the six months ended December, 1922, imports of aluminium hollow-ware from Poland were valued at £36, and from Germany at £104,141. Imports of domestic and fancy glassware from Belgium during the same period were valued at £223,661 and from Germany at £89,856.—(Mar. 13.)

Dyestuffs (Import Regulation) Act

Mr. Baldwin, in answer to Lieut.-Col. Hilder, said he was not aware that German dyestuffs subject to the restrictions of the Dyestuffs Act, were being improperly introduced into this country from the Irish Free State, and he would be glad to hear of any cases where this was alleged to have occurred.—(Mar. 13.)

Home-grown Sugar Beet

In a written answer to Mr. Barnes, Sir R. Sanders said that the Kelham sugar factory had not operated since the excise duty on home-grown sugar was remitted. The whole of last season's beet-crop was worked at the Cantley sugar factory, 7,011 tons of white sugar being produced.—(Mar. 14.)

Reparation Duty

Mr. Baldwin, in answer to Mr. Graham-White, said that the net receipts under the provisions of the German Reparation (Recovery) Act during 1922 amounted to £6,847,000.—(Mar. 15.)

Chemical Factories in the Ruhr District

In a written answer, Lieut.-Col. Guiness informed Mr. Newbold that no facilities for producing poison-gas existed in the towns in Baden seized by the French Government.—(Mar. 15.)

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for March* 15)

TARIFF CUSTOMS EXCISE

Austria.—Goods subject to import licence include saccharin, dulcin, chocolate, opium; wares of rubber, leather, paper, asbestos; abrasives, china, wares of iron and common metals, salt, soda, calcium carbide, glue, varnish, soap, sugar, fats, oils, camphor, paraffin wax, vaseline, lubricating greases, nickel anodes, etc. A special export licence is required for preserved milk, charcoal, ammonium sulphate, anthracene, naphthalene, carbolic acid, fusel oil, and chlorosulphonic acid.

Belgium.—The import duties on sugar and matches have been amended.

British India.—Revised tariff valuations for paper have been issued.

Egypt.—Requirements for imports of alcohol are set out in the issue of March 15.

France.—An export prohibition has been applied to waste of tinned iron.

French Somaliland.—Regulations have been issued controlling the importation of and trade in poisons, including alkaloids and certain chemicals.

Italy.—Export licences are required for scrap of copper, brass and bronze.

Madagascar.—Modified consumption duties have been applied to soap, pottery, glassware, and iron and steel.

San Salvador.—A reduced duty of 40 centavos (gold) per kg. has been applied to pharmaceutical specialities with a base of pure paraffin oil.

South Africa.—A "dumping" duty equal to the difference between the home (Norwegian) and export prices, but not exceeding 15 per cent. *ad valorem*, has been applied to Norwegian cement.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Canada ..	Disinfectants, disinfectant soap, insecticides, soap, wax ..	324
Egypt ..	Paper	362
,,	Oil, paint, varnish ..	10205/F.E./ C.C.2.
France ..	Raw sugar, palm kernels, groundnuts ..	351
Italy.. ..	Pig iron	353
Netherlands .	Silver and tin foil ..	18730/F.W./ M.C.2
Norway ..	Perfumery, soap ..	358
,, ..	Rubber flooring ..	359
Panama ..	Castor oil, soap, chemicals	366
Peru.. ..	Porcelain, crockery, glassware	367
South Africa	Insecticides, disinfectants	346
,,	Earthenware	347
Spain (Canary Islands) ..	China, glassware ..	360
Switzerland..	Soldering tin with resin centre.. ..	18866/F.W./ E.C.2
United States	Acetone	18776/F.W./ C.C.2
,,	Cresylic acid	18812/F.W./ C.C.2

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

A much stronger tone is evident in the market position to-day, prices as a consequence being very firm, and in many cases showing a tendency to advance. The almost complete cessation of supplies from Germany is largely the reason but at the same time the recently improved demand is expected to extend still further, with a general increase in trade. The Heavy Chemical section has shown particular activity of late, both at home and for export, especially in the latter direction. Altogether, the outlook is good, and only requires evidence of an early improvement in the comparatively parlous textile trade to justify a really optimistic forecast.

Acid Acetic, 40% tech..	£22 10s. per ton. Available supplies extremely limited, and price stronger.
Acid Hydrochloric ..	4s. to 5s. carboy.
Acid Nitric	£24 10s. per ton. Not in much demand.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw. is 70s., f.o.r. Makers' Works with slight variations up and down, due to local considerations.
Acid Sulphuric 94% arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d. to £8 per ton. Home trade maintained, with improved foreign business.
Arsenic (White).. ..	£72 to £75 per ton. Price unaltered, but not much doing at the figure.
Bisulphite of Lime ..	£7 per ton. Packages extra.
Bleaching Powder ..	£10 10s. per ton delivered. No change.
Calcium Chloride ..	£6 per ton delivered. Slightly better.
Copper Sulphate ..	£27 per ton. Somewhat firmer.
Potash Caustic, 88/90%	£31 to £32 per ton. Very firm, with prospects of shortage and probable increase in price.
Potassium Bichromate..	6½d. per lb. delivered.
Salammoniac	£32 per ton delivered.
Salt Cake	£4 10s. carriage paid. No change. Probably position will considerably improve with facilities for shipment in Spring.
Soda Caustic 76% ..	£20 to £21 per ton. Brisk demand particularly from the continent, where there appears to be a shortage of supplies.
Soda Crystals	£5 5s. carr. paid. Position well maintained.
Sod. Acetate, 97/98% ..	£25 per ton.
Sod. Bicarbonate ..	£10 10s. per ton. No change.

Sod. Bisulphite Powder, 60/62%	£19 10-ton lots; £19 10s. 5-ton lots; £20 2-ton lots; £20 10s. 1-ton lots. F.o.b. or f.o.r. London, 1-cwt. iron drums included.
Sod. Chlorate	3d. to 3½d. per lb., considerably firmer in price, demand not yet brisk.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. ..	£15 per ton; much better tone, although still disappointing.
Sod. Sulphite, Pea Cryst.	£17 2-ton lots; £17 10s. 1-ton lots (1-cwt. wooden kegs included).

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£10 per ton d/d.
Grey	£20 per ton d/d.
Acetate of Lime Liquor	9d. per gall. 32° Tw.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. per gall. 24° Tw.
Red Liquor	1s. 3d. per gall. 14/15° Tw.
Wood Creosote	2s. 6d. per gall. unrefined. Lower prices, however, are required in some quarters.
Wood Naphtha—	
Miscible	6s. 6d. per gall., 60% O.P.
Solvent	5s. per gall., 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead ..	£39 per ton d/d.

TAR PRODUCTS

Acid Carbolic, crystals..	1s. 7d.-1s. 8d. lb. Supplies very scarce, and price advancing. Demand well maintained.
Acid Carbolic, crude 60's	4s.-4s. 6d. Market advancing.
Acid Cresylic—97/99 ..	1s. 11d.-2s. 3d. per gall. Depending on quality. Rather more business passing.
Pale 95%	1s. 10d.-2s. 2d. per gall. According to quality. Not much demand.
Dark	1s. 9d. per gall. is the average price. Fair demand.
Anthracene Paste, 40%	4d. per unit per cwt. Price still nominal. No business doing.
Anthracene Oil—	
Strained	9½d. to 11d. Fair enquiries.
Unstrained	8¾d. per gall.
Benzole—	
Crude 65's	1s. 1d. per gall.
Standard Motor ..	1s. 6½d.-1s. 8d. per gall. Fair enquiry.
Pure	2s.-2s. 6d. Fair enquiry.
Toluole—90%	1s. 9d.-1s. 11d. Fair enquiries.
Pure	2s.-2s. 9d. Still steady.
Xylol	3s. 3d. per gall.
Creosote—	
Cresylic, 20/24% ..	11d.-1s. 1d. Fair demand. Price unchanged.
Middle Oil	8½d. to 10d. per gall. Regular and increasing demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d.-9½d. per gall.
Solvent 90/160 ..	1s. 6d.-1s. 9d. per gall. Not many inquiries.
Solvent 90/190 ..	1s. 6d. to 1s. 7½d. per gall. Fair demand at steady prices.
Naphthalene, Crude—	
Drained Creosote Salts	£6-£9 per ton, according to quality. Supplies still scarce.
Whizzed or hot pressed	£10-£12 per ton. Prices firm for forward delivery.
Pitch, medium soft ..	£9-£10 per ton. Demand steady and plenty of inquiries.
Pyridine—90/140 ..	11s.-12s. 6d. per gall.
Heavy ..	8s.-9s. nominal.

INTERMEDIATES AND DYES

Acetic Anhydride ..	1s. 5d. per lb.
Acid H	5s. per lb. 100% basis d/d.
Acid Naphthionic ..	2s. 7½d. lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic ..	1s. 6d. lb. 100% basis d/d.
Aluminium Chloride anhydrous	1s. per lb. d/d.
Aniline Oil and Salts ..	9½d. per lb. naked at works.
Antimony Pentachloride	1s. 1d. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis.
Benzyl Chloride.. ..	1s. 4½d. per lb. 100% basis.
Dinitrobenzene	11d. to 1s. lb. naked at works
Dinitrochlorbenzol ..	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene 48/50 ..	8d. to 9d. naked at works.
66/68 ..	1s. 2d.-1s. 3d. naked at works
Diphenylamine	3s. 2d. lb. d/d.
Dichloraniline	2s. 2d. lb. 100% basis.
Dichloraniline S Acid ..	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Meta Phenylene Diamine	5s. 6d. per lb. d/d.
Meta Toluylene Diamine	5s. per lb. d/d.
Monochlorbenzol ..	£70 per ton.
a-Naphthol	2s. 9d. per lb.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine ..	1s. 6½d. per lb. d/d.
β-Naphthylamine ..	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d. -8d. per lb.
Nitronaphthalene ..	1s. per lb. d/d.
Naphthionate Soda ..	2s. 8½d. per lb. 100% basis d/d.
o-Nitrochlorbenzole ..	2s. lb. 100% basis d/d.
p-Chlorphenol	4s. 6d. per lb.
p-Dichlorbenzol.. ..	£55 per ton.
p-Nitrophenol	1s. 9d. per lb. 100% basis.
p-Chloraniline	3s. per lb. 100% basis.
p-Nitro-*o*-amidophenol	4s. 6d. per lb. 100% basis.
p-Phenylene Diamine ..	12s. 6d. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Prices generally for pharmaceutical chemicals are very steady, although the market has been quiet during the past few days.

Acid Acetic 80% ..	£50 per ton. Very little available on spot, and no visible future supplies ex Continent.
Acid Acetyl Salicylic ..	3s. 1d. per lb. still quoted on a very firm market.
Acid Benzoic	2s. 3d. per lb.
Acid Citric	1s. 8½d. per lb., less 5%. Market steady.
Acid Gallic	3s. per lb. for 2-cwt. lots. 3s. 3d. per lb. for 56lb. lots.

Acid Pyrogallic, cryst.	5s. 9d. lb. Price advanced.
Acid Salicylic	Pulv. 2s. 3d. per lb., Cryst. 2s. 5d. per lb. Market very firm and considerable inquiry.
Acid Tartaric	1s. 2¾d., less 5%. As much as 1s. 3½d. per lb. has been asked for foreign makes. The increase in price is likely to be progressive, as reports from the Continent state that German deliveries are held up and Italian makers have raised their prices.
Amidol	9s.-10s. per lb.
Acetanilide	1s. 6d. per lb.
Ammon. Benzoate	3s. per lb.
Ammon. Carbonate B.P.	£37 10s. per ton nett.
Ammon. Sulphocyanide	2s. per lb.
Barbitone	15s.-16s. per lb. advanced, at which rate market is very firm.
Benzaldehyde	3s. per lb.
Benzonaphthol	3s. 9d. per lb. lower.
Bismuth Salts	Steady demand at unchanged prices.
Bromides	Considerably firmer. Higher prices are now quoted on the Continent.
Calcium Lactate	1s. 9d. per lb.
Chloral Hydrate	4s.-4s. 3d. per lb. Steady. Stocks small.
Formaldehyde, 40%	£88-£90 per ton.
Guaiacol Carbonate	8s. per lb. Very little demand exists.
Hexamine	4s. 3d. per lb., as quoted previously. This price is well maintained.
Homatropine Hydrobromide	30s. per oz.
Hydroquinone	3s. per lb.
Iron Ammon. Citrate	2s. 5d. per lb. for 1-cwt. lots.
Iron Perchloride	£20-£22 per ton.
Magnesium Carbonate—	
Light Commercial	£38 per ton.
Magnesium Oxide—	
Light Commercial	£85 per ton.
Heavy Commercial	£28 per ton.
Menthol	32s. for original cases. Smaller quantities 33s. lb.
Metol	12s. per lb.
Methyl Salicylate	2s. 3d.-2s. 4d. lb. Steady.
Methyl Sulphonal	12s. 6d.-13s. lb. Unchanged.
Mercurials	Very firm in view of the uncertain position of the metal.
Paraformaldehyde	3s. 3d.-4s. per lb.
Paraldehyde	1s. 6d. per lb.
Phenacetin	5s. 3d.-5s. 6d. per lb.
Phenazone	6s. 9d.-7s. per lb.
Phenolphthalein	4s. 9d. per lb. on a weaker market.
Potass. Bitartrate—99/100% (Cream of Tartar)	95s. per cwt. Market steady.
Potass. Ferricyanide	4s. per lb.
Potass. Iodide	15s. 8d. per lb. for cwt. lots. Good steady demand.
Potass. Metabisulphite	6d.-7d. per lb.
Potass. Permanagnate	9½d.-10d. per lb. Is now asked by some makers and still higher prices are anticipated.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. Steady market.
Salol	2s. 3d.-2s. 6d. per lb. higher.
Silver Proteinate	10s. per lb.
Sod. Benzoate	2s.-2s. 3d. per lb.
Sodium Citrate—	
U.S.P. quality	2s. 2d.-2s. 3d. lb. } for quantity.
B.P.C. quality	2s. lb.
Sod. Hyposulphite—	
Photographic	£14 15s. for 5-ton lots.
Sod. Potass. Tartrate (Rochelle Salt)	82s.-85s. cwt. No change.
Sod. Salicylate	Slightly higher and very firm at 2s. 5d. per lb. for Powder, 2s. 6d. per lb. for Crystal.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. per ton, according to quantity; f.o.r. London, drums included.
Sulphonal	12s. 6d. per lb.
Tartar, Emetic	1s. 3d.-1s. 4d. per lb.
Thymol	19s. per lb. for good white crystal.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	12s. ,, ,,
Amyl Acetate	2s. 6d. ,, ,,
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (melting point 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from chlorine-free Benzyl Alcohol)	3s. ,, ,,
Benzyl Alcohol free from chlorine	3s. ,, ,,
Benzaldehyde free from chlorine	3s. ,, ,,
Benzyl Benzoate, 19·5° C.	3s. ,, ,,
Cinnamic Aldehyde—	
98/100% Natural	14s. 9d. ,, ,,
Coumarin	13s. 9d. ,, ,,
Citronellol	22s. 6d. ,, ,,
Citral, 100%	9s. 6d. ,, ,,
Ethyl Cinnamate	18s. 6d. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	7s. 6d. per lb.
Iso Eugenol	17s. ,, ,,
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	22s. 6d. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Ketone	35s. ,, ,,
Musk Xylol	9s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	24s. ,, ,,

ESSENTIAL OILS

Almond Oil, Foreign, B.P.A.	13s. 6d.
Anise Oil, Red Ship brand	2s. 1d.
Cananga Oil, Java	9s.
Bergamot Oil	12s. 6d. spot, 13s. 6d. forwd.
Cinnamon Oil, Leaf	4½d. per oz.
assia Oil, 80/85%	8s. 3d.

Citronella Oil—	
Java, 85/90%	4s.
Ceylon	3s. 4½d.
Clove Oil	8s.-8s. 6d.
Eucalyptus Oil, 70/75%	1s. 9d.
Lavender Oil, Mont Blanc, 38/40%	12s. 6d.
Lemon Oil, Spot	3s. Higher prices are asked for forward delivery.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet, Spot	10s. 6d. Higher prices are asked for forward delivery.
Otto of Rose Oil—	
Anatolian	24s.
Bulgarian	26s.
Palma Rosa Oil	17s.
Peppermint Oil—	
English, Mitcham	80s.
Wayne County	13s.
Japanese	6s. 6d.

TRADE NOTES

The Photographic Fair

The large variety of exhibits at the Photographic Fair, now being held in London in the Holland Park Hall, affords convincing evidence of the progressive nature of this peculiarly British industry. All requirements—ranging from those of the most critical expert to those of the most helpless amateur—are catered for by the various photographic firms, and the quality of their products demonstrates how much the industry appreciates the value of the services of chemists and other scientific workers. Limitations of space alone prevent adequate mention of all the exhibitors, but, from the chemists' point of view, pride of place must be given to Johnson and Sons, Ltd. Amongst many photographic chemicals, this firm exhibits numerous developers, many of which, such as metol, hydroquinone and amidol, were not made in this country before the war, and a fine display of specimens of salts of gold, silver and platinum; mention should also be made of the universal single-solution developer, Azol, which replaces the German Rodinal, of a one-solution sepia-toner, and of dyes for tinting films, etc. Salts of the precious metals, so essential in photography, are also exhibited by Messrs. Johnson Matthey and Co., on whose stand specimens of barium platinocyanide, prepared for X-ray work, are to be seen. The help of science has never been neglected by Ilford, Ltd., a firm which exhibits a series of colour-sensitising dyes, the well-known "Desensitol" and various colour filters, including the new colourless "Q" filter containing acetaminoquinoline, which completely cuts off ultra-violet rays. Particularly noteworthy is the introduction by this firm of a new plate of the phenomenal speed of 700 H. & D., a claim well substantiated by the negatives made from it. An interesting series of prints illustrates the quality and utility of the panchromatic plates so long made by this firm. An ultra-speed plate of 650 H. & D., produced in four varieties, two of which are orthochromatic, is also made by the Imperial Dry Plate Co., whose exhibit includes a new roll-film, a series of light-filters, and plates and screens for X-ray work. Despite their speed, the ultra-rapid plates made by these two firms will withstand rough handling. Space is not available to comment on the variety of materials provided by other well-known firms or on the many aids to technical photography exhibited, but it is of interest to note the progress in the optical industry evidenced by the new lenses introduced by J. H. Dallmeyer, Ltd. (an anastigmat of 3 in. focal-length and the very large aperture of $f/2{\cdot}9$) and by Ross, Ltd. (a light, fixed-focus telephoto lens). Altogether the fair shows the steady advance of the photographic and related industries, and it is to be hoped that this will be appreciated both at home and abroad, as success in this direction is an important factor of the prosperity of our fine-chemical industry.

Department of Overseas Trade

This department has issued a useful handbook which explains the nature of its functions and some of the methods by which it carries them out. The department was founded in 1917 in response to a demand from business men for such an organisation, and that its work has been successful is shown by the strong representations made for its continuation when recently threatened with suppression. A tribute to its value is provided by the fact that its organisation has been copied by the Governments of some of our chief competitors. The handbook shows, briefly, how the department assists the British exporter, outlines the exports-credits scheme and states how information is distributed and how co-operation with the business community is maintained. Copies of the handbook can be obtained by United Kingdom merchants and manufacturers on application to the Department of Overseas Trade, 35, Old Queen Street, Westminster, London, S.W. 1.

PUBLICATIONS RECEIVED

Publications of the United States Geological Survey, *Department of the Interior. Washington: Government Printing Office*, 1922:—

Cadmium in 1921. *By* C. E. Siebenthal *and* A. Stoll. I:1. *Pp.* 1—5.

Chromite in 1921. *By* E. Sampson. I:3. *Pp.* 15—17.

Clay in 1921. *By* J. Middleton. II:18. *Pp.* 105—110.

Feldspar in 1921. *By* F. J. Katz. II:19. *Pp.* 111—115.

Fuel Briquets in 1921. *By* W. F. McKenney. II:1. *Pp.* 1—5.

Fuller's Earth in 1921. *By* J. Middleton. II:6. *Pp.* 21—22.

Gems and Precious Stones in 1921. *By* B. H. Stoddard. II:23. *Pp.* 143—146.

Graphite in 1921. *By* L. M. Beach. II:2. *Pp.* 7—12.

Gypsum in 1921. *By* K. W. Cottrell. II:16. *Pp.* 89—96.

Lead and Zinc Pigments and Salts in 1921. *By* C. E. Siebenthal *and* A. Stoll. I:8. *Pp.* 55—62.

Lime in 1921. *By* G. F. Loughlin *and* A. T. Coons. II:25. *Pp.* 155—168.

Magnesite in 1921. *By* Charles G. Yale. II:15. *Pp.* 83—88.

Magnesium in 1921. *By* G. F. Loughlin. I:4. *Pp.* 19—20.

Manganese and Manganiferous Ores in 1921. *By* H. A. C. Jenson. I:7. *Pp.* 45—54.

Mica in 1921. *By* B. H. Stoddard. II:14. *Pp.* 77—82.

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EDITORIAL

IN the issue of *Nature* for March 24 Messrs. C. J. Smithells and F. S. Goucher, of the Research Laboratories of the General Electric Co., Wembley, contribute a letter in which they state that, as the result of careful chemical and X-ray analysis of the black Maketu sand from which Dr. Scott had isolated the oxide of a new element, they are able to confirm Dr. Bohr's conclusion that no new element is present. Starting with 1000 g. of the sand, the authors obtained 1·7 g. of material free from silica and insoluble in sulphuric acid. As Dr. Scott found, this material was not brought into solution on fusion with sodium bisulphate, but on fusion with *potassium* bisulphate the residue went into solution completely, and was found by both chemical and X-ray analysis to consist of about equal parts of iron and aluminium. Prof. Bohr found an appreciable quantity of titanium in the residue, but the authors state that they only found a trace, and point out that as their residue was only 0·2 per cent. of the ore their extraction was probably more complete.

Whether the sand investigated by Messrs. Smithells and Goucher came from the same locality as Dr. Scott's sample is not stated, and further information seems desirable before it is assumed that his sand is identical with that from Maketu.

* * *

The Anniversary Dinner of the Chemical Society, held at the Hotel Cecil on March 22, was a conspicuous success, and gave great satisfaction to the large number of chemists of both sexes who were present. Our French visitors were able to meet a number of old friends and new acquaintances, who will retain a most agreeable recollection of the occasion. We were much gratified by the flattering remarks of the new President, Prof. Wynne, on the progress of this *Journal* since, with the co-operation of the Chemical Society, we have included both pure and applied chemistry in our pages. The reunion of chemists of every variety at the Hotel Cecil is a sign of a greater reunion of chemical activity, the manifestations of which are becoming now very frequent. In the early days of the science of chemistry the research student was busily engaged in attempting to solve the mysteries of Nature by heating together at a proper temperature and at the best phase of the moon, various oils, ores, powdered bricks, orpiment, litharge, horse-hair and other ingredients, and there seemed to be no reason why these novel methods of investigation should not speedily explain the present and the future, to say nothing of the past. It was somewhat unexpected that so immense a tract of knowledge should become visible as the result of these early experiments, and though astrology and mysticism were dropped out of the science it grew in bulk to an amazing extent, until a generation ago chemistry became too vast a subject for any one individual to cope with.

* * *

The early workers were explorers who found themselves confronted by a tangled mass of tropical jungle through which paths were cut with infinite labour, and in order to facilitate progress they formed groups of workers who specialised in the domains of inorganic chemistry, physical, organic, colloid and the many other varieties, leading somewhat independent existences, but each pursuing the rather tortuous path upon which he had commenced. But during the last few years it seems that these paths are converging and already the explorers in one locality hear the voices of their neighbours and occasionally get a glimpse of some exceptionally bold adventurer. They will shortly be meeting again on some common ground, and though much remains to be explored in various side issues, it is becoming obvious that we are approaching a period when there will be much greater community of ideas than has hitherto been possible. The physical conceptions which result from X-ray analysis are essential to the progress of modern organic chemistry: the spectroscopists and phtosynthesists are trying to explain how plants live and grow; the labours of Lewis and Langmuir will be applied to the investigation of indigo and the mathematical methods of Barlow and Bragg will be directed towards the preparation of photographic sensitisers.

* * *

It looks as if there will, in the near future, be a New Chemistry of the great principles which explain all the manifold branches of the science which have hitherto been somewhat segregated, and it is a fortunate circumstance that the Society of Chemical Industry has embarked on its new venture at a time when the increase of human knowledge shows signs of linking together again in a very rapid manner the interests of chemists of all sorts and conditions. We look forward to new books which will deal with chemistry as a whole in a manner entirely different from anything which has hitherto appeared, and can imagine only one diversion more fascinating than reading such books: that is, the writing of them.

* * *

If it be true that the underlying principles common to all branches of chemistry will turn out to be more numerous and important than now appears, we shall find a marked tendency during the next few years towards greater co-operation between the various chemical societies than has hitherto prevailed. The Annual Dinners of the Chemical Society will provide most pleasant opportunities for discussing some aspects of this problem, and others will no doubt receive attention from the Federal Council and the numerically smaller groups who frequent the Chemical Industry Club.

We see no signs that the public interest in chemistry is diminishing since the Armistice terminated that struggle, which compelled so many people in so many countries to engage in the manufacture of chemical compounds. On the contrary, we see signs that in education, in commerce, in financial circles, and in politics there has been an awakening of interest in the science and its applications, which will steadily grow so long as our leaders will take the trouble to make the public understand how chemistry contributes to our prosperity, our civilization and our happiness. This is to be achieved not merely through our daily and weekly Press, but also by the delivery of popular lectures and addresses which will be understood by those whose scientific knowledge is small. We wonder if one of our Societies could make such an experiment without unduly risking its reputation and prestige.

PATENT CLAIMS FOR PRODUCTS*

By ERNEST F. EHRHARDT, D.Sc., Ph.D.

To those who study patent law the development in various countries of the nature of the protection given to the patentee is a matter of great interest. In this country until lately there has always been room for difference of opinion as to whether valid Letters Patent could be granted for a new product, so as to enable the inventor of a new product to prevent any subsequent inventor, who devised a different process for making the same product, from carrying out his subsequent invention. There has been a swing of the pendulum going on for many decades, if not for centuries, with reference to this point. It may be thought that the 1919 Act settled the matter. This paper is an attempt to show some of the uncertainties it has introduced.

The expression used in the original Patent Act, the Statute of Monopolies, "any manner of new manufacture" was at first taken to include the article manufactured even if subsequently made by new processes. Later, the opposite view was held, and at any time during the last twenty years, one could have found leaders at the Patent Bar, some of whom would have given the opinion that there could not be a product claim in the above sense, whilst others expressed the opposite view.

The state of the law as applied to patents for coal-tar colours can well be seen by considering the judgment of Mr. Justice Wills in the case of Monnet *v.* Beck, R.P.C., Vol. 14, page 843. In the patent under discussion in that case, the third claim was: "As new products the colouring matters or dyes hereinbefore called Anisolines obtained substantially in the manner set forth."

Mr. Moulton argued that the claim should be read as if it were:—"As new products anything identical with the substances produced by my process, no matter by what process obtained."

The judge did not accept this construction of the claim, but confined it to colouring matters obtained by the process described, and then went on to say:—"I decide this question as to the third claim, not on the ground that there could not be a patent for all Anisolines as new things, but adopting the words of Cotton L.J. in Vorwerk *v.* Evans, 7 Patent Reports 265-271, that, having regard to the whole of this specification, it is not a claim to Anisolines only, but to those made in the way pointed out by the specification." This case shows that Mr. Moulton, as he then was, not merely submitted that there could be a claim for a chemical product which would cover that product, however obtained, but even argued that Monnet's third claim was such a claim in spite of the restriction "obtained substantially in the manner set forth." The judge decided that this restriction narrowed the claim so that it did not carry the invention beyond the process claims, but he particularly stated that he did not decide that there could not be a patent for all Anisolines as new things. This shows that in 1897 the point was quite an open one.

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* Paper read at the Meeting of the Manchester Section, held on January 5, 1923.

I am not aware of any attempt by the Courts of the Legislature to settle the question until the new Patent Act of 1919 came into force. Section 11 of that Act was apparently intended to settle this point; there was inserted in the principal Act, a new Section 38*a*, which opens as follows:—"In the case of inventions relating to substances prepared or produced by chemical processes or intended for food or medicine, the specification shall not include claims for the substance itself, except when prepared or produced by the special methods or processes of manufacture described and claimed or by their obvious chemical equivalents." The results of this alteration of the law have been curious, and some of them, I think, were not intended by those who suggested the amendment of the law. In the first place, by this alteration of the law the doctrine of Heath *v.* Unwin was definitely made applicable to the product claims of chemical patents. It will be remembered that, in the case of Heath *v.* Unwin, it was decided that the change of a process by substituting for "carburet of manganese," a mixture of "oxide of manganese and tar" did not constitute an infringement of the "carburet of manganese" process patent because it could not have been foretold with certainty, at the date of the specification, that the tar and manganese oxide would have acted in the same way as the "carburet of manganese."

The most recent case in which this doctrine has been applied to a dyestuff patent is the Sulphur Black case—A.-G. für Anilin Fabrikation *v.* Levinstein, Ltd. In that case the patentee claimed the manufacture of a sulphur black "by boiling dinitrophenol with an aqueous solution of sulphur and a sulphide of an alkaline metal." The defendants, instead of using dinitrophenol itself as claimed, used sodium dinitrophenolate—that is, the corresponding sodium salt of the free acid claimed. Applying the doctrine of Heath *v.* Unwin, the Court of Appeal said:—"We think the real question is whether in 1900, at the date of the plaintiff's patent, it was known to persons reasonably instructed in the industry, that a claim for the process of boiling dinitrophenol, with an aqueous solution of sulphur and a sulphide of an alkali metal, would necessarily cover one from which dinitrophenol is excluded and in which sodium dinitrophenolate is substituted." They decided that this was not the case, and that there was no infringement.

This doctrine of Heath *v.* Unwin now becomes applicable to product claims because a claim to a product has to be restricted to the special process by which the new product is obtained:—"The specification shall not include claims for the substance itself except when prepared or produced by the special methods or process of manufacture described and claimed or by their obvious chemical equivalents."

If we were to apply this section to one of the most striking recent inventions of a new chemical dyestuff, we could perhaps best take for that purpose the invention of Jade Green by the chemists of Scottish Dyes, Ltd. That is beyond doubt a new product. If anyone makes a change in the process of producing it which satisfies the conditions of Heath *v.* Unwin he will be in a position to manufacture and sell his Jade Green without regard to the patent of Scottish Dyes, Ltd.

This result strikes me as curious, although it must be taken to have been intended by those who made this amendment in the law; but when we come to other results of the amendment now embodied in decisions of the Patent Office and the Law Officer of the Crown (R.P.C., Vol. 38-39, pp. 292 and 264), the effects can only be adequately described as "curiouser and curiouser"

It will be noticed that in the new section substances prepared by chemical processes are coupled together with substances intended for food or medicine, and the same alteration in the law is made with reference to specifications relating to inventions of these three classes—food, medicine, products of chemical processes—and so a decision on a food patent interprets the law as to product obtained by chemical processes.

Recently a patent was put in which included the following claim:—"A step in the process of making bread, as claimed in Claim 1, which consists in immersing flour for some time in an atmosphere of strong chlorine gas so that the flour absorbs and is acted upon by the gas, and incorporating with this chlorine-treated flour acid ammonium sulphate, so that when the flour thus treated is made into dough and baked, the results set out in the specification are secured." This claim has been disallowed under the new section to which I have repeatedly referred, and the rejection has been upheld on appeal to the Solicitor-General. You will note that the claim is a process claim; it covers a step in the process of making bread, which consists in immersing the flour in chlorine gas so that the flour absorbs and is acted upon by the gas, incorporating this treated flour with ammonium sulphate, making dough and baking to bread, and yet this *process* claim is rejected under the new section, which on the face of it refers only to *product* claims.

The reasons given for this decision are very subtle; first of all, there is the argument that, while this claim is in form a process claim, it is in effect a product claim, because *the only way* of making this composition is by mixing the ingredients together. If only one way is known of making a product, a patent for that way of making the product gives the patentee the monopoly of the product; a claim for the process has all the effect of a product claim because no alternative way of making the product is known. Consequently, so long as a process claim covers the only way of making its product it is in effect a product claim, and, in accordance with this decision of the Solicitor-General, it must be considered to fall under this Section 38*a*.

The second step of the reasoning by which this process claim has been rejected is equally subtle; it turns on the *wording* of the section which provides that the specifications for the bodies in question shall not include claims for the substance itself, except when prepared or produced by the *special* methods or process of manufacture described and claimed. It was held that the process described was not "special." What is meant by the word "*special*"? It was contended on behalf of the patentee that the word meant the particular process claimed, but the retort was that then it was superfluous and that the section might have read that the specification shall not include claims for the substance itself except when prepared or produced by the methods or processes of manufacture described and claimed. This is, in my opinion, the plain and obvious meaning of the section. That argument was, however, not accepted The Legislature must have meant something by inserting the word "special," and the question arises in the case of any process claim which is in effect a product claim, *is it special?* If it is not special it is to be rejected. As to what is or what is not special I can give no guidance, because the claim set out above was decided not to be "special."

I can understand anyone who eats bread exclaiming, upon reading this process, "What a nasty thing to do—to treat the flour from which bread is to be made with a poison gas and then mix it with ammonium sulphate before turning it into dough and bread," and one is inclined to think that the officials of the Patent Office and the Solicitor-General were keen to find a way of preventing an inventor of a nasty process like this being rewarded with a Letters Patent; but when we consider the effect of this decision on patent applications for dyestuffs there is reason to anticipate serious difficulties.

If a man prepares a new azo dye by diazotising a new amino body in the usual way, and combining it in the usual way with a well-known component, will he be allowed to claim the process for the manufacture of his new colour? His claim to the process will in effect be a product claim, for as a rule azo dyes can only be made by the process referred to. The section will apply to a patent of the nature I have mentioned; will the process of making azo dyes be regarded as special?

It may well be argued by an opponent of the patent that, since there is only one method of making the particular azo body, the claim is a product claim. Since it is a product claim, it is to be disallowed unless the method of preparation described is a "special" method within the meaning of Section 38*a*. As to the meaning of "special," the only reported instance of a decision on the point is one in which a clearly-described series of chemical operations was held not to be a "special" method. If impregnation of the raw material with chlorine, and heating with the acid sulphate of ammonium is not a "special" method, why should diazotising be "special" when scores of bodies are diazotised daily in the usual course of chemical manufacture.

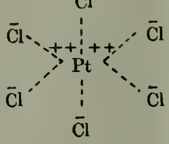
The decision in the flour case is clearly bad, but it is to be feared that inventors of chemical processes for making new substances will be liable to have trouble with their applications until another case can be taken up to some other Law Officer, when some way of reversing the decision for all practical purposes will be found.

SOME FACTORS INFLUENCING CO-ORDINATION

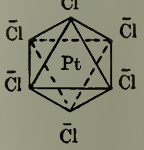
BY PROF T. MARTIN LOWRY, F.R.S.

1. *Close-packing of Ions*

(*a*) The fundamental factor in co-ordination is a close-packing of ions. This is similar, both in origin and in character, to that which we now know, as a result of X-ray analysis, to prevail in crystals. Thus, when platinic chloride is mixed in aqueous solution with an excess of potassium chloride, the quadruply-charged platinic ion, $\overset{++++}{Pt}$, attracts to itself a shell of six chlorine ions, as in the formula I. below. In this formula the electrostatic attractions, or electrovalencies, between the ions are represented by dotted lines, in the manner commonly employed to represent "partial valencies"; but the distinction which is sometimes made between the four "primary valencies" of the $PtCl_4$ molecule, and the two supplementary valencies of the $PtCl^{--}$ ion is not, and indeed cannot be, maintained.



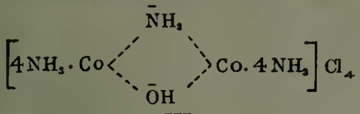
I.



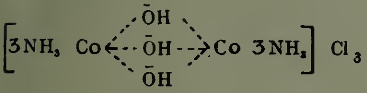
II.

The orientation of these six ions is identical with that of the six chlorine ions which are distributed round each ion of sodium in a crystal of rock salt, and is shown clearly in formula II. This octahedral arrangement of the groups in co-ordinated compounds of the type [MeR_6] has been established by proofs of precisely the same type as those used by van't Hoff in establishing the tetrahedral symmetry of methane, or by Kekulé in establishing the hexagonal formula for benzene, and rests upon an equally firm experimental basis.

(*b*) The idea that the principal forces in co-ordination are of the same character as those which determine the formation of crystals finds support in the fact that negative ions can link together ions of metal, just as metals can co-ordinate a number of negative ions. The sharing of negative ions by two adjacent metallic atoms is, however, limited to three, since this is the maximum number of apices that can be brought together in two adjacent octahedra. Thus Werner has prepared octammine-aminol-dicobaltic salts of the type III. and hexammine-triol-dicobaltic salts of the type IV.

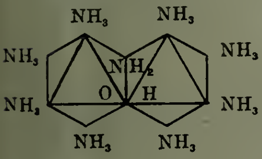


III

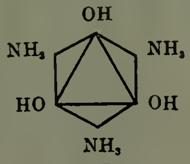


IV

The former compound may be represented by the symbol V; in the latter compound each half of the molecule is represented by the symbol VI., but the top face of the octahedron is shared with a second octahedron resting symmetrically upon it.



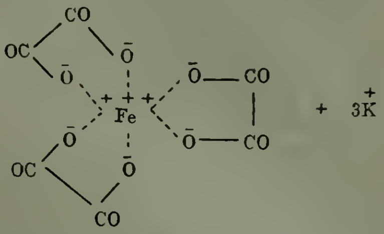
V



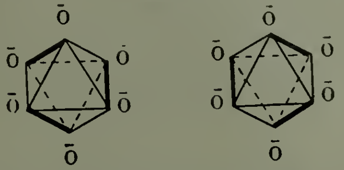
VI

A number of compounds containing *three* atoms of cobalt linked together in this way have also been prepared by Werner, and these may be expected to show complex isomerism, corresponding with that observed in derivatives of polycyclic hydrocarbons such as anthracene.

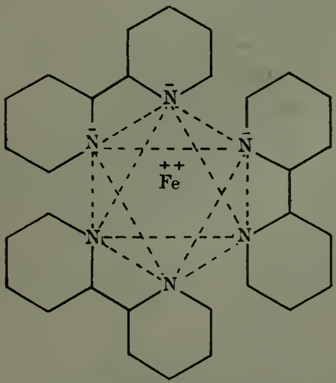
(*c*) In the case of bivalent anions, such as those of the oxalates, negatively charged oxygen atoms take the place of the negatively charged univalent chlorine ions of the platinichlorides; but the bridges between the oxygens reduce the symmetry of the complex to a point at which optical activity may be developed even in such simple compounds as the ferrioxalates —*e.g.*, $K_3[Fe.3C_2O_4]$. The ions of this salt may be formulated as



The enantiomorphism of the series of oxalates of the type M_3 [$Me.3C_2O_4$] can be seen more clearly by marking the bridges between the oxygen atoms by heavy lines instead of inserting the complete –CO–CO– groups, thus :



(*d*) Another case of the same type as the oxalates, but with a basic radical as the co-ordinated complex, is that of the additive compound of ferrous chloride with three molecules of α-dipyridyl, $FeCl_2,3C_{10}H_8N_2$, or [Fe.3Dip]Cl_2. In this compound the bivalent atom of iron is surrounded octahedrally by six nitrogen atoms, to each of which the theory of "mixed double bonds" would assign a negative charge. This compound has also been prepared in optically active forms, one of which only is formulated below :—



The hexagonal ring-systems shown in the formula are not parallel to the plane of the paper,

A

but are inclined to it like the blades of a propeller revolving about the central three-fold axis of the figure.

2. *Completion of Shells of Electrons.*

(*a*) A second factor in determining the stability of co-ordinated compounds is the completion of shells of electrons. Langmuir has attributed the high valency of the metals in the three carbonyls

$$Mo(CO)_6,\quad Fe(CO)_5,\quad Ni(CO)_4$$

to the fact that molybdenum requires 12, iron requires 10, and nickel requires 8 electrons to complete the outer shell. In the case of co-ordinated compounds, the central atom of metal is present as an ion—*i.e.*, it has lost some of its electrons, and therefore requires a larger number of electrons in order to complete its outer shell. It is therefore probably much more than a mere coincidence that, when allowance is made for this difference, the number of co-ordinated groups so often agrees with the number of molecules of carbon monoxide required under Langmuir's scheme to complete the shell of electrons. Thus the platinum atom, with atomic number 78, contains 2+8+8+18+18+24 electrons in the successive shells. The platinic ion, $\overset{++++}{Pt}$, therefore contains 20 electrons in the outer shell, and requires 12 more to complete the shell of 32. By drawing into this shell one pair of electrons in each of six chlorine atoms, the outer shell can be completed. In the same way cobalt, with atomic number 27, contains in successive shells 2+8+8+9 electrons. The cobaltic ion $\overset{+++}{Co}$ therefore contains 6 electrons in the outer shell and requires 12 more to complete it. It finds these by drawing into its orbit six atoms of ammonia, as in the hexammine $[Co.6NH_3]Cl_3$, where the ammonia is held so strongly that it cannot be displaced even by sulphuric acid.

(*b*) This factor may be invoked in order to account for the stability of the six-fold co-ordination compounds of $\overset{++++}{Pt}$, $\overset{+++}{Co}$, $\overset{+++}{Rh}$, $\overset{+++}{Ir}$, $\overset{++}{Fe}$, in all of which the outer shell of electrons can be completed by the attachment of six co-ordinated groups. It also accounts for the vigour with which potassium cobalto-cyanide, $K_4CoC_6N_6$, passes into the cobalti-cyanide, $K_3CoC_6N_6$, an action which is sufficiently violent to liberate hydrogen from acids and to convert oxygen into hydrogen peroxide.

$$2K_4CoC_6N_6+2HCl=2K_3CoC_6N_6+2KCl+H_2$$
$$2K_4CoC_6N_6+2HCl+O_2=2K_3CoC_6N_6+2KCl+H_2O_2$$

All this fuss arises from the fact that the cobaltocyanide ion contains, on the basis of the electronic theory of co-ordination, one surplus electron over and above those required to complete the outer shell! The surplus atom of potassium in potassium cobaltocyanide therefore behaves almost as if it were in the metallic state, and is almost ready to decompose water, like metallic potassium, in the effort to get rid of an unwanted electron.

The same factor may, however, also be invoked to account for the fact that this order of stability is reversed in the corresponding compounds of iron. Here the co-ordinating force of the triply charged ferric ion, $\overset{+++}{Fe}$, would normally be much greater than that of the doubly charged ferrous ion, $\overset{++}{Fe}$. The greater stability of the ferrocyanides may be attributed to the fact that the ferricyanides are one electron short of the number required to complete the outer shell, and are therefore ready to acquire one by passing over into ferrocyanides. This shortage of electrons is, however, tolerated much more readily than a surplus, as is indeed indicated by the fact that a shortage of 3, 2 and 1 electrons respectively is found in the co-ordinated compounds of $\overset{+++}{Cr}$, $\overset{++}{Pt}$ and $\overset{+++}{Fe}$, typified by the formulæ

$$K_3[Cr.6CN],\quad K_2[Pt.4CN]\quad \text{and}\quad K_3[Fe.6CN].$$

(*c*) According to the views set out above compounds with a co-ordination number of four, compare $Ni(CO)_4$, should be specially frequent in *univalent* elements containing *one* electron more than nickel and its homologues, *bivalent* elements with *two* more, etc.; or alternatively in elements occupying similar positions relatively to the inert gases He and Ne, which also require eight electrons to reconvert them into the inert gases Ne and A. This conception finds support in the fourfold co-ordination compounds of bivalent beryllium as well as in the existence of compounds such as $KAlCl_4$, $K_2ZnC_4N_4$, K_2HgI_4, etc. This type of co-ordination is, however usually much less stable, and is of far smaller importance, than the sixfold co-ordination discussed above.

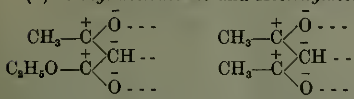
3. *Tautomeric Ions*

(*a*) It is remarkable in how many cases tautomeric ions give rise to co-ordinated compounds. This term is here applied to ions which, although often represented by different formulæ, are (in the sense of Laar's original definition) "not isomeric but identical." A common feature of all these ions is that hydrogen, or an alkyl radical, can be attached to the ion *at two different points*. One of the most important results that follow from the theory of "mixed double bonds," which I described at a meeting of the Chemical Society in October, 1922, is that the two tautomeric forms of these ions become identical in appearance as well as in fact. This may be illustrated in the case of four typical ions as follows:—

(i) *Hydrogen cyanate* and *Hydrogen thiocyanate*

$$\cdots\overset{-}{O}-\overset{+}{C}=\overset{-}{N}\cdots\qquad\qquad \cdots\overset{-}{S}-\overset{+}{C}=\overset{-}{N}\cdots$$

(ii) *Ethyl acetoacetate* and *Acetonylacetone*



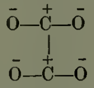
In these formulæ the alternative points of attachment are represented by dotted lines; and these do in fact represent fields of force having the character of the "partial valencies" which this sign is often used to denote. The existence of two or more *similar* points at which a hydrogen atom or a radical can be attached, where the older formulæ indicated a difference, is also seen in the corresponding formulæ for the ions of :—

(iii) *Nitrous acid* $\overset{-}{O}—\overset{+}{N}—\overset{-}{O}$

(iv) *Formic acid and Acetic acid*

$\overset{-}{O}—\overset{+}{C}H—\overset{-}{O}$ and $\overset{-}{O}—\overset{+}{C}Me—\overset{-}{O}$

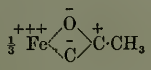
(v) *Oxalic acid*



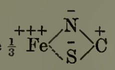
$$\begin{array}{c}\overset{-}{O}—\overset{+}{C}—\overset{-}{O}\\ |\\ \overset{-}{O}—\overset{+}{C}—\overset{-}{O}\end{array}$$

(*b*) The use of these formulæ introduces a new element of order into the study of co-ordination-compounds, as may be illustrated in the following cases, where in each instance the symbols to the right of the metal are repeated three times in the complete formula of the compound :—

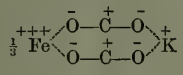
(i) Ferric acetate



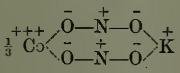
(ii) Ferric thiocyanate



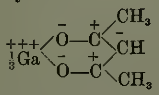
(iii) Potassium ferrioxalate



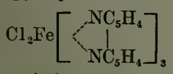
(iv) Potassium cobaltinitrite



(v) Gallium acetonylacetone



Ferric acetate and ferric sulphocyanide are probably unstable co-ordinated compounds, since they possess the red colour which Werner uses as evidence of the co-ordinated character of ferrous-tri-dipyridyl chloride :—



and of the iron in hæmoglobin. It will be noted that a place has been assigned to the potassium ion in the formulæ of the complex double oxalates and nitrites. It is probably legitimate to think of the univalent metal as "co-ordinated" in this way with two negatively charged oxygen atoms, either when *in the undissociated state* or when *in a crystal;* but this can only be regarded as the very weakest type of co-ordination.

4. *Summary*

(*a*) Co-ordination is the result of an attraction between ions, which is similar, both in origin and in its geometrical effects, to the forces which bind together the ions in crystals, such as rock-salt.

(*b*) In the compounds of $\overset{++}{Fe}$, $\overset{+++}{Co}$, $\overset{+++}{Rh}$, $\overset{+++}{Ir}$, $\overset{++++}{Pd}$ and $\overset{++++}{Pt}$, six co-ordinated groups are just sufficient in number to complete the outer shell of electrons of the metal, if each group shares one pair of electrons with the metal. The ammines, such as $[Ir.6NH_3]Cl_3$ and $[Pt.6NH_3]Cl_4$ and the metallic carbonyls, such as $Mo(CO)_6$, $Fe(CO)_5$ and $Ni(CO)_4$, appear to owe their formation and stability to this sharing of electrons. Whilst a deficiency of 1, 2 or 3 electrons can be tolerated readily, the surplus electron of potassium cobaltocyanide is expelled with great violence from the co-ordinated complex, giving rise to the extremely stable cobalticyanide.

(*c*) Co-ordination usually involves the attachment to a metal of more radicals than it can carry on the old theory of valency. The theory of "mixed double bonds" allows this to be expressed by means of symmetrical formulæ in compounds, such as ferric acetate.

(*d*) Tautomeric ions, which can be written in two ways since they possess two possible points of attachment for a hydrogen nucleus or an alkyl group, often give co-ordinated complexes, in which a multivalent ion is attracted to both points simultaneously.

NOTES FROM HEATHFIELD—III

By the Rector, Rev. B. V. WHITE, M.A.

Dear Mr. Editor,—The avocations of a country clergyman tend rather towards those departments of knowledge which can be developed by the perusal of books—especially the older and simpler sort—than those which demand costly pieces of apparatus and the study of what are now distinguished by the name of "transactions." I fear that I shall never attain to a deep understanding of most of the branches of chemistry, but I hope I may spend many an agreeable hour with the writers of bygone days—Glanvill, Thomson, Boyle, Faraday, Franklin and Bishop Watson; from the last, indeed, I claim to be a remote descendant.

It gave me quite an exaltation of my spirits to read the proposals for a convocation of chemists in Cambridge next June, and I think it highly probable that I shall myself be present. I was hardly more than eleven or twelve years old when I was taken there by my parents, and I well remember my first impressions of the colleges and the King's Parade. The charm and peacefulness of the town was a great change from the dirt and noise of Bradford, where I was born and spent my early days. It was on this occasion that I first met my future spouse, then a mere child. As Virgil puts it :—

" Saepibus in nostris parvam te roscida mala
dux ego vester eram—vidi cum matre legentem ;
alter ab undecimo tum me jam acceperat annus ;
jam fragiles poteram ab terra contingere ramos ;
ut vidi, ut perii."

As some of your readers have not that knowledge of Latin, which I am glad to find Professor Baly has, I append a translation of these charming lines : " It was in our orchard I saw you gathering apples with the dew on them. I myself was your guide, in company with my mother—another year had just bidden me leave my eleventh, and I could barely reach from the ground to the tender branches. I watched you, and fell a prey."

Professor Baly has been most obliging, and his communication to you has been, as it were, an arc-lamp compared with my poor little candle. And it comes into my mind that, in my father's time, a green colour obtained from nettles, was used for colouring sweets, and candles, and some other objects. Now, there is one very surprising observation about green candles which, if confirmed, may be of great interest.

Sir David Brewster records it in one of his " Letters on Natural Magic," addressed to Sir Walter Scott in the year 1834 (p. 319) : " A singular species of invisible combustion, or of combustion without flame, has been frequently noticed. I have observed this phenomenon in the small green wax tapers in common use. When the flame is blown out, the wick will continue red hot for many hours ; and if the taper were regularly and carefully uncoiled, and the room kept free from currents of air, the wick would burn on in this way till the whole of the taper is consumed. The same effects are not produced when the colour of the wax is red. In this experiment the wick, after the flame is blown out, has sufficient heat to convert the wax into vapour, and this vapour, being consumed without flame, keeps the wick at its red heat. A very disagreeable vapour is produced during the imperfect combustion of wax." Sir David Brewster, like Sir Humphry Davy and Michael Faraday, was the recipient of the three great medals of the Royal Society —the Copley, the Rumford, and the Royal ; so that we cannot doubt the accuracy of his statement that the green taper burns continuously whilst the red one does not, although he offers no explanation. Is it possible that photo-catalysis occurs as between the green chlorophyll and the formaldehyde produced by the incomplete combustion of the wax ? Now, whether " isorropesis " or what other action accounts for this I know not.

It is the incredible observations both in theology and science which are the most important and interesting, as indeed Sir Oliver Lodge has recently pointed out in a lecture published in *Nature*. I must leave the discussion of green candles to those who are better informed than I am, and make use of this occasion to offer to Professor Baly my most hearty thanks for his admirable elucidation. As for the sceptical friends I mentioned in my previous letter, they inform me that they propose to repeat Professor Heilbron's experiments, using synthetic ammonia, which is now being manufactured in the vicinity of the district in which they reside.

In reply to your correspondent who signs himself " Sales Manager," the poem, " The Progress of Man " is contained in the poetry of the anti-Jacobin, of which my edition was published in 1800. The author of it, I find, was George Canning, and the following extracts illustrate the nature of it :—

" The feather'd race with pinions skim the air—
Not so the mackerel and still less the bear :
This roams the wood, carniv'rous for his prey !
That with soft roe, pursues his watery way.

. . . . .

Ah ! who has seen the mailed lobster rise,
Clap her broad wings, and soaring claim the skies ?

. . . . .

The same with plants—potatoes 'tatoes breed—*
Uncostly cabbage springs from cabbage seed ;
Lettuce to lettuce, leeks to leeks succeed ;
Nor e'er did cooling cucumbers presume
To flow'r like myrtle, or like violets bloom.
Man, only—rash, refined, presumptuous Man—
Starts from his rank, and mars creation's plan.

* Elision for the sake of verse, not meant to imply that the root degenerates."

I have often pondered over the way in which light may be influenced by the cells in the tissues of the plant. An acquaintance of mine, Dr. Wager, whom I have met a few times in Littondale and Wharfedale, showed me once some photographs he had taken, using the cells in various leaves as small lenses, and very clear and sharp were the pictures he obtained, even portraits of people, unless my memory deceives me. Now, if it be possible to photograph objects by such lenses, how great a concentration of heat in selected spots may be expected, what diffusion and refraction of light and gathering into one focus the rays most chemically active undiluted by the feebler sort ! And I fancy that at the same time he told me that chlorophyll and many other substances are capable of making formaldehyde on exposure to light even in the absence of carbonic acid, which I find difficult to understand, although I do not doubt the fact.

Sir, as for the other subjects, you have invited me to write upon, your partiality towards my small abilities persuades you, I fear, that I am able to do more than is in my power. Nevertheless, I will make an attempt, and am, with all respect, &c., &c.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

Mr. Chaston Chapman's Letter

in your issue last week is, as might be expected, the most polished and temperate statement on the use of the title "Chemist" which I have seen. The controversy which rages round this topic every now and then has, so far, led nowhere, and I am inclined to think this is largely due to the manner in which, up to now, it has been conducted. We must not forget our history. The title "Chemist" was conferred by an Act of 1868. Later the Institute of Chemistry was founded, and it is worthy of note that among those who assisted in establishing the Institute was the then President of the Pharmaceutical Society (Michael Carteighe). So that in those days there was no thought of any clashing of interests between the two bodies. The title "Pharmacist" is of more recent date, and was first introduced, I think, in the Poisons and Pharmacy Act of 1908. The position, therefore, is that the pharmacist has the title "Chemist," and that while he also has the title "Pharmacist," he has only had it for fifteen years, and this is not a long time as things go in which to educate the public. I have listened to so many embittered conversations on this subject that I welcome the tone of the letter from the President of the Institute of Chemistry, and shall be interested to read what the President of the Pharmaceutical Society has to say about it.

The Institution of Chemical Engineers

is now in being. I have watched the growth of this new body with some interest, not to say anxiety. When the project was first mooted I was afraid it was doomed to failure because nobody could tell me what a Chemical Engineer was, and if you could not tell what a Chemical Engineer was, how could you have an Institution of them ? But I took heart because as time went on I noticed that, although nobody knew what a fine chemical was, "fine chemicals" not only continued in commerce, but actually remained in an Act of Parliament. It seemed possible that Chemical Engineers—whatever they may be—would be equally persistent. They have been. During the time we were hearing nothing of the proposed Institution, it appears that they were quietly preparing the ground and have now blossomed forth with a Memorandum and Articles of Association and Bye-Laws all complete, to say nothing of the Seal, a drawing of which appeared last week. So far they have been housed at a certain address in Piccadilly, which I decline to advertise further, but I hear they have now obtained premises of their own nearer Westminster. I wonder if this means they are looking for a Royal Charter !

Another New Anæsthetic

has arrived, according to my daily paper. It is called Narcylene and is reported to consist of purified acetylene and oxygen with some oil of pine to mask the objectionable smell of the acetylene. It has always been a surprise to me that our range of general anæsthetics should be so small. Chloroform, Ether, Nitrous Oxide and Ethyl Chloride do not present a wide choice, but Acetylene, even when mixed with oxygen and with oil of pine I should not have expected to join this select body. I wonder whether it will still be in use ten years hence. I remember how keen for news my colleagues and myself were about fifteen years ago, when certain major operations were being performed with what was then a new local anæsthetic—stovaine. All sorts of rumours were about, and the story went that a certain distinguished surgeon had two operating tables in one operating theatre, on one of which he removed a leg from a patient under spinal analgesia, while the patient smoked a cigarette, and then transplanted a tendon from the removed leg to the patient under chloroform on the other table. It was a good journalistic story, but whether it was true or not, I do not know.

Last Week was Memorable

for the visit to London of a number of our distinguished French colleagues. On Thursday Professor and Madame Urbain and M. Paul Kestner were entertained at a small private luncheon party by a number of members of the Council of the Society of Chemical Industry. I heard that the feature of the post-prandial oratory was Sir William Pope's speech in French, in proposing the health of the guests, and M. Kestner's reply in English. In the evening the same guests with the addition of Professor le Chatelier, M. le Bel, M. Gérard, M. Deschiens, and M. Lucien Bonzon were present at the Annual Dinner of the Chemical Society. The President of the Royal Society was there, as well as the heads of all the other societies and associations connected with the science and industry, and the list of all those present comprises everybody you would want to know. Those who heard the speeches told me they were very good, and I can well believe it. For my part the pleasant company around me compensated me for the inaudibility of some of the speakers. There is something—and I cannot define it—which makes this dinner, year after year, very enjoyable, and in a way distinguishes it from other similar functions.

FORTHCOMING EVENTS

Apr. 4. Society of Public Analysts, Chemical Society's Rooms, Burlington House, W. 1, at 8 p.m. (1) "Physiological Standardisation," by Dr. Stanley White. (2) "An Investigation into the Chemistry of the Reinsch Test for Arsenic and Antimony, and its Extension to Bismuth," by B. S. Evans, B.Sc. (3) "The Estimation of Boric Acid in 'Liquid Eggs' and other Foodstuffs," by G. W. Monier-Williams, Ph.D.

Apr. 6. Society of Chemical Industry, *Manchester Section*, at 16, St. Mary's Parsonage, Manchester, at 7 p.m. (1) "The Recovery of Nitrogen from Sewage by the Activated Sludge Process," by E. Ardern, D.Sc., and C. Jepson, M.Sc. (2) "The Activated Sludge Process, Withington Works," by E. Ardern, D.Sc., and W. T. Lockett, M.Sc.

Apr. 9. Society of Chemical Industry, *London Section*, at the Engineers' Club, Coventry Street, W. 1, at 8 p.m. (1) "The Cod-liver Oil Industry of Newfoundland," by S. S. Zilva and J. C. Drummond. (2) "A Study of the Separation of the Gases formed in the N-Butyl-Alcohol-Acetone Fermentation Process," by E. W. Blair, T. S. Wheeler and J. Reilly.

Apr. 9. The Ceramic Society, the Central School of Science and Technology, Stoke-on-Trent, at 7.30 p.m. "Black and Grey Flints," by A. Heath and A. Leese.

Apr. 11. The Institution of Electrical Engineers, *Wireless Section*, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "Magnetic Drum High-Speed Recorder and Key Transmitter," by Dr. N. W. McLachlan.

Apr. 12. The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "The X-Ray Examination of Materials," by A. G. Warren.

Apr. 12. Society of Chemical Industry, *Ottawa Section*, University Club, Elgin Street, Ottawa, at 8 p.m. "Electrolytic Iron," by R. J. Trail.

Apr. 12. Institute of Metals, *London Local Section*, Institute of Marine Engineers, 85-88, The Minories, Tower Hill, E. 1, at 8 p.m. Annual General Meeting, followed by a paper on "The Surface Tension of Metals," by S. W. Smith, D.Sc.

Apr. 16. Society of Chemical Industry, *Yorkshire Section*, at the Queen's Hotel, Leeds. "Some Notes on the Production of Alkali by Bacteria as Registered by Different Indicators," by J. A. Reddie.

Apr. 26. West of Scotland Iron and Steel Institute. Annual General Meeting.

Apr. 26. The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "The Drive of Power Station Auxiliaries," by L. Breach and H. Midgley.

SOCIETY OF CHEMICAL INDUSTRY

MEETING OF COUNCIL

The monthly meeting of Council was held on Friday, March 9, 1923, the President (Dr. E. F. Armstrong, F.R.S.) being in the chair.

The President intimated that Dr. C. C. Carpenter had accepted the award of the Society's Medal for 1923.

The Council agreed to contribute Ten Guineas towards the publication of the Annual Tables of Chemical and Physical Constants.

The Reports of the Hon. Treasurer and of various Committees of the Council were discussed, and 28 new members (Home 21, Overseas 7) were elected.

A preliminary programme of the Annual General Meeting, 1923, was submitted, and it was intimated that, subject to confirmation by the Annual Meeting at Cambridge, the Meeting for 1924 would be held in Liverpool.

A scheme for organising chemical propaganda in connexion with the British Empire Exhibition 1924 was submitted, and it was agreed to pay over the sum of £250 to the Central Fund of the Exhibition during the present year, with a recommendation to the Council of 1923-4, that if possible, a similar amount should be paid next year. It was also decided that these donations should be made out of the income from the Messel Fund.

ANNUAL GENERAL MEETING, 1923

The Annual General Meeting will be held on Thursday, June 21, at 11 a.m., in the Arts School, Benet Street, Cambridge, and will be preceded by a meeting of the Council at 10 a.m. At the former, members will be welcomed to Cambridge by the Vice-Chancellor of the University, and the President of the Society, Dr. E. F. Armstrong, F.R.S., will deliver his address. The Vice-Chancellor will hold a reception to the Society at the Fitzwilliam Museum at 5 o'clock, and in the evening there will be a reception and dance.

On the Monday, Tuesday and Wednesday of the same week, the International Union of Pure and Applied Chemistry meets in Cambridge and the President of the Union extends a welcome to members of the Society to attend any of the public meetings of that body.

On Friday, June 22, the Society's Medal (1923) will be presented to Dr. C. C. Carpenter, who will then give an address. On the afternoon of the same day there will be an address by Dr. F. W. Aston, F.R.S., on "Isotopes," and in the evening the Annual Dinner of the Society, which ladies may attend, will be held.

On Saturday there will be a visit to Ely.

All communications should be addressed to the General Secretary at the offices of the Society in London until further notice.

NEWS FROM THE SECTIONS

LIVERPOOL SECTION

A paper on "Some Aspects of Fractional Distillation" was read by Messrs. A. Brittain and C. Elliott, at the meeting held on March 16, Dr. J. T Conroy in the chair.

The paper dealt chiefly with the recovery and rectification of volatile constituents of gases such as gasolene from casing-head or natural gas and benzol from coal gas. It was pointed out that the action of a scrubber was similar to that of a fractionating tower. In the scrubber vapour was removed from a gas which was ascending the column by washing it in counter-current with a liquid in which the vapour was soluble. The wash oil leaving the bottom of the scrubber and the gas entering were rich in the vapour. In a fractionating-tower vapours were ascending and a liquid ascending, more or less intimate contact being effected in various ways. The liquid leaving and the vapour entering were both richer in the less volatile component than at the top. In both systems, the vapour and liquid should theoretically be in equilibrium, although this was never attained in practice.

Various continuous systems for debenzolising oils were discussed and also intermittent and continuous systems for the distillation of benzol into crude and refined fractions. The advantages of continuous distillation were that the concentration of the components remained the same at any point in the system, whereas in the discontinuous type the concentration changed as distillation proceeded. Continuous distillation resulted in :—(1) A uniform quality of product ; (2) heat economy due to recovery of part of the waste heat by means of heat interchangers ; (3) saving in labour by avoidance of intermittent fractions. The disadvantages of a continuous system were :—(1) High initial cost ; (2) complicated construction and operation ; (3) sensitiveness to change in condition such as variations in the crude material to be treated. The discontinuous type was more popular, since it could be used with considerable success for the distillation of other materials than that for which it was originally intended.

The various types of columns used industrially were discussed and reference made to the Kubierschky column for the distillation of benzol and other liquids. The efficiency of a column depended on the intimacy of contact between the vapours and the liquid reflux. In filled-in columns where the reflux liquor was allowed to flow over various kinds of solids, a film effect was employed, but there was considerable danger of channeling. In columns such as those with perforated plates or bells, contact was obtained by bubbling the vapours through the reflux liquor flowing downwards from plate to plate. Perforated plates necessitated a reasonably constant velocity of the vapours ; otherwise there was danger of reducing the level of liquid on each tray if the speed fell or of entrainment of the liquid if the speed was too high. The bell type of tray was still the most efficient.

A resolution of sympathy was passed for the relatives of the late Mr. H. H. Froysell, of Liverpool University, who for many years acted as Hon. Demonstrator to the Section. It was also resolved to invite the Council to arrange to hold the Annual Meeting of the Society in Liverpool in 1924.

MEETINGS OF OTHER SOCIETIES

INSTITUTE OF BREWING

At the meeting of the Burton-on-Trent Section, held on March 1. Messrs. J. L. Baker and H. F. E. Hulton read a joint paper entitled "The Carbonic Acid Content of Beer." The carbon-dioxide cycle in nature was briefly described leading up to a discussion of the formation of the gas during the fermentation of wort in the fermenting vessels from which about 100 cubic feet of CO_2 are lost for every barrel of wort (original gravity 1043) fermented, unless special plant is employed to collect it.

Previously recorded values for the solubility of carbon dioxide in beer, water, and dilute alcohol were discussed, and the authors described the apparatus employed by them for estimating the carbon-dioxide content of a large number of draught and bottled beers of all kinds and at all stages of fermentation, bottling, filtering, carbonating, etc. Thirteen years ago the average amount of carbon dioxide in draught mild ale in the London area was under 800 c.c. per litre, and even to-day, with chilled, filtered and carbonated ale delivered in tank-waggons to the public-house, the carbon-dioxide content, which at the brewery may be 1,400 c.c. per litre, sometimes shows a decided fall by the time the beer is actually served. This loss is particularly noticeable at the later houses reached in the round supplied by the tank-waggon, owing to the splashing about of the beer in the partially emptied space during transit, although such loss may be considerably lessened by maintaining a pressure of carbonic-acid gas in the tank during delivery. The engine used for raising beer from the cellar to the counter was not found to be nearly as responsible for the loss of gas as is generally believed.

The paper was illustrated by slides showing in graphical form the carbon-dioxide content of beer in all stages of its history, and an interesting discussion followed. In some preliminary remarks Mr. Baker alluded to the fact that Burton-on-Trent was widely known as a most distinguished centre of English brewing, and had been associated with the names of Cornelius and James O'Sullivan, Dr. Horace Brown, Peter Griess, and George Harris Morris.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

The meeting held on February 27 was devoted to the presentation of a paper on "German Industry" by Monsieur Victor Cambon. The lecturer, who was already intimately acquainted with the organisation of German industry in pre-war days, has had the opportunity of obtaining still further information recently during repeated visits.

The subject treated by M. Cambon was the development of the coal and metallurgical districts of the Rhine and Westphalia, districts with an area of 3800 square km., a total production of 100,000,000, tons of coal, and a population which has increased from 2,300,000 in 1905 to 3,700,000. Along with this development, works, towns, railways and water-ways have been constructed and one result has been the exploitation on scientific lines of the lignite deposits of the Saale Valley, mostly used locally in enormous electric generating-stations such as that at Golpa near Bitterfeldt, which develops 150,000 horse-power and supplies Berlin. These lignites are also utilised locally by the synthetic-ammonia factory at Launa near Merseburg, belonging to the Badische Anilin und Soda Fabrik, and which has a capacity twice that of the Oppau works.

Amongst recent industrial developments, mention may be made of the manufacture of sulphuric acid from gypsum, a process due to the necessities of the war, but subsequently modified by the Bayer Co., of Leverkusen, which utilised gypsum and coal intimately mixed in definite proportions and finely powdered. On calcination, this mixture yields cement, and leaves sulphuric acid as a by-product, the operation being carried out in rotary furnaces 60 m. long, heated to 1100° to 1200° C. A daily production of 80 m. tons of sulphuric acid is said to have been attained. Another new industry consists in the recovery of coke from slag, either by electro-magnetic separation, or by the wet process of Meguin. By this means, 250,000 to 300,000 tons of coke could be recovered, and the remaining slag used for brick-making. Further advances are the construction of trucks to carry 50 tons of coal on rail; improvements of enormous gasometers without water seals; and the development of an important union of automobile manufacturers working on the mass-production system.

Referring to further advances in the utilisation of waste products, the speaker described the installation recently at Berlin of a factory in which vegetable debris, sawdust, paper, etc., are carbonised in special furnaces to yield tar, charcoal, and gas, used to drive internal combustion engines coupled with electric dynamos. In conclusion a survey was made of the possibilities of developments of the water-transport system in Germany.

BRITISH CHEMICAL STANDARDS' MOVEMENT

At the meeting of the co-operators in the above movement held at York on February 9, a "Report on the Second Three-Years' Working" (ending September 30, 1922) was read, and a list was given of 53 Analysts who had taken part in the work of standardisation, and of 20 firms who had provided material. Ten new samples comprising 46 actual standards were described; a chronological list of standards was shown; and copies of the 32 certificates issued, British, French and Italian price lists, and diagrams illustrating the preparation of the standards, were exhibited. The extreme precautions taken to ensure perfect homogeneity were detailed and it was stated that every means was used to meet difficulties, and to warrant the confidence of users.

Within six years the movement had steadily developed, in spite of the adverse conditions of recent years. Commencing with a few co-operators in three or four localities in Great Britain, the movement now included members from several countries, some 15 to 20 co-operators taking part in each standardisation. The 23 samples produced, comprising 83 standardized results had covered practically the whole range of plain carbon steels in regular use and included four alloy steels as well as two cast irons and a basic slag. The weight per standard had arisen by 20 or 25 times, and hence the utility had increased proportionately; yet the quality had not merely been maintained, but improved. Now not only most of the large works' laboratories and many public ones in this country used these standards, but their use had so spread that sole agents had been appointed in Italy and France. The 450 British and foreign users included 10 Government Departments, 30 universities and technical schools, and five railways.

Financially, though there was still a deficit, the situation was improving and the movement was gradually progressing towards being self-supporting. The organisation was not restricted to any one Society, Country or Industry, and therefore had a world-wide choice of co-operators, and was able to select for each type recognised specialists in that class of analysis. The work had demonstrated the necessity of standard samples to reveal divergencies in analytical results and that the methods used for iron and steel standards could be applied equally well to other materials. It was hoped that the fullest use would be made of the standards to ensure continued extension of the movement and to make it financially self-supporting. A committee was formed to report on the formation of a more formal organisation with separate headquarters, and a resolution was passed urging engineering and chemical societies to bring before their members the scientific and practical value of chemical standards.

CORRESPONDENCE

THE WORD "GAS"

SIR,—In the Editorial Notes of the current issue you make reference to the origin of the word "gas." There is no doubt that it was first used by Van Helmont (1577–1644), the occasion being in a work written by him and published after his death, *Ortus Medicinæ* (1648). He says, "*halitum illum Gas vocavi, non longe a chao veterum secretum*" ("I have called this spirit Gas, it being scarcely distinguishable from the chaos of the ancients"). He used the word in the course of his description of the gas now known as carbon dioxide, and prior to Van Helmont's time known as *spiritus silvestris*. There is no earlier indication of the derivation of the word "gas" than that given in *Ortus Medicinæ*, and the alleged derivation from the Dutch *geest* or German *geist*, *gascht*, or *gast* is one of much later date than the time of Van Helmont. It was Joseph Priestley in his work, *Experiments and Observations on Different Kinds of Air* (1775), who ascribes to the word *geist* (spirit) the origin of "gas," and Cavallo in his *Treatise on the Nature and Properties of Air* (1781) says: "The word *gas* is derived from the German *gascht*, or *gast*, which signifies an eruption of wind." When it is recalled that the alchemists described the gaseous state in such terms as *spiritus*, *flatus*, *halitus*, words signifying "wind" or "breath," and that in German this is rendered *geist*, it is easy to understand how Priestley accounted for "gas" as being derived from *geist*. The fact, however, is clear, that a hundred and twenty-seven years prior to Priestley's book being published, Van Helmont, after remarking on the incoercible character of *spiritus silvestris*, and comparing it to the Greek *chaos*, invented the term "gas."—I am, Sir, etc.,

WILLIAM A. KIRKBY

The University, Manchester
March 19, 1923

THE UNIQUENESS OF HYDROGEN

SIR,—The editorial on page 252 of the issue dated to-day occasions two comments.

"Uniqueness of Hydrogen." The non-existence of any accurate determinations of the mass to inertia ratio for hydrogen is very curious, if not unique, for a common element. The need for this ratio in certain speculations prompted inquiries to the recognised authorities, but no determinations by reversible pendulum methods could be found. One authority suggested tetrapropylammonium fluoride for such experiments as being the solid with the highest hydrogen content.

"In the case of units of electricity, at any rate, attractiveness is not a function of mass." Conjunction with matter is an essential for electrical attraction and/or repulsion. Free electricity, represented usually by waves, has not this property of attraction.

Electrostatic attraction. Assuming that electrons are units of electricity, the Cavendish proof of the inverse square law fails for small quantities if the attraction and/or repulsion is of electrons *per se*. Postulating the attraction as a secondary effect, the conjoint effect of electrons and matter, it is easy to envisage the necessary uniform distribution on the spherical surface assumed in this proof.

Electro-magnetic attractions. Electrons with the velocity of light in parallel streams could not have mutual actions; as the attractions and/or repulsions have only the same speed of propagation as the velocity of travel, no pair of electron could have mutual actions. The effect of streams of electrons travelling along wires with the velocity of light on each other would similarly be *nil* if Newton's law that action and reaction are equal be true.

If electricity in motion of itself produced magnetic effects then these would result from the rotation of a charged non-conductor. In Rowland's experiment conducting studs were used. Two vectors are here concerned; change of motion, or orientation, of the electrons free to move within the studs measured by the vector radius and the electron momentum. The vector product is the magnetic effect perpendicular to the plane. With parallel currents the effects can be simply deduced from the secondary disturbance caused by the passage of the electrons through matter, propagated with the velocity of light.—I am, Sir, etc.,

Manchester E. F. MORRIS
March 16, 1923

INVISIBLE INK

SIR,—Is it possible to make an "invisible ink" which, when applied to paper, will become visible an hour or two later without putting the paper through any process such as heating, etc.? If so, I should be grateful if you would tell me how it is done. This, I may add, is in connection with a conjuring trick.—I am, Sir, etc.,

F. LEAHY

Middlesbrough
March 12, 1923

BAYBERRY OIL

SIR,—May I thank the gentlemen who so kindly replied to my query *re* the above. The information I received was of the greatest possible use to me, and was instrumental in enabling me to solve a most difficult problem.—I am, Sir, etc.,

Birmingham W. LESLIE CARTER
March 23, 1923

THE TITLE "CHEMIST"

Sir,—In the *Liverpool Daily Post* for March 9, an account of Major Lefebure's lecture on "Chemical Warfare," under the title "Chemists in Warfare" appeared next to a two column advertisement of the Pharmacist's Retail Association, headed in one-inch letters, "Chemists." This sort of thing is very misleading to the general public who might anticipate reading something about Number Nines in the article on Chemical Warfare. The younger members of the Institute of Chemistry are to be encouraged in their efforts to obtain for the name "chemist" the same meaning in English as it has in most other languages.—I am, Sir, etc.,

E. M. Shepherd

Rock Ferry
March 18, 1923

PERSONALIA

The honorary degree of D.Sc. of Manchester University is to be conferred on Mr. W. B. Worthington, President of the Institution of Civil Engineers, 1921-1922.

Prof. A. C. Seward has been elected President of the Geological Society for 1923-24.

Dr. Wilder D. Bancroft has been elected Editor in Chief of the *Journal of Physical Chemistry*, now controlled by an editorial board of English and American physical chemists.

Mr. C. S. Garland, M.P., managing director of the Volker Lighting Corporation, has been appointed by H.M. the King in Council to the Governorship of the Imperial College of Science, vacant through the resignation of the Hon. N. Rothschild.

The Institute of Mining and Metallurgy has awarded its Gold Medal to Mr. Edgar Taylor for his work on Indian mining, the Consolidated Gold Fields Medal to Dr. Leonard Hill for his paper on ventilation and human efficiency, and the Gold Fields Premium of 40 guineas to Mr. H. F. Collins for his paper on the igneous rocks and the pyritic ore-bodies of Huelva.

* * *

With the death of Prof. H. H. Stoek, the American coal industry loses a prominent investigator in the field of coal technology.

With regret we announce the death of Sir James Dewar, F.R.S., at the age of 80. We hope to publish an obituary notice in a later issue.

From Germany the deaths are announced of Dr. F. Bössenecker, chemist to the Chemischen Fabrik Griesheim-Elektron; Prof. E. von Raumer, formerly director of the Untersuchungsanstalt für Nahrungs- und Genuszmittel, Erlangen; and of Dr. H. Franzen, professor of biochemistry in the Technical *Hochschule*, Karlsruhe.

NEWS AND NOTES

AUSTRALIA

Gold Discovery in Western Australia

It is announced officially that a narrow interrupted belt of auriferous country, about 50 miles long, with good gold prospects, has been found in the district east of Mt. Shenton, and about 100 miles north-east of Lavator, a terminus of the Kalgoorie railway. The discovery is regarded as promising, but is as yet quite undeveloped.

BRITISH INDIA

Final Forecast of the Sugar-Cane Crop, 1922-23

The final general memorandum based on reports received from provinces containing 99 per cent. of the total area under sugar cane in British India estimates the area sown at 2,721,000 acres and the total yield of raw sugar at 2,988,000 tons, increases of 14 and 15 per cent., respectively. The condition of the crop is reported to be generally good. In addition to the area to which the above estimate applies, the crop is grown in certain other regions in British India which have an estimated annual production of 24,000 tons. The importance of the Indian sugar crop can be realised when it is stated that the world's production of cane sugar in 1922–23 is estimated at 12,676,000 tons, an increase of 10,000 tons over that of the previous season.—(*Ind. Tr. J., Feb.* 22, 1923.)

FRANCE

Notes from Paris

The Convention concluded recently between France and Poland is of particular interest, for it provides that both Governments are to collaborate not only in general political matters, but also in the development of the petroleum industry. The French Government does not participate directly but acts through French companies established in Poland. In exchange for the services of the technical experts and for the capital provided by these companies, the Polish Government undertakes to give the French companies preferential treatment over other foreign companies in Poland. The preference so guaranteed will naturally place French companies operating in Poland in a most favourable financial position.

Certain resolutions passed by the Chamber of Deputies relating to the "National Fuel" have been discussed by the Senate. These resolutions lay down that importers of petrol must purchase from the State a minimum of 10 per cent. of ethyl alcohol. Importers of petroleum products destined for the chemical and dyestuffs industry are, however, exempted. Contemporaneously with this discourse, Monsieur de Berthelot was speaking before the Société des Ingénieurs Civils on the present state of the "National Fuel" question. After discussing the various scientific, technical and economic aspects of this question, Monsieur

Berthelot insisted that the problem could only be solved by the utilisation of a mixture of petrol and 40 to 50 per cent. of absolute alcohol, a mixture which had been found satisfactory in the course of tests extending over eighteen months. Of other solutions of the problem, the recovery of benzole from gas, the exploitation of lignites and shales, and the use of catalytic processes for producing liquid products from solid hydrocarbons, are only for the future, and for France the only method appears to be to intensify the production and use of alcohol. There is nothing new in the use of alcohol as a motor fuel, the first trials dating from 1900, but the question was complicated by the numerous taxes which affect the market prices of alcohol, and by the State monopoly of alcohol declared in June, 1915. This monopoly, however, reduced the human consumption of alcohol by two-thirds, and made it necessary to seek a new outlet as a motor fuel.

The public interest shown in chemical problems is further evidenced by a meeting held at the Sorbonne on March 3, under the auspices of the Red-Cross Society, to support the adoption of the resolutions carried at the third International Labour Conference at Geneva concerning the uses of white lead. The dangers arising out of the use of white lead were discussed, but it is certain that other products which are economically and technically suitable as substitutes are hard to find.

UNITED STATES

Antimony in 1921

According to a recent Report of the United States Geological Survey, the United States has produced no antimony ore since 1918, the total output during the period 1915–1918 being 10,750 short tons of ore carrying 4310 t. of metal. Small amounts of metallic antimony were produced at smelters in 1919–20, but the figures are not available for publication. Although there was no production in 1921, there was an output of by-product antimonial lead from foreign and domestic ores, amounting to 10,064 t., with an antimony content of 1589 t., and 4720 t. of antimony in the form of alloys was recovered from old alloys, scraps and dross. Imports of antimony ore in 1921 amounted to 213 t., of antimony matte 353 t., of metal 10,130 t., of antimony oxides and compounds 154 tons. The chief source of the metal was China, which supplied 20,530,079 lb., followed by Japan with 302,750 lb., and England with 302,457 lb. The world's yearly peacetime consumption of antimony was about 22,000 m.t., of which the United States consumed 10,000 tons, in addition to about 2100 t. of virgin antimony contained in domestic antimonial lead, and 3500 t. of secondary antimony recovered from alloys, etc. Over 60 per cent. of the world's production is derived from China, but important deposits occur in Canada, Mexico, Argentina, Bolivia, Peru, France, Italy, Turkey, Algeria and Australia.

Metallic antimony is used chiefly as a constituent of alloys. The oxides are used for making white enamel, and the oxide and sulphide as colouring agents in paint pigments. The field of use for antimony compounds, especially for the oxides in paint, is rapidly widening. A successful substitute for antimony as an agent for hardening lead is said to consist in a compound of calcium and barium.

GERMANY

Wages in the German Chemical Industry, 1922

The following figures show the enormous increase in wages which occurred in the German chemical industry during 1922.

	Average weekly wage (marks)					
Month	Operatives		Process workers		Unskilled workers	
	Single	Married*	Single	Married*	Single	Married*
Pre-war	32·96		26·81		23·85	
1922						
April ..	888	942	841	894	832	886
May ..	1018	1072	967	1021	955	1010
June ..	1117	1233	1112	1168	1095	1152
July ..	1443	1506	1355	1416	1330	1393
Aug. ..	2047	2119	1921	1993	1900	1972
Sept. ..	3578	3682	3346	3451	3301	3408
Oct. ..	5076	5217	4738	4879	4673	4815
Nov. ..	9076	9490	8506	8920	8353	8788
Dec. ..	16222	16836	15175	15789	14915	15564

The following figures show the relative increase over pre-war wages, these being taken as 1.

Month	Operatives		Process workers		Unskilled workers	
1922	Single	Married*	Single	Married*	Single	Married*
April ..	27	29	31	33	35	37
May ..	31	33	36	38	40	42
June ..	36	37	41	44	46	48
July ..	44	46	51	53	56	58
Aug. ..	62	64	72	74	80	83
Sept. ..	109	112	125	129	138	143
Oct. ..	154	158	177	182	196	202
Nov. ..	275	288	317	333	350	368
Dec. ..	492	511	566	589	625	653

* Includes allowance for wife, and two children under 14 years of age.

Metal Linings by the Spray Process

The spraying of molten metal on to surfaces in order to produce metallic coverings is no new process, and yet it has not been completely successful in the past. The covering obtained hitherto possessed a somewhat porous texture, an undesirable quality in resistant linings for chemical apparatus. Now, however, it is claimed by the director of the Metallisator-A.-G. (Altona), that thoroughly satisfactory tin, lead, aluminium and copper linings can be produced on iron by subjecting the sprayed metal coat to a finishing process, which may be either mechanical or chemical, or both. The lining may be rendered more coherent by hammering; or the pores may be filled up with some chemically resistant material, *e.g.*, in the case of a lead lining, with lead sulphate obtained by treating the lining with sulphuric acid. The great advantage of these sprayed linings over the usual laid-on ones lies in their close contact with the substratum, an important factor in apparatus with walls through which heat is to be transferred. Unfortunately the publication of the details of the methods is postponed owing to patent proceedings.—(*Chem.-Z.*, *Jan.* 11, 1923.)

GENERAL

Strontium Minerals, 1913-1919

A digest of statistical and technical information relating to the production of strontium minerals during the period 1913–19 has been published by the Mineral Resources Bureau (pp. 12. Price 3d.) The pamphlet reviews the sources and properties of the chief strontium minerals, celestite and strontianite, and states that the chief uses of strontium compounds are in sugar-refining and pyrotechny, as a substitute for barytes in fillers, and in the manufacture of glass and medicines. The world's production of strontium minerals has fallen from 18,425 long tons in 1913 to 4,319 t. in 1920 and 7,232 t. in 1921. The output in 1921 consisted of 6,622 t. of celestite produced in England and 610 t. of strontianite in Germany. Both minerals occur in Canada, but the deposits of strontianite appear to be of no commercial importance (see *Chem. and Ind.*, 1923, p. 80.). Occurrences are recorded from India, Canada, Germany, Sicily and the United States (*cf.* J , 1922, 176 R), but it appears that production from these localities cannot compete with that of England. The pamphlet concludes with a series of bibliographical references to chemical literature relating to the uses, occurrences, and mining of strontium minerals.

Mexican Poppy Oil

The oil of the Mexican or prickly poppy (*Argemone mexicana*) is used to some extent medicinally in India and the West Indies, and is reported to possess purgative properties. It is also used as a lubricant and illuminant in Mexico and the West Indies. From its moderately high iodine value, the oil would be classed as a semi-drying oil, and it is stated to be employed in South America in paint-making. Experiments carried out at the Imperial Institute indicate that the oil would not be satisfactory for paint making, though it might be employed in admixture with linseed oil as a cheap substitute for the latter. The bitter taste and therapeutic action of the oil make it unsuitable for human consumption, and the only possible commercial use would appear to be in soap-making. The meal left after extracting the oil could not be used as cattle food, and therefore could be utilised only as a manure, a purpose for which it would be of value on account of its large content of nitrogenous compounds.—(*Bull. Imp. Inst.*, **XX**, *No.* 3, 1922.)

REVIEWS

Paracelsus. *By* Prof. J. M. Stillman, *of Stanford University. Pp. viii.*+184. *London : The Open Court Publishing Co.*, 149, *Strand, W.C.* 2. 1920. *Price* 10*s*.

In the history of chemistry, Paracelsus is a great name. Nevertheless, his actual achievements in that science are somewhat problematical. Professor Stillman's biography gives an interesting account of this exceptional man, but adds little to the knowledge we already possess of the chemical side of his activities. This was to be expected. Theophrastus Bombastus von Hohenheim, commonly called Paracelsus, was born in 1493 at Einsiedeln, now in Switzerland. He studied mining in Carinthia and the Tyrol, and became an army surgeon or physician in Denmark and Sweden. He travelled over the greater part of Europe, sometimes practising as a physician, but always quarrelling with the orthodox practitioners, for whom he appears to have maintained the utmost contempt. A theologian of some acuteness, he engaged in controversies in theology. He died at Salzburg in 1541, at what we should now consider the early age of forty-eight.

The chief characteristics of Paracelsus as a man were his power of clear thinking, his contempt for all knowledge not the result of direct observation and his underestimation of the strength of the traditions, skill and inertia which he was bound to find opposed to him. He had a wide conception of alchemy as the following quotation from his writing shows : "For the baker is an alchemist when he bakes bread, the vine-grower when he makes wine, the weaver when he makes cloth." As a teacher of medicine he refused to teach the ancient books, and taught according to his own experience ; he was defiant and insulting to those who did not agree with him, which did not make for popularity. As a thinker he was unusually self-reliant and independent.

The great service he rendered to chemistry was his advocacy of the use of various chemical substances by physicians and his successful application of certain chemically prepared remedies. Like some other reformers, the roughness of his methods interposed a barrier between him and those to whom he preached ; he was an earnest, powerful and prophetic voice crying in the wilderness. He was a voluminous writer, usually ready to enter into a controversy on almost any subject.

The following quotation from his book "*De natura rerum*" may interest some of our readers : "The mortification of lead consists in converting it into *cerussa*, which is also called *Bleiweiss*. Its preparation is in two ways—one in medicine, the other in alchemy. Its preparation in medicine is thus—that you hang lead in thin sheets over a sharp wine-vinegar in a glazed pot. The pot is then well stoppered, so that no spirits may volatilise, and set in warm ashes, or in winter behind the stove: then you will find in ten to fourteen days good whitelead adhering to the sheets which you may may remove with a hare's foot, and again hang the sheets, and do this until you have white-lead enough. The other preparation of white-lead—in alchemy—is like this, except that in the vinegar much of the best and finest salmiac is dissolved. That gives a fine and subtle white-lead."

Professor Stillman's biography is pleasantly written and the type easy to read.

(1) SECOND YEAR COLLEGE CHEMISTRY. *By* WILLIAM H. CHAPIN. *Pp. xii*+311. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.,* 1922. *Price* 15*s*.

(2) A MANUAL OF LABORATORY EXERCISES. *By* WILLIAM H. CHAPIN. *Pp. viii*+115. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.,* 1922. *Price* 7*s*. 6*d*.

(1) It is almost as difficult to review a second-year text-book as it would be to criticise the second act of a play without knowing what had preceded it or what was to follow. Professor Chapin, however, gives an indication of the ground covered in the first year in his introduction to "Second Year College Chemistry," which represents the course followed by his students in Oberlin College, Ohio. The first year course is "largely given over to descriptive matter"; and acting on the convenient assumption that any generalisations introduced in that course have passed into oblivion, whereas the descriptive matter still survives the summer vacation, the second year is devoted to the revival and expansion of general principles. Hence the volume is really an introduction to physical chemistry, or rather to portions of that subject; for the most noticeable feature is a curious unevenness in the treatment of the topics introduced. Thus, following on a discussion of the kinetic theory, the gas laws and the atomic theory, Chapter VII deals with symbols, equations, etc., in a very elementary manner and introduces the simplest chemical arithmetic. One feels that, if the student requires instruction in such matters, he must be quite unprepared to digest the excellent account of recent work on radio-activity and atomic structure which follows in Chapters X and XI. The sections on the ionic theory, indicators, and electrochemistry are refreshingly up-to-date, although the discussion would have been simplified by the introduction of the p_H notation at an earlier stage. In contrast, it is strange to find two pages devoted to a serious discussion of what is meant by "molar" and "normal" solutions. The action of catalysts is dismissed in one page and thermo-chemical measurements receive no mention.

(2) The laboratory manual, which is intended to be used with the text-book, contains detailed descriptions (sometimes almost too detailed) of sixty experiments, the rest of the time in the laboratory being devoted to qualitative analysis. Many of the experiments are novel at any rate in a second-year course; and, aided by the lucid diagrams, no student should have difficulty in carrying this part of his work to a successful end. The theoretical work dealt with in the lecture room is effectively illustrated without the invidious suggestion that the student discovers laws of nature by two or three simple experiments; and a good deal of quantitative analysis is unobtrusively brought in. It is, however, undesirable that students should set out to determine an equivalent with a previous knowledge of the atomic weight; and the one experiment given to illustrate the law of volumes, in which cupric oxide is reduced by ammonia and the volume of nitrogen produced is alone measured, should be replaced by others.

The manual can be strongly recommended to harassed teachers who have little opportunity to try out experiments for the use of their classes.

P. C. L. THORNE

CAROTINOIDS AND RELATED PIGMENTS. THE CHROMOLIPOIDS. *By* PROF. LEROY S. PALMER, Ph.D. *American Chemical Society, Monograph Series. Pp.* 316. *New York: Chemical Catalog Co., Inc.,*1922. *Price* $4·50.

At the present moment there are five more or less well defined substances included under the term Carotinoids, namely carrotene, xanthophyll, lycopin, fucoxanthin and rhodoxanthin, of which carrotene and lycopin on the one hand, and xanthophyll and rhodoxanthin on the other, appear to be isomeric. Ranging in colour from yellow to red, and having very similar physical properties, these substances nevertheless differ chemically from each other in rather striking manner, inasmuch as carrotene and its isomer are hydrocarbons of the formula $C_{40}H_{56}$, whilst xanthophyll and fucoxanthin are represented by the formula $C_{40}H_{56}O_2$ and $C_{40}H_{54}O_6$, respectively. For carrotene as a hydrocarbon to have such a strong yellow colour is in itself somewhat remarkable, since comparatively few coloured hydrocarbons are known, and it is certainly noteworthy that the introduction of oxygen into the complex should produce substances of much the same colour and general physical and chemical properties.

The very wide distribution of these substances in the plant world is evidenced by the fact alone that chlorophyll is invariably associated with carrotene and xanthophyll and, in the case of the brown algæ, with fucoxanthin as well; apart from this, the carotinoids also frequently occur separately, causing, for example, the high pigmentation of the carrot and of many fruits and flowers, algæ and fungi. The occurrence of carotinoids is, however, not confined to the plant world, since it appears from recent work that many of the yellow animal pigments formerly described as Lipochromes are either true or modified plant carotinoids. With regard to their origin it has now been well established that in the case of man, the higher mammals and fowls, the yellow chromolipoids of their tissues and secretions are derived from the carotinoids of their food. The occurrence of such carotinoid pigments is, however, not universal, even among herbivorous animals, since practically none occur in sheep, goats and swine. In this connexion attention is drawn by the author to the remarkable fact that the cow and the horse resorb the carotin of their rations to the relative exclusion of the xanthophylls, although the latter are more abundant in their food, whilst with the fowl the conditions are reversed.

To those seeking information regarding the distribution and occurrence of carotinoids in any particular group of plants or animals, this monograph will be found to be invaluable, since separate chapters are devoted to each main division of the plant or animal world. Other chapters are devoted to the biological relations between plant and animal carotinoids, and to the methods of isolation, identification and quantitative estimation of carotinoids, and their possible function in the plant and the animal. The fallacy of the view at one time current, especially in America, to the effect that vitamins and carotinoids were identical is dealt with in the last chapter. Here also attention is drawn to a practical aspect of the question—namely, that there is a correlation between low pigmentation of the visible skin parts of certain breeds of fowls and high egg production; this is attributed to a selective mobilisation of pigment in the ova preventing its excretion by means of the skin. One other significant example of the application of scientific knowledge concerning the association of carotinoids with chlorophyll is mentioned in the preface, where attention is drawn to the fact that by employing from aeroplanes, during the late war, light filters absorbing practically all light rays except a wide band in the red, and a narrow band with low transmission in the green, natural green foliage appeared red, whilst camouflaged foliage, on which only green paint was used, appeared green. Each chapter is provided with a useful summary, and at the end of the book will be found a comprehensive bibliography. Throughout the text and in the index are to be found a great many mis-spellings of plant names, of which only a few need be mentioned, such as *Ribus glossularia* (for *Ribes grossularia*), *Odintiglossum*, *Nicotinia tabacum*, *Philobolus Doronium*, etc. These are, however, minor blemishes which can be put right in a later edition, and do not detract seriously from the value of the book, which forms a very valuable compendium of an extensive subject set forth in a very attractive and readable form.

PAUL HAAS

PLASTICS AND MOLDED ELECTRICAL INSULATION. *By* E. HEMMING. *Pp. vii*+713. *New York: Chemical Catalog Co., Inc.*, 1923. *Price* $5.

During the past twenty years the use of plastic materials has increased so greatly that a single volume dealing with them should be widely welcomed, even though it is, of necessity, far from exhaustive. The present work consists essentially of two parts, of which the first is devoted to clay products, cements, artificial stones, glass, casein products, road-materials, adhesives, linoleum, artificial leather and silk, rubber, paper, cellulose and sundry other plastic compositions, whilst the second part is devoted almost exclusively to moulded insulating materials.

The second portion of the volume is of much better quality than the first, but this is not surprising, as it deals with a subject with which the author has been chiefly concerned for many years.

Any reader who looks for a scientific treatment of the subject will be disappointed. No definition of plasticity, or of its causes is given, but the author makes it quite clear that, for most purposes, a material must not only be plastic, but must be capable of being hardened by some simple process. On the contrary, the volume consists largely of a compilation of technical matter, much of which appears to have been selected in a somewhat haphazard manner. For instance, nearly four pages are devoted to refractory bricks, but building bricks and tiles do not appear to be mentioned. Similarly, in the section on dental cements, no information is given to show that commercial zinc oxide is useless unless subjected to a preliminary treatment which renders it more compact. The section on silicate dental cements is particularly disappointing.

The most valuable portion of the book commences on p. 205 and deals with the author's method of "cold-moulding mixtures of silica, asphalt, and resin for insulators and other articles used in the electrical industry," because this section is not merely a compilation, but contains some of the results of the author's own experience. Even here, however, the information given is so slight as to be of little use to anyone wishing to make articles of the kind described, though users of moulded articles will find numerous useful suggestions to aid them in specifying which class of composition will best suit their purpose. It is also instructive to observe that in the author's opinion, "No electrical engineer wants to replace porcelain, but has to, because of the lack of stimulant and progress on the part of the porcelain manufacturer."

At the end of the sections is a list of Patent Specifications with brief notes on each. None of these patents is earlier than 1907, and the lists are incomplete as regards British, French and German patents. This partly arises from the author's opinion that " there is an enormous number of others . . . of no value or interest."

The volume should be very useful to those who require a brief though superficial survey of the various plastic materials and their uses. It would be greatly improved by the inclusion, at the end of each section, of a short list of books or papers dealing with that branch of the subject, and by abstracts of the more important of the patents granted prior to 1908. The latter would be particularly useful to those whom the author describes as " inventors not familiar with the properties and the purposes for which the inventions are intended " and might save much useless expenditure on " combinations which are really no invention, as they were probably known before the patentees were born."

Alfred B. Searle

An Advanced Laboratory Manual of Organic Chemistry. *By* M. Heidelberger, Ph.D. *Pp.* 103. *New York: Chemical Catalog Co., Inc.*, 1923. *Price* $2.

This is an interesting little collection of organic preparations, some of which are rather difficult, chosen to stimulate and test the manipulative skill of the advanced student.

Each chapter deals with preparations involving a definite operation or group of operations, such as nitration and nitrosation, but as the number of preparations given altogether is not large, it is not surprising that the examples chosen cover the unusual or lesser-known types of reactions. For the same reasons the compounds prepared are for the most part chiefly of theoretical interest. At the same time some products of technical importance are described, and there is an excellent chapter which deals with organo-metallic preparations, involving the direct arsenation of phenol and the direct mercuration of aniline. These operations typify reactions, which now almost rank with the standard operations of organic chemistry in general applicability.

References are mostly given to the work of the original investigators, but it is evident that the author and his colleagues have worked through many of the original processes and presented them in a modified form.

In the text, the author discusses the more theoretical aspect of the changes involved in the experiment in hand, and occasionally he describes the effect of any change in procedure on the proportions of the position isomers and such matters. One would have liked to see the author discuss the question of yields in the same way, or at least direct the student to think about it. In the " Veronal " synthesis, attention is called to the need of having all the re-agents absolutely anhydrous in order to secure good yield, and in another place a poor yield is explained by the fact that phenols readily oxidise, but otherwise the value of the quantitive aspect of the work is neglected. Surely the student should be directed to consider why an excess of a reagent or a solvent is used, what its function is and what would happen if it were not there or applied in another way ? If, as the author says, it is his ambition " to provide as broad a foundation as possible for the student's work," then the student might well have been directed to the economics of some of the operations with the view to studying the factors which affect them. When the yield of a preparation is less than 50 per cent. then the other 50 per cent. should hardly be allowed to go down the sink without comment. After all, when the student gets into the manufacturing laboratory he will find that it is the other 50 per cent. that matters.

L. A. Jordan

REPORT

The Cleaning and Restoration of Museum Exhibits: Second Report upon Investigations Conducted at the British Museum. *Department of Scientific and Industrial Research. H.M. Stationery Office*, 1923. *Price* 2*s. net*.

Prints and Pictures.—The method of restoring white-lead preparations on drawings and bleaching foxed marks on engravings in which the surface is exposed to hydrogen peroxide vapour (this J., 1922, 23 R) has been in constant use and with great success for both purposes. A warning is given, however, as to the action of hydrogen peroxide on the sizing of certain kinds of paper, which, under the prolonged treatment often required, become fragile and brittle. In other cases where drawings supposed to have been executed in sepia have, in reality, been done with an ink with an iron salt basis, the lines have been bleached to a faint yellow by the hydrogen peroxide, whereas real sepia remains practically unaffected by the reagent. Careful treatment with potassium ferrocyanide and ammonia will, to a large extent, restore the original details of a bleached iron ink, but this experience shows that a preliminary test should be made upon a small portion of a drawing before exposing it to the vapour.

To ascertain whether the pigment in a drawing consists of sepia or bistre, a minute drop of sodium hypobromite is applied : sepia turns red before being bleached, whilst bistre does not turn red, and is only imperfectly bleached, residual black specks appearing on the bleached surface. Stains of an organic nature probably due to red ink or red dyes can be readily removed by applying a solution of sodium hydrosulphite (" Hydros "). When the paper is very thick a solution of hydrogen peroxide in ether may be applied to the blackened pigment by means of a soft brush.

Pigments showing a tendency to flake off from the surface can be fixed by treatment with a solution of cellulose acetate in acetone ; and the same medium has been used for preserving mural tablets, and for attaching decayed paintings on silk to a cloth basis.

Stone and Earthenware.—Experiments are described showing the chief types of salt causing the destruction of stone. Extracts from specimens of material which had crumbled from three different objects (all of limestone) contained : (1) Ammoniacal salts and free ammonia ; (2) sulphates chlorides, nitrates and calcium, but no ammonium salts ; and (3) calcium sulphates and chlorides, magnesium, but no ammonia or nitrates. The disintegration is to be attributed to the crystallisation of the less hygroscopic salts in the pores of the stone. Preservation of stone and earthenware is therefore effected by removing the soluble salts (derived from external sources) by washing.

Silver.—When formic acid does not readily remove incrustations as previously described (*loc. cit.*), resort may be had to the use of zinc dust and very dilute sulphuric acid.

Lead.—The solutions previously recommended (*loc. cit.*) have been successfully used on numerous objects. Some of these have been coated with a varnish of about 5 per cent. of celluloid dissolved in a mixture of equal parts of acetone and amyl acetate. The distortion of the surface of objects of lead caused by decay has been found to be due to the most active corrosion taking place in the interior of the mass, and a resulting expansion which ruptures the surface

Copper and Copper Alloys.—A suitable alkaline solution for cleaning copper, brass and bronze when the acid solutions previously described are not admissible consists of 3 parts of Rochelle salt and 1 part of caustic soda in 20 parts of water. The use of granulated zinc in association with 5 to 10 per cent. caustic soda solution has also proved an effective cleaning agent.

Wooden Objects.—The best solvent for extracting the ammonium salts, to the crystallisation of which disintegration is frequently due, has been found to be dilute (about 5 per cent.) acetic acid, followed by repeated soaking in water, immersion in 0·5 per cent. mercuric chloride solution, and final treatment with a celluloid varnish. Ravages due to insects, are best prevented by treatment with carbon disulphide or hydrogen cyanide vapour. Chloroform, tetrachlorethane are dangerous where coloured objects are in question owing to the possibility of free chlorine being liberated after exposure to light. Experiments with a painting containing flake white (white lead) showed that the picture film, varnish, oil and pigment did not absorb carbon disulphide from wood which had been saturated with that compound in liquid form.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for March* 22)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Crockery, porcelain ..	*
British India	Brass and copper tubes	368, 373
British West Indies ..	Metals, chemicals, drugs, oil, grease, explosives, paint, laboratory equipment, and other mining supplies ..	370
Canada ..	China, earthenware, druggists' supplies..	372
Egypt ..	Oil, paint, varnish ..	10205/F.E./C.C.2
France ..	Pharmaceutical products, etc.	378
Italy ..	Metals, alloys.. ..	379
Morocco ..	Sugar	386
Netherlands .	Rubber goods.. ..	380
South Africa	Earthenware	375
,,	Iron piping	9935/E.D./E.C./A.2
Spain ..	Coal	383
United States	Calcium arsenate, white arsenic	5411/B./T.C./C.C.

* Ref. No. Com. 412/7/1/192. Official Secretary, Commercial Bureau, Australia House, Strand, W.C. 2.

TARIFF CUSTOMS EXCISE

Colombia.—A consolidated duty, consisting of the import and consumption duties, is applied to alcoholic beverages, pharmaceutical preparations, patent medicines, and perfumery.

France.—More favourable tariff treatment has been applied to wood sawdust, cellulose pulp, newsprint paper, magnesite bricks, and electric lamps of Austrian origin. The text of the commercial convention with Canada is given in the issue of March 22.

Greece.—Modified import duties have been applied to raw gums, waxes, turpentine, mineral oils, various metals, soap, starch, glue, leather, earthenware, glass, photographic plates, and emery and glass paper.

Hungary.—Special import licences are required for gas coke, wrapping paper, photographic paper, salicylic acid, and various wares of leather. X-ray apparatus, quartz lamps, and glove leather may be imported without licence.

Palestine.—The customs duties on motor fuel, spirits, etc., sugar, perfumes, and perfumery essences have been revised.

Rumania.—Modified export taxes are leviable on benzine, lamp, gas and mineral oils, and paraffin wax.

Switzerland.—Increased export duties have been applied to scrap and waste of iron, brass, and copper.

PARLIAMENTARY NEWS

Safeguarding of Industries Act

In a written answer Major Boyd-Carpenter informed Sir R. Hamilton that the revenue received under the above Act during the current financial year up to March 10, amounted to £509,000.—(Mar. 19.)

Imports of Dyestuffs

Lieut. Col. Buckley, replying to Mr. Short, said that the imports into the United Kingdom of Alizarin and Anthracene dyestuffs during 1913 were 60,813 cwts., valued at £272,245, compared with an import of 11,387 cwts. of Alizarin dyes, valued at £60,607, in 1922. Owing to changed classification, separate particulars of imports of Anthracene dyes in 1922 were not available.—(Mar. 19.)

West African Palm-Oil Industry

Answering Mr. C. Roberts, Mr. Ormsby-Gore stated that means of assisting the West African oil-palm industry to meet Dutch competition had been engaging the attention of the Colonial Office and the West African Government for several years. In Nigeria and the Gold Coast the Agricultural Departments were being strengthened to enable experts to investigate the industry, and to develop better methods of cultivation and extraction.—(Mar. 19.)

Unemployment in the Paper Industry

In reply to Mr. Becker, Mr. Betterton said that he had no information of the number of paper mills now closed. Out of 61,000 workpeople insured against unemployment in the paper-making and staining trades, 4528, or 7·4 per cent., were registered as unemployed at February 26. It was not possible to say how much unemployment was due to foreign competition.—(Mar. 20.)

The Gas Industry

Mr. P. Lloyd-Greame stated in reply to Mr. F. Gray that he was communicating with representatives of the gas industry in regard to the recommendations in the recent report of the Departmental Committee on the sale of gas by the therm, and he hoped it would be possible to give effect to the report without legislation.—(Mar. 20.)

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acid Acetic, 40% tech. ..	£23-£25 per ton. Very firm with little available. Complete absence of German supplies.
Acid Hydrochloric ..	4s.-5s. carboy.
Acid Nitric	£24 per ton. No signs of improvement.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d.-£8 per ton. Steady demand. Continental inquiries more frequent.
Arsenic (White) ..	£70-£75 per ton. Market steady.
Bisulphite of Lime ..	£7 per ton. Packages extra.
Bleaching Powder ..	£10 10s. d/d. No change. Spot demand poor.
Calcium Chloride ..	£6 per ton d/d.
Copper Sulphate ..	£27 per ton. Somewhat firmer.
Potash Caustic, 88/90%	£35 per ton. Considerably advanced in value. No German supplies.
Potass. Bichromate ..	6¼d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton. Normal.
Soda Caustic, 76% ..	£20-£21 per ton. Demand good, especially for the Continent.
Soda Crystals	£5 5s. carr. paid. No change. Demand quite good.
Sod. Bicarbonate ..	£10 10s. per ton.
Sod. Acetate, 97/98% ..	£25 per ton.
Sod, Bisulphite Powder, 60/62%	Ton lots. £19 .. 10 £19 10s. 5 £20 .. 2 £20 10s. 1 F.o.b. or f.o.r. London, 1-cwt. iron drums incl'd.
Sod. Chlorate	3d. per lb. Demand not quite so brisk with better supplies.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, conc. ..	£15 conc. solid carr. paid. Better demand.
Sod. Sulphite—Pea Crystals	Ton lots. £17 .. 2 £17 10s. 1 1-cwt. wooden kegs included.

WOOD DISTILLATION PRODUCTS

Acetate of Lime Brown	£10 per ton d/d.
,, ,, Grey ..	£20 per ton d/d.
Acetate of Lime Liquor	9d. per gall., 32° Tw.
Iron Liquor	1s. 6d. per gall., 32° Tw. 1s. 2d. per gall., 24° Tw.
Red Liquor	1s. 3d. per gall., 14/15° Tw.
Wood Creosote	2s. 6d. per gall., unrefined. Lower prices, however, are asked in some quarters.

Wood Naphtha—	
Miscible	6s. 6d. per gall., 60% O.P.
Solvent	5s. per gall., 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead	£39 per ton d/d.

TAR PRODUCTS

Acid Carbolic, crystals	1s. 7d.-1s. 8d. per lb. Practically no change. Market well maintained for next two or three months.
,, ,, crude 60's	4s.-4s. 4d. Demand good. Business still being done at lower figure, but higher prices spoken of in some quarters.
Acid Cresylic, 97/99	1s. 11d.-2s. 3d. Fair enquiries for forward delivery.
,, ,, pale 95%	1s. 10d.-2s. 2d. Moderate enquiry.
,, ,, dark	1s. 6d.-1s. 11d. Fair demand.
Anthracene Paste, 40%	4d. per unit per cwt. Price still nominal. No business.
Anthracene Oil—	
Strained	9¾d.-11d. gall. Fair enquiries.
Unstrained	9d. per gall.
Benzole, crude, 65's	1s. 1d. per gall.
Benzole, standard motor	1s. 6½d.-1s. 8d. per gall.
Benzole, pure	2s.-2s. 3d. per gall.
Toluole, 90%	1s. 9d.-1s. 11d. per gall. Little demand.
Toluole, Pure	2s. 2d.-2s. 6d. per gall. Market firm.
Xylol	3s. 3d. per gall.
Creosote—	
Cresylic, 20/24%	11d.-1s. 1d. Prices still steady.
Middle Oil	8¾d.-9½d. per gall. Good demand.
Heavy	
Standard specification	
Naphtha, crude	9d.-9¼d. per gall.
,, Solvent 90/160	1s. 7d.-1s. 9d. Very little business doing.
,, Solvent 90/190	1s. 6½d.-1s. 7½d. Market still steady.
Naphthalene—	
Crude, drained Creosote salts	£7-£9. Good demand, market firm.
Crude, whizzed or hot pressed	£11-£12. Numerous enquiries for forward delivery.
Pitch, medium soft	185s.-200s. per ton. Market active.
Pyridine, 90/140	11s.-12s.
,, heavy	8s.-9s. per gall. Price still nominal—no business.

INTERMEDIATES AND DYES

Acetic Anhydride	1s. 5d. per lb.
Acid H.	5s. lb. 100% basis d/d.
Acid Naphthionic	2s. 7½d. lb. ,, ,, ,,
Acid Neville & Winther	6s. lb. ,, ,, ,,
Acid Sulphanilic	1s. 6d. lb. ,, ,, ,,
Aluminium Chloride anhydrous	1s. per lb. d/d.
Aniline Oil & Salts	9½d. lb. naked at works.
Antimony Pentachloride	1s. 1d. lb.
Benzidine Base	6s. 6d. lb. 100% basis.
Benzyl Chloride	1s. 4½d. ,, ,, ,,
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. lb. 100% basis.
p-Dichlorbenzol	£55 per ton.
Dinitrobenzene	11d.-1s. lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene 48/50	8d.-9d. naked at works.
66/68	1s. 2d.-1s. 3d. naked at works.
Diphenylamine	3s. 2d. lb. d/d.
Dichloraniline	2s. 2d. lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. lb. d/d. packages extra.
Metanitraniline	5s. 6d. lb. d/d.
Monochlorbenzol	£70 per ton.
α-Naphthol	2s. 9d. lb.
β-Naphthol	1s. 1d. lb. d/d.
α-Naphthylamine	1s. 6½d. lb. d/d.
β-Naphthylamine	4s. lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d.-8d. per lb.
Nitronaphthalene	1s. lb. d/d.
o-Nitrochlorbenzol	2s. lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. lb. 100% basis.
p-Nitro-*o*-amidophenol	4s. 6d. lb. 100% basis.
m-Phenylene Diamine	5s. 6d. lb. d/d.
p- ,, ,,	12s. 6d. 100% basis d/d.
Sod. Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. lb. d/d.
m-Toluylene Diamine	5s. lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Prices in this Section show a strong upward tendency. With regard to Tartaric Acid products it is generally recognised that the prices that have been prevailing for some time past have been below the cost of production. There is no doubt that the market has been depressed by stocks carried by speculators and others who bought largely during the demand that was created by the short spell of hot weather last year. The sudden cessation of the warm period caused a slackening in demand, with the consequence that there were large accumulations of Acid from the Continent, which had been bought for forward delivery. For financial reasons, these stocks were thrown on the market at prices which must, in many cases, have represented a loss to importers. Similarly, in order to finance themselves by selling, Continental makers were compelled to bring down their prices to the level thus created. Stocks here are, to a great extent, now liquidated, also demand is increasing hence the upward tendency in price.

Acid Acetic 80%	£52 10s. Position firm.
Acid Acetyl Salicylic	2s. 11d.-to 3s. 3d. per lb. Now quoted on a firmer market. Supplies restricted.
Acid Benzoic	2s. 3d. per lb. Steady and in good demand.
Acid Boric	Unchanged.
Acid Citric	1s. 8½d. per lb., less 5%. Market steady.
Acid Gallic	3s. per lb. for 2-cwt. lots. 3s. 3d. per lb. for 56 lb. lots.
Acid Pyrogallic, cryst.	5s. 9d. per lb. Price advanced.
Acid Salicylic	2s.-2s. 6d. per lb. Very firm. Several makers cannot book further orders for some time.
Acid Tannic	3s. 3d. per lb. is the present limit.

Acid Tartaric	1s. 2¾d. less 5%. Demand still increasing. Spot supplies reported to be short. It is stated that some Italian makers have withdrawn from the market, in view of the anticipated further rise in price to a figure that will be more compatible with the cost of production.
Acetanilide	1s. 6d. per lb. Unchanged owing to lack of any considerable demand.
Ammon. Benzoate	3s. per lb. This price will soon have to be advanced in common with other benzoates.
,, Carbonate, B.P.	£37 10s. per ton. nett.
Atropine Sulphate	12s. 6d. oz. Steady.
Barbitone	14s.-17s. 6d. per lb. Very much advanced. Some holders are asking still higher prices.
Benzonaphthol	3s. 3d. per lb. Still further reduced.
Bismuth Salts	Unchanged. Good steady market.
Bromides	All very firm. Prices on the Continent continue to advance.
Calcium Lactate	2s. 3d. per lb. with prices hardening upwards.
Chloral Hydrate	4s. 3d. per lb.
Chloroform	2s.-2s. 3d. per lb.
Creosote Carbonate	10s. per lb.
Formaldehyde 40%	£88 to £90 per ton.
Guaiacol Carbonate	7s. 6d.-8s. 6d. per lb. now quoted in view of more demand having arisen.
Hexamine	4s. 3d. per lb., with very much higher rates being quoted from Germany.
Homatropine Hydrobromide	30s. per oz.
Hydroquinone	3s. 3d.-3s. 6d. per lb.
Iron Ammon. Citrate	2s. 5d. per lb. for 1-cwt. lots.
Iron Perchloride	£20 to £22 per ton.
Magnesium Carbonate Light comml.	£38 per ton.
Magnesium Oxide—Light comml.	£85 per ton.
Heavy comml.	£28 per ton.
Menthol	32s. for original cases. Smaller quantities 33s. per lb.
Methyl Salicylate	2s. 6d.-2s. 8d. per lb. in glass containers.
,, Sulphonal	13s. 6d. per lb. now quoted.
Mercurials	Unchanged but still very firm
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 6d.-1s. 8d. per lb.
Phenacetin	6s. 6d. per lb. is now quoted being an appreciable advance on previous rates.
Phenazone	7s. per lb., still fully maintained.
Phenolphthalein	5s. per lb. firming up again.
Potass. Bitartrate 99/100% (Cream of Tartar)	95s.-98s. per cwt. less 2½% demand good.
Potass. Ferricyanide	4s. per lb.
Potass. Iodide	15s. 8d. per lb. for cwt. lots. Good steady demand.
Potass. Permanganate	10d. per lb. is now the minimum price for quantity.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz.
Resorcin	5s. per lb.
Salol	2s. 6d.-3s. 3d. per lb. now quoted.
Silver Proteinate	9s. 6d.-10s. per lb.
Sod. Benzoate	2s. 3d. per lb., with greatly increased quotation from Germany.
Sod. Citrate	U.S.P. quality 2s. 2d. for cwt. lots.
Sod. Hyposulphite, Photographic	£14 15s. for 5-ton lots.
Sod. Potass. Tartrate (Rochelle Salt)	80s.-82s. cwt. Poor demand.
Sod. Salicylate	2s. 6d. per lb. for powder, 2s. 7d. for crystal is now quoted. Makers are mostly fully sold for the next few weeks.
Sod. Sulphite Anhydrous	£27 10s.-£28 10s. per ton according for quantity, f.o.r. London drums included.
Sulphonal	13s. per lb. is the present value.
Tartar Emetic	1s. 4d. per lb. Unchanged.
Thymol	19s. per lb. for good white crystals. Lower prices would be accepted for quantity.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	12s. ,, ,,
Amyl Acetate	2s. 6d. ,, ,,
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (melting point 21/22°C.)	4s. 3d. ,, ,,
Benzyl Acetate from chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate, 19.5°C.	3s. ,, ,,
Cinnamic Aldehyde—98/100% Natural	14s. 9d. ,, ,,
Coumarin	15s. ,, ,,
Citronellol	22s. 6d. ,, ,,
Citral, 100%	9s. 6d. ,, ,,
Ethyl Cinnamate	18s. 6d. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	7s. 6d. per lb.
Iso Eugenol	17s. ,, ,,
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	22s. 6d. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Ketone	35s. ,, ,,
Musk Xylol	9s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	24s. ,, ,,

ESSENTIAL OILS

Almond Oil, foreign, S.A.P.	13s. 6d.-16s. per lb.
Anise Oil	2s.-2s. 1d. per lb. spot, 1s. 10½d. c.i.f. forward. Very quiet indeed.
Bergamot Oil	12s. 6d. per lb. spot. Will probably advance with the improvement in the lira.
Bourbon Geranium Oil	28s. per lb. spot. Substantial grounds for the advance difficult to find. Will probably decline when new crop comes to hand.
Camphor Oil, White	82s. 6d. per cwt. Quiet.
Cananga Oil, Java	9s.-10s. 6d. per lb. Quiet.
Cinnamon Oil, leaf, Ceylon	4d.-4½d. per oz.
Cassia Oil	8s. 6d. per lb. spot, 8s. c.i.f. forward. This is likely to go dearer.
Citronella Oil—	
Java	3s. 10d.-4s. 1d. per lb. Very firm.
Ceylon	3s. 3d. per lb. Very firm.
Clove Oil	7s. 9d.-8s. 6d. per lb. Quotations vary daily owing to fluctuations of the spice.
Eucalyptus Oil	1s. 6d.-1s. 9d. per lb. Steady but not much doing.
Lavender Oil—	
Mont Blanc	12s. 6d.-13s. per lb. for high grade oil. Expected to go dearer.
Lemon Oil, spot	3s. per lb., 3s. c.i.f. forward.
Lemongrass Oil	2⅝d. per oz., about the same forward.
Orange Oil, Sweet, spot	10s. 6d. per lb. Distinctly a good market.
Otto or Rose Oil	20s.-32s. per oz., according to quality. A large quantity of very inferior otto offering.
Palma Rosa Oil	17s. per lb. Steady.
Peppermint Oil—	
English	70s.-80s. Quiet.
Wayne County	13s.-13s. 6d. spot, easier forward.
Japanese	6s. 6d.-6s. 9d. per lb.
Petitgrain Oil, Paraguay	7s. per lb. Flat.

TRADE NOTES

Amalgamation of Fertiliser Companies in Japan

H.M. Commercial Councillor at Yokahama has forwarded a report which states that the following three fertiliser companies have amalgamated:—The Japan Artificial Fertiliser Co. (Dai Nihon Jinzo Hiryo Kabushiki Kaisha); the Eastern Acid and Alkali Co (Kanto Sanso K.K.); and the Japan Chemical Fertiliser Co. (Nihon Kagaku Hiryo K.K). The question of the amalgamation of fertiliser companies has frequently been to the fore since the slump of 1920, and the continued lack of market and the vital necessity of lowering the cost of production has made such a step inevitable. As a result of the amalgamation, the two last-named companies will be dissolved, and the Japan Artificial Fertiliser Co. will remain with its capital increased from 14.300,000 yen to 23,400,000 yen.—(*Official.*)

Capital Increases of German Chemical Firms

The following is a list showing the extent to which the capital of some of the most important German Chemical firms has recently been increased:—

	Million marks From	Million marks To
Verein für chemische Industrie Mainz, Frankfurt a. M.	6·5	28·0
Rosol-Werk Magnetine A.-G., chemische Fabriken	9·7	10·0
Bayerische Stickstoffwerke A.-G., Munchen	70·0	100·0
Consolidierte Alkaliwerke Westeregeln	31·5	75·5
Olea-Werke, A.-G. für Mineralöl-Industrie	48·0	60·0
Norddeutsche Sprengstoffwerke A.-G., Hamburg.	4·0	7·0
Mitteldentsche Stickstoffwerke A.-G., Berlin	250·0	500·0
Max Hahn, Chemische Fabrik A.-G., Berlin	6·0	11·0
Norddentsche Acetylen- und Sauerstoffwerke A.-G., Hamburg	6·75	10·0
Gebr. Meyer, chem.-techn. Fabrik A.-G., Hannover	9·0	15·0
Alberdingk-Oelwerke A.-G., Uerdingen	6·0	12·0
Concordia, Chemische Fabrik auf Aktien, Leopoldshall	2·5	6·8
Aktiengesellschaft fur Bergbau- Blei- und Zinkfabrikation in Stolberg und in Westfalen	36·0	72·2
Chem.-pharmaz. Werke Mayer-Alapin A.-G., Frankfurt a. M.	8·6	12·2
I. D. Riedel A.-G., Berlin	90·0	150·0
A. F. Heyde, Chemische Fabrik A.-G., Berlin	7·5	12·0
Lingner-Werke A. G., Dresden	24·0	36·0

These and other increases represent an aggregate augmentation in capital from 675,950,000 marks to 1,220,637,600 marks. Among recent establishments of new chemical firms, the following may be mentioned, the capital being given in parentheses in millions of marks:—Verein für Zellstoff-Industrie A.-G., Berlin (40); Bayrische Farben- und Lackindustrie A.-G., Munchen (20); Pharmazeutisches Werk Pharmasaar A.-G., Saarbrucken (20); Roth and Paschkis A.-G., Stuttgart (40).—(*Chem. Ind., Feb.* 19, 1923.)

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EDITORIAL

THE interest, which the nation as a whole ought to take in chemistry, is well illustrated by the Report of the Home Office Departmental Committee on the use of Lead Paints published to-day. Of the seven members of the Committee, one, Dr. Alexander Scott, F.R.S., is well known as a chemist, and two or three others have some considerable acquaintance with the science. Several of the witnesses who gave evidence before the Committee are chemists, and most of these have contributed articles to this Journal. The whole problem, though not strictly a chemical one, involves chemistry in every aspect; the solubility of various lead compounds in dilute acids including gastric juices, the causes of the deterioration of pigments in the atmosphere of our manufacturing towns and the effects of turpentine and other volatile thinners are chemical phenomena which had to be investigated by the Committee. The durability of the paint on Government buildings was investigated by the Chief Government Chemist, and the analyses he made of various paints scraped from doors and windows are published with the Report. Chemists must be pleased that an important set of problems should be studied by a body of men, a large proportion of whom have some scientific knowledge, and studied in a manner which recognises the principles which underlie modern civilisation. The work of this Committee and the Report it has published might well become models which many other committees might strive to emulate.

* * *

The Committee has accepted the principle that lead poisoning is caused by dust and has rejected, as chemists had already rejected, the suggestion that it was caused by some volatile lead vapour or emanation. The idea of a lead emanation from painted surfaces seems to have received some support from black stains on filter papers proved to contain traces of copper due to the wire gauze on which the filter papers were dried. Modern chemical tests are frequently very sensitive, and colour effects due to minute traces of metals, alkaloids and other bodies are not always trusted quite so much as tests which involve larger amounts of ponderable matter. The report recommends the abolition of the dry rubbing down of paint, a fruitful source of dust. Dust is bad for human beings and probably in the damp climate of England we are less able to endure it than are the inhabitants of other countries. Washing down the dust from the throat is a time-honoured practice, and indeed some, believing that prevention is better than cure, practise thus before the dust has largely accumulated; but to keep the dust out of the atmosphere is a still safer expedient. Wet rubbing down of paint reduces the dust to about five per cent. of that present during dry rubbing down, the difference between safety and danger, and we wonder in how many chemical operations similar precautions would be helpful.

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Those who manufacture chemical compounds and those who use them day after day have a duty to perform, to avoid waste, waste of human life and energy, waste of time, waste of material. During the last four or five days many of us have been able to exchange the smoke of a town for "an ampler ether, a diviner air," and though we cannot all afford to journey to those climes "where falls not hail, or rain or any snow, nor ever wind blows loudly," we can all do something towards making use of modern science in mitigating the adulteration of the air we breathe. When we compare the atmosphere of Liége with that of Sheffield or that of some of the French manufacturing towns with that of Widnes, we realise what a task lies before us. But if we work at the problem in the manner and with the care of the Home Office Departmental Committee we may do much. Three-quarters of the dust and fumes in our factories and workshops and of the smoke in our towns could be avoided without any very revolutionary methods. Meanwhile the Committee's Report seems to be of such interest that we will shortly publish a summary of it.

* * *

If we are to take our national receipts and expenditure as evidence—and why not?—we are making slow yet steady progress towards that prosperity which we covet and deserve. We deserve it because we are facing our huge indebtedness in the only practical way—cutting down our spending so as to leave a margin as recommended by the late Mr. Micawber, whose financial theory was better than his practice. Grievous as is our taxation, it has diminished and will continue to diminish, and this enables our home trade to revive somewhat. There are many indications which point to a steady recovery in trade here, and the outlook is distinctly more encouraging. Our foreign trade will also improve. The ordinary expendidure of France is now met by taxation, and her extraordinary expenditure in repairing the devastated areas has been much curtailed. We may shortly hope for four or five prosperous foreign countries. As for those who make up their minds to live within their income, even if they have to borrow money to do it, such a policy cannot long continue; already there are symptoms of barter, or trading by means of obligations secured by material assets, in Germany, and before many months the nearly worthless marks of that country may be discarded and a stable currency founded on a new basis may be established. A new chemistry there may be, but the principles of political economy have been settled as the result of innumerable experiments conducted during countless centuries.

* * *

Prof. Stanley Allen, who contributes to this number an article on the Structure of the Atom, has provided an interesting account of the growth of our ideas from the early days of Democritus to the New Chemistry which we referred to in a recent editorial. The quotations he makes from the writings of Democritus are in some cases out of date, but in others singularly in accordance with modern views. This is true also of the verse of Lucretius and of many another ancient writer. The ancient Greeks knew that the square root of 2 could not be expressed by any vulgar fraction, and this is evidence of considerable reasoning on a rather abstruse point of mathematics. On the other hand, the facts upon which chemistry is founded were almost wholly unknown to them, and great as are the virtues of imagination, a superstructure founded on this as a foundation becomes insecure.

THE STRUCTURE OF THE ATOM

By **H. STANLEY ALLEN, M.A., D.Sc.**

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§ 1. The Development of the Atomic Theory

Greek philosophers, some twenty-five centuries ago, were teaching that changeful matter is made up of indestructible particles in constant motion. Amongst the principles of Democritus (420 B.C.), as quoted by Tyndall, we find the following:—

"The only existing things are the atoms and empty space; all else is mere opinion.

"The atoms are infinite in number and infinitely various in form; they strike together and the lateral motions and whirlings which thus arise are the beginnings of worlds.

"The varieties of all things depend upon the varieties of their atoms, in number, size, and aggregation."

Thus far we have statements which, with some slight modifications, might be accepted by the majority of physicists or chemists of the present day. We might, however, find some difficulty in subscribing to the further principle:—

"The soul consists of fine, smooth, round atoms like those of fire. These are the most mobile of all. They interpenetrate the whole body and in their motions the phenomena of life arise."

Boscovich, author of *A Theory of Natural Philosophy* (1763), is sometimes claimed as the father of modern atomic theory. He showed "with admirable clearness how many diverse phenomena in mechanics and even in other branches of physics can be explained in a natural qualitative way on his hypothesis that matter consists of discrete points accelerated towards each other by a perfectly definite law of suitable form. But from the modern point of view his work in this connexion is scarcely more interesting than the earlier work of Daniel Bernoulli, or the still earlier ideas of Hooke." *

The work of Dalton and his successors during the first half of the nineteenth century gave precise and quantitative form to the early speculations of the Greeks. Instead of an infinite variety of atoms it was found that only seventy varieties, constituting the "elements" of the chemist, were necessary to build up by means of their different combinations and groupings the substances of the material world. It is not overstating the case to say that the atomic hypothesis put forward by Dalton has within the last twenty-five years been proved to give an extremely close representation of the actual state of affairs. Even Wilhelm Ostwald, the distinguished chemist and philosopher, who until recently, withheld his allegiance from the atomic theory, has now avowed his belief in the discrete or grained structure of matter.

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* "Nature," vol. 110, p. 870, 1922.

"The isolation and counting of gaseous ions on the one hand . . . and on the other the agreement of the Brownian movements with the requirements of the kinetic hypothesis . . . justify the most cautious scientist in now speaking of the experimental proof of the atomic theory of matter. The atomic hypothesis is thus raised to the position of a scientifically well-founded theory."

§ 2. The Atomic Theory of Electricity

If, then, we accept without hesitation an atomic theory of ordinary matter, what are we to say of electricity? It was clearly recognised by the great master of electrical science, Michael Faraday, that the experimental facts which he discovered with regard to the decomposition of chemical compounds by the passage of an electric current through a solution necessitated a similar view with regard to electric charges. Faraday wrote in 1834: "If we adopt the atomic theory or phraseology, then the atoms of bodies which are equivalent to each other in their ordinary chemical action, have equal quantities of electricity naturally associated with them." The charge carried by a univalent ion is independent of the nature of that ion. A divalent ion carries exactly twice and a trivalent ion three times this quantity. Faraday's disciple in electrical theory, Clerk Maxwell, suggested that the constant molecular charge (revealed by Faraday's experiments) might be called one molecule of electricity, but he regarded this as a provisional hypothesis not likely to be retained when we come to understand the true nature of electrolysis. It is not a little remarkable that in 1871 Weber pictured the elementary magnets, which Ampère had imagined fifty years earlier, as due to the rotation of light, positive charges about massive negative ones. "The two unlike particles in the condition described constitute then an Amperian molecular current." This suggestion corresponds closely to our modern ideas, save that the *rôle* of the positive and negative particles must be interchanged. In 1874 Johnstone Stoney gave a clear statement of the atomic theory of electricity, and in 1891 suggested the term "electron" to designate the "natural unit of electricity" or the electric atom. It was largely the experiments of J. J. Thomson and his fellow-workers at the Cavendish Laboratory at Cambridge from 1897 onwards, which furnished convincing evidence of the atomic constitution of electricity, and determined the charge carried by the electron, or "corpuscle" as J. J. Thomson termed the negatively electrified unit found, for example, in the "cathode rays" of a Crookes tube.

To the physicist the electron is just as "real"—no more and no less—as is the atom to the chemist. Perhaps there is no fact which reveals more clearly the power of modern physical methods than our ability to detect and examine the effects produced by a *single* atomic projectile or a *single* electron. If we cannot *see* an atom or an electron we can at least render its track visible, provided only it is moving with sufficiently great velocity. The most striking results of this kind are those obtained by C. T. R. Wilson, at Cambridge, who caused drops of water to condense on the ions produced along the track of the swiftly moving particle.

§ 3. Atomic and Molecular Numbers

The *atomic weight* of an element has long held a proud position in the chemical world, but at the present time still greater importance must be attached to the *atomic number*. This number may be defined as the integer which determines the position of an element in the Periodic Classification. The conception of such a characteristic number originated in the work of M. de Chancourtois (1862-3), who stated definitely that: "The properties of the bodies (elements) are the properties of number," and of Newlands (1863-5). The latter arranged the elements in the ascending order of their atomic weights, numbering them from 1 to 56. According to his "Law of Octaves":—

"The numbers of analogous elements, when not consecutive, differ by 7 or some multiple of 7."

Newlands admitted that it might be necessary to alter the number 7 to some higher figure, if other elements should be discovered.

One critic, whose cynicism was greater than his foresight, asked Newlands, "whether he had ever examined the elements according to the order of their initial letters?"

The chemical evidence for an atomic number has in recent times received overwhelming support from the physical side; van den Broek first made the fruitful suggestion that the atomic number represented the number, N, of negative electrons which, together with an equal number of unit positive charges, constituted an electrically neutral atom.

The use of the chemical balance led to the development of the atomic theory, and so to the determination of atomic weights. The gold leaf electroscope, employed in connexion with X-rays and Becquerel rays, may be said to have fixed the atomic numbers. In this connection the name of H. G. J. Moseley, killed, alas! in Gallipoli, will ever be remembered. By examining the X-ray spectrum of a large number of elements he was able to show that a definite whole number must be associated with each element. This integer varies by unity from one element to the next. The values so determined are, however, only *relative*. It was assumed that the characteristic integer for aluminium was 13, and the numbers for elements of greater atomic weight were assigned on this basis. Evidence has been accumulating that the choice made by Moseley was correct; in particular the work of Prof. Barkla on scattered X-rays indicates 6 electrons per atom of carbon, 7 for nitrogen, 8 for oxygen, 16 for sulphur and 1 only for hydrogen. Thus the atomic numbers for the first few elements run

H, 1
He, 2; Li, 3; Be, 4; B, 5; C, 6; N, 7; O, 8; F, 9
Ne, 10; Na, 11; Mg, 12; Al, 13 . . . .

In the case of the elements of high atomic weight at the other end of the Periodic Table, mention must be made of the important work carried out by Prof. Soddy and other chemists which has done so much to explain the relative positions of the radioactive elements through the discovery of "isotopes," *i.e.*, substances differing in atomic weight but having identical chemical properties.

If a Periodic Table of the elements be prepared with the atomic numbers inserted in place of the atomic weight, it is found, as I pointed out in 1918,* that the numbers for corresponding elements frequently differ by 8, or a multiple of 8, in general agreement with the prediction of Newlands. Owing to the presence of three elements instead of a single element in Group VIII., the difference is in some cases increased by 2 units, giving the figure 10 in place of 8, or 18 in place of 16. At the same time I pointed out the significance of what I called the "molecular number" which represents the total number of unit positive charges or the corresponding number of negative electrons in a neutral molecule. Here, too, the "Rule of Eight" is applicable.

§ 4. THE ARRANGEMENT OF THE ELECTRONS IN SPACE

The Theory of Lewis and Langmuir

So far we have been concerned with the *arithmetic* of the electrons. We pass now to the next step in the development of the electron theory of the constitution of atoms and molecules—namely, that of assigning a definite spatial configuration to the electronic system. From arithmetic we proceed to *geometry*. A most interesting attempt of this kind has been made by Lewis and Langmuir.

The facts of stereochemistry make it clear that a three-dimensional geometry is required.

The inert gases are the most stable of the elements. We infer that in these the groupings or configurations of the electrons are the most stable possible. We may go further and say that in these gases the groupings are complete, whilst in other elements the groupings are incomplete, so that the activity of such elements is attributed to the tendency "to conform as nearly as possible to the complete and therefore inert elements."

Consider, then, the atomic numbers of the inert gases. These form the series :—
He, 2 ; Ne, 10 ; A, 18 ; Kr, 36 ; Xe, 54 ; Nt, 86 ;
These are all *even* numbers and Rydberg has pointed out that they form the series :—

$$N=2\ (1+2^2+2^2+3^2+3^2+4^2+)$$

From a consideration of this equation and of the principles of symmetry Langmuir developed a theory as to the geometrical arrangement of the electrons in these atoms. He supposes the electrons are distributed through a series of concentric spherical shells; the effective radii of the different shells stand in the ratio 1 : 2 : 3 : 4, and the effective surfaces are in the ratio $1 : 2^2 : 3^2 : 4^2$.

The most stable element of all is *helium*. The nucleus has a positive charge of 2, and the atom has two electrons. We imagine the nucleus in the centre, and each electron in one half of a complete shell (like a walnut shell) surrounding it. Neither electron trespasses upon the territory of the other. It is not necessary to regard the electrons as stationary, but we may for simplicity consider each as occupying its average position.

In the helium atom we have a complete satisfaction of the positive and negative charges, with practically no external field. The grouping in pairs about a positive charge may be regarded as the first electronic ideal.

The next most stable element is *neon*, N=10. It is assumed that, like helium, 2 electrons are near the nucleus. The remaining 8 arrange themselves in a second shell, four in either hemisphere. This arrangement of 8 electrons may be called an *octet*. Next to the balanced pair of electrons the octet is the most stable grouping.

Argon has N=18. There are 8 more electrons to dispose of, and Langmuir imagines that each cell of the second shell now contains 2 electrons instead of 1 as in neon.

In *krypton*, N=36, it is necessary to employ a third shell containing 18 electrons, 9 in each hemisphere. Xenon, N=54, is similar to krypton, except that each cell in the outer shell contains 2 electrons in place of 1.

Niton, N=86, necessitates a fourth shell containing 32 electrons, 16 in each hemisphere.

The stability and inactivity of these elements is attributed to the electrons being placed in the most ideal position for the production of a balanced system, so that there is a minimum field of external force.

The key to all chemical combination is found in the striving of all elements to become as nearly as possible like the fixed gases.

According to Lewis chemical compounds may be divided broadly into two types—*polar* and *non-polar*. As an example of the former type we may take lithium fluoride. The single electron in the outer shell of the lithium atom may be supposed to pass to the outer shell of the fluorine atom so as to complete the octet. We then have a positively charged lithium ion and a negatively charged fluorine ion, and the electrostatic attraction between these ions results in the formation of a molecule of lithium fluoride (LiF). This view is in harmony with the results obtained by Sir William Bragg and his son, Professor W. L. Bragg, by X-ray analysis of crystals of rock salt (NaCl) or sylvine (KCl).

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* Journal of the Chemical Society, vol. 113, p. 389, 1918.

In chemical compounds of the second type no ionisation need be involved, and the chemical bonds or "valencies," *i.e.* the couplings between the atoms, are determined by pairs of electrons. One electron held in common never holds two atoms together. Two atoms held together by a single valency bond hold two electrons in common. This is illustrated in the case of the fluorine molecule.

At first one may be inclined to regard Langmuir's postulates as too artificial to form the basis of a satisfactory theory, but a closer examination serves to show that the essential points are comparatively simple. No one who heard the theory expounded by Langmuir in its simplified form at the Edinburgh meeting (1921) of the British Association for the Advancement of Science could fail to admire the brilliant way in which so large a number of chemical facts might be co-ordinated. It is not necessary to regard the arrangement of the electrons in the Lewis-Langmuir atom in too definite a manner; indeed, the geometrical representation may be looked upon as essentially schematic.

§ 5. THE MECHANICS OF THE ATOM

But even when the spatial distribution of the electrons has been determined, a third step still remains to be taken. It is necessary to consider the mechanics of the system, or at least such modified mechanics as are suggested in the modern theory of Quanta.

The electrical theory of the constitution of matter in many respects resembles Prout's hypothesis, according to which all chemical elements are built up of the same primordial stuff. But in the electrical theory we are left with the dualism of positive and negative electricity. Various models based on this theory have been suggested for the structure of the atom, but all agree in postulating the combination of a definite number of negative electrons with an equal number of unit positive charges.

Lord Kelvin pictured the positive electricity as distributed uniformly throughout a sphere of atomic radius with the negative electrons scattered inside the sphere. The possible arrangements of the electrons in space have been discussed by Sir J. J. Thomson, who has obtained very suggestive results as to the grouping of the electrons and has shown how the facts exhibited in Mendeléef's periodic classification of the elements may be explained, or at least illustrated, by the recurrent arrangements of rings of electrons.

In 1904 Nagaoka discussed an atomic model, which may be termed a Saturnian atom, with an attracting centre and a large number of equal particles, repelling one another inversely as the square of the distance, moving round the circumference of a circle. Very similar is the "nucleus atom" developed by Rutherford in 1911. In this model the positive charge is concentrated in a nucleus of extremely small dimensions, but containing practically the whole mass of the atom, whilst the electrons are arranged round about the nucleus, perhaps moving in orbits or in certain definite rings. Here, however, we are faced by a serious difficulty. According to classical dynamics such a system must ultimately come to rest through exhaustion of energy by radiation. To meet this and other difficulties Prof. Niels Bohr has boldly discarded the Newtonian laws and substituted a new set of principles embodied in what is known as the Quantum Theory.

In the simple case of the hydrogen atom Bohr supposes that the single electron is circling round the positive nucleus in an orbit which may be described as a one-quantum orbit, a two-quantum orbit, and so on. Radiation occurs when the electron in some unexplained manner jumps from one possible orbit to another of greater stability. In helium in its normal state the two electrons are both moving in one quantum orbits, the planes of the orbits being inclined to one another. The arrangements of the electrons in the atoms of the inert gases, according to the theories of Langmuir and of Bohr, are given in the following table. The small subscript figures indicate the kind of orbit in which Bohr supposes the electrons to be moving, whether a one-quantum orbit, a two-quantum orbit, or so on.

Langmuir	*Element*	*Bohr*
2	Helium	2_1
2 8	Neon	2_1 8_2
2 8 8	Argon	2_1 8_1 8_2
2 8 8 18	Krypton	2_1 8_2 18_3 8_2
2 8 8 18 18	Xenon	2_1 8_2 18_3 18_3 8_2
2 8 8 18 18 32	Niton	2_1 8_2 18_3 32_4 18_3 8_2

It will be noticed that whilst in Langmuir's theory the number of electrons in the outer shell increases up to 32, in Bohr's theory the outermost electrons never exceed eight in number.

In 1914–15 I suggested that Rutherford's model atom might be modified if it were supposed that the positive part of the atom were endowed with a magnetic moment, so that we should obtain an atomic model with a magnetic core.

An interesting attempt to construct an atomic model on mechanistic principles has been made by A. L. Parson, who supposed the electron endowed with a magnetic moment. A simple way of effecting this is to distribute the charge of the electron round a circular ring, like an anchor ring, which spins about its axis. Such a spinning "ring electron" will be threaded by lines of magnetic induction and will possess a magnetic moment. It may conveniently be termed a "magneton," and Parson's paper published by the Smithsonian Institution in 1915 bears the title, "A Magneton Theory of the Structure of the Atom." The theory as there presented suffers to some extent from the fact that it is based on the Kelvin and Thomson idea of a uniform sphere of positive electricity, although Parson himself recognised that this part of the theory was purely formal, and it suffers also because the number of magnetons assumed in the atom does not agree with the atomic number of Moseley, which is now generally accepted as correct. The theory gives a simple representation of the hydrogen atom and of the hydrogen molecule. A prominent feature of Parson's theory is the group of 8 magnetons, which forms a system of low magnetic energy, and therefore of considerable stability. Parson constructed a working model to illustrate the behaviour of such a group when under the influence of an external magnetic field.

Many of the properties of organic compounds indicate an apparent localisation of the affinities in particular regions of the atoms. Stark attempted to account for this by his theory of valency, but the attempt scarcely bears rigid examination when electrostatic forces only are considered. On the other hand, if the electron acts also as a magneton, the difficulty becomes less serious, for the magnetic attraction may serve to link the atoms together, and provide the force of chemical affinity in non-polar compounds.

To be satisfactory an atomic model must explain the facts of magnetism, for it is now recognised that magnetism is an attribute of the atom or its parts, not of the molecule. This means that the elementary magnet postulated by Weber is to be found in the atom, the "Weber element" being due either to electrons circulating in orbits about a central nucleus, or to the electron itself possessing a magnetic moment and behaving as a magneton. Sir Alfred Ewing has recently revised his original theory of magnetism and has constructed a number of models to represent more accurately the Weber elements and their positions of stability. In some of the models the electron orbits are shown by coils conveying currents, in others the Weber element is represented as a small magnet or a group of small magnets. In one case an octet of magnetic poles can turn from one position of stability to another under the influence of the fixed magnets surrounding it. In these new models a narrow range of stable deflection is secured without excessive stability.

In a most suggestive paper Prof. Whittaker has developed from Sir Alfred Ewing's new model a mechanism for explaining how it comes about that all exchanges between the kinetic energy of electrons and radiant energy conform to the "quantum" condition. Shortly afterwards I pointed out that this mechanism, which may be termed a "magnetic wheel," provides a law of force which renders possible a static atom with electrons occupying fixed positions as pictured by Langmuir.

§ 6. THE STRUCTURE OF THE NUCLEUS

It is possible to refer only in the briefest way to that most interesting problem, the structure of the nucleus itself. For that the nucleus of a heavy atom is complex seems clearly proved by the emission of α and β particles (helium nuclei and negative electrons) from radioactive substances. Further, recent experiments of Sir Ernest Rutherford have shown that on passing rapidly moving α particles through nitrogen gas, particles are projected forward by the impact of the α particles on the nitrogen atoms, which can be identified as charged atoms of hydrogen. Thus it appears that the hydrogen nucleus is a constituent part of the nitrogen atom. Sir Ernest Rutherford suggests the name "proton" for the hydrogen nucleus, and the nucleus of any other atom may be regarded as formed of a certain number of protons bound together by the requisite number of negative electrons. It may be that the protons tend to arrange themselves in groups of three or four.

This return to Prout's hypothesis is supported by the very remarkable work of Dr. Aston on "positive rays." By an ingenious method he has been able, using an instrument which he calls a "mass spectrograph" to determine the atomic weights of the elements, and has shown that, taking oxygen as 16, the masses of the different atoms can be expressed as whole numbers. Thus chlorine, for which chemists had found an atomic weight 35·4, is found to be a mixture of two gases (isotopes) of atomic weight 35 and 37. The only exception to the whole number rule appears to be hydrogen itself, and it may be inferred that the formation of a helium nucleus by the combination of four protons and two electrons is accompanied by the liberation of a considerable amount of energy. It is perhaps idle to speculate on the possibility of utilising such energy, but it has been calculated that the conversion of 1 gram of hydrogen into helium would liberate enough energy to run a 2000 kilowatt motor continuously for more than four days. The fact that the hottest stars, when examined by the spectroscope, are found to contain little but hydrogen, helium and two unknown substances, may be of significance in this connexion. Possibly we are witnessing here the process of building up complex atoms from the simple elements. If that be the case, we have found the missing half of the cosmic cycle of which the opposite process—the breaking up of atoms—is already known to us in the disintegration of the radioactive elements.

THE EXISTENCE OF AMMONIUM HYDROXIDE IN SOLUTION

By PROF. T. S. MOORE

Professor R. M. Caven, in a recent article on "The Basic Strength of Ammonia and Allied Bases" (*Chemistry and Industry*, 1923, p. 164), states that it is "unlikely that in a N/100 solution of ammonia any but a small quantity of undissociated ammonium hydroxide exists," and his chief arguments in favour of this conclusion are:—(*a*) the compound NH_4OH has never been isolated; (*b*) no distinctive and recognisable properties attributable to NH_4OH are shown by aqueous solution of ammonia; (*c*) physical evidence derived from observations on solid ammonium compounds show that "in the series of alkali metals ammonium occupies a very high place near to caesium," so that ammonium hydroxide, if it exists at all, would be a very strong base and therefore practically completely ionised in dilute solution; and finally (*d*) that no information has been furnished as to the proportion of non-ionised ammonium hydroxide present in aqueous solution. The object of this article is to point out the weakness of these arguments and to offer some positive though indirect evidence that a considerable proportion of ammonia in dilute aqueous solution does exist in the form of an ionisable hydroxide.

Purely negative arguments such as those under (*a*) and (*b*) might be advanced against the existence of $(H_2O)_2$, and H_2CO_3 in aqueous solution, yet the indirect evidence for the existence of these compounds is generally thought to outweigh the absence of direct evidence. Such arguments have little weight against the evidence for the existence of ammonium hydroxide mentioned below.

The evidence on which argument (*c*) is based is that the pressure of aqueous vapour in equilibrium with the systems $CuSO_4 \cdot M_2SO_4 \cdot 6H_2O \rightleftarrows CuSO_4 \cdot M_2SO_4 \cdot 2H_2O$ (M=ammonium or univalent metal) at any one temperature, decreases as M travels along the series K, Rb, Tl, NH_4, Cs (Caven and Ferguson, *Chem. Soc. Trans.*, 1922, **121**, 1406); and that the order thus found is confirmed by the morphological and physical properties of the salts of the same radicles (Tutton, *Chem. Soc. Trans.*, 1903, **83**, 1049). The deduction from this evidence is best given in the exact words of the original paper (p. 1413):—"The present results may be supposed to relate directly to the basigenic properties of the metallic radicles concerned since they express the power conferred on the double sulphate molecule of retaining water of crystallisation against the dissociating influence of rising temperature. The inference therefore, is that the corresponding hydroxides stand in the following order of increasing basic strength: KOH, RbOH, TlOH, NH_4OH, CsOH."

No reason is given for thus connecting the power of retaining water of crystallisation with the basigenic properties of the metal, and that these properties are directly connected seems to be an arbitrary assumption. But if we assume such a relation and apply it to the series of double salts $CuSO_4$, M_2SO_4, $2H_2O$, we must conclude that caesium is the least basigenic of the radicles under consideration, for only the caesium compound of this type loses water below 100° C. (*loc. cit.*, p. 1407). Thus the basis of argument is obscure, and it leads to different conclusions when it is applied to the two different series of double salts.

As regards (*d*), a method for investigating the equilibria in solutions of ammonia and amines was published in 1907 (Moore, *Chem. Soc. Trans.*, 91, 1373) and developed and applied in 1912 (Moore and Winmill, *ibid.*, 101, 1635). The method is somewhat complicated and is subject to considerable error, but it is the only one yet published which allows of the determination of the equilibrium constants of the reactions involved. At 25° these constants were found to be:—

$$k_1 = C_{NH_4^{\cdot}} \times C_{OH'} / C_{NH_4OH} = 3{\cdot}41 \times 10^{-3}$$
$$k_2 = C_{NH_4OH} / C_{NH_3} = 1{\cdot}15.$$

(concentration in gm.—equivalents per c.cm.)

These numbers are calculated from, and therefore in agreement with, the electrical conductivity of solutions of ammonia, the partition coefficient of ammonia between water and chloroform, and the heat of neutralisation of ammonia. From them, using Perman's measurements of the partial pressure of ammonia above aqueous solutions (*Chem. Soc. Trans.*, 83, 1174, 1903), the heat of solution of ammonia in water was calculated to be 8460 cals., a value in excellent agreement with 8440 cals. found by Thomsen for the same concentration and temperature.

Calculation from these constants shows that in a N/100 solution roughly 51 per cent. of the ammonia is present as NH_4OH, 45 per cent. as NH_3 or a non-ionisable hydrate, and 4 per cent. as the ammonium ion. If the views put forward by Professor Caven had been correct, the concentration of NH_4OH would have been found very small or zero, k_1 very large or infinity, and k_2 very small or zero.

We have at present no experimental method for distinguishing between the alternative paths by which equilibrium could be reached. The application of the law of mass action to the equations put forward by Professor Caven leads to equilibrium equations identical in form with those derived from the older scheme $NH_3 + H_2O \rightleftarrows NH_4OH \rightleftarrows NH_4^{\cdot} + OH^1$, and the values of the constants involved have been found as already described. The physical significance of these constants—not their numerical values—will of course be different, according to the set of reaction equations used.

In any case there is definite evidence that ammonium hydroxide exists in solution and that it is a weak base.

Royal Holloway College, Surrey

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

The Passing of Sir James Dewar

removes one of the outstanding figures in the scientific world from our midst. He held a peculiar position by reason of his dynamic personality. Others will write of his scientific discoveries, but I prefer to think of his personality as I knew it. I think the leader writer of *The Times* summed up in a sentence what one would like to say:—"He was a great man, vigorous, kindly and combative." I wonder whether anybody else has been described as "kindly and combative," yet that is exactly what he was. To sit in that wonderful drawing-room of his and listen to his talk over the tea-table was a delightful experience. To hear him in his room downstairs pour out his wrath on some misguided individual was to realise how effective the English language can be in the mouth of a master. I recall a third phase, when on a particular occasion during the war, surrounded by nearly the whole Army Council, he demonstrated some of the properties of liquid air. The great ones sat as little children while for an hour they absorbed the information he gave them and only once, and then for a brief moment did the combative spirit break through and he became volcanic. His many kindnesses will be remembered by men all over the world long after his combats are forgotten.

The Development Committee

under the Dyestuffs Act is one of those Committees which you do not hear very much about. I met some of its members in a train in the North of England some weeks ago and again on the Underground in London recently. It appears that the Committee are personally inspecting all the dyestuff factories in the country and are noting the developments which are taking place. I understand that the dyestuff makers' representatives do not visit each other's works, but that Prof. Jocelyn Thorpe and Prof. Morgan, with the representatives of the Board of Trade, War Office and Admiralty and the Technical Advisers to the Committee, are making a very thorough investigation. I am assured that in some respects the amount of development which has taken place has exceeded the Committee's expectations. There are now eighteen firms engaged in the manufacture of dyestuffs, and while 75 per cent. of the total output comes from one firm, I am told that some of the smaller firms are not only doing valuable work in special dyestuffs, but are doing it in such a way as to earn high praise from members of the Committee.

The International Dye Position

is becoming more complicated day by day. The central factor in the problem is the fact that during the War the Allies were all compelled to increase their dyestuff factories to meet the requirements of their colour users. Hence to-day the amount of dyestuff plant in the world is probably as much as 50 per cent. in excess of the world's requirements. This excess of plant will have to be scrapped before prices can be got to a proper economic level. But the conditions vary in the different countries. In Switzerland I believe the plants are written down to practically nothing owing to the profits made during the war. In Germany the same applies and in addition there is the advantage of the exchange. England and America, however, are in the position of having to fight not only the German exchange, but the difficulty of not having sufficient orders to keep their plant running at an economic rate of production. Nevertheless, to supply 80 per cent. of the users' requirements is no mean feat, and although there are no dividends for the British dyemaker I hope he will not give up the fight.

Reparation Dyes

are also a perplexing subject at the moment. In accordance with the Treaty of Versailles the Allies are entitled to take a certain amount of German dyestuffs which they are supposed to require for their own use; there is, however, a grave suspicion at the moment that reparation dyestuffs are being sold at ridiculous prices by some of the Allies. One can quite see that if one of our Allies is in a position in which she knows she is not likely to obtain any cash from Germany but can obtain some dyestuffs, these dyestuffs having cost her nothing she is liable to sell at anything they will fetch. I believe quite a large quantity of German dyestuffs have gone from Italy to America recently and constantly such dyestuffs are finding their way from Belgium to England. This is a matter somebody ought to look into.

Colonel Jos. I. McMullen,

who has just left our shores, is a most interesting personality. He came over here as the representative of the United States on the Royal Commission on Awards to Inventors. I met him several times at various functions. He is one of those people who have gone about the world with their eyes wide open and have acquired an immense amount of information. He gave, however, as much as he received and was one of the most pleasing and efficient representatives who have come over from the States. His knowledge of chemical industry both in America and on the Continent is very wide and during the few months he was over here he managed to find time to have many talks, not only with our statesmen and politicians, but with industrialists as well.

FORTHCOMING EVENTS

Apr. 9. Royal Society of Arts, John Street, Adelphi, W.C. 2, at 8 p.m. "Nitrates from Air": E. K. Scott, M.I.E.E. Also on April 16 and 23.

Apr. 9. The Institution of Rubber Industry, Engineers' Club, Coventry Street, Piccadilly, W. 1. "Rubber Pigments," by Dr. D. F. Twiss.

Apr. 9. Society of Chemical Industry, *London Section*, at the Engineers' Club, Coventry Street, W. 1, at 8 p.m. (1) "The Cod-liver Oil Industry of Newfoundland," by S. S. Zilva and J. C. Drummond. (2) "A Study of the Separation of the Gases formed in the n-Butyl-Alcohol-Acetone Fermentation Process," by E. W. Blair, T. S. Wheeler and J. Reilly.

Apr. 9. The Ceramic Society, the Central School of Science and Technology, Stoke-on-Trent, at 7.30 p.m. "Black and Grey Flints," by A. Heath and A. Leese.

Apr. 10. Society of Chemical Industry, *Birmingham and Midland Section*, the University Buildings, Edmund Street, Birmingham, at 7 p.m. "Some Observations on the Activated Sludge Process," by F. R. O'Shaughnessy, A.R.C.Sc. "Some Studies in Catalytic Hydrogenation," by E. J. Lush, M.A.

Apr. 10. Institute of Metals, *Birmingham Local Section*, the Chamber of Commerce, New Street, Birmingham, at 7 p.m. Annual General Meeting.

Apr. 10. Institute of Metals, *North-East Coast Local Section*, Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. Annual General Meeting.

Apr. 11. Society of Chemical Industry, *Newcastle-on-Tyne Section*, The Chemical Lecture Theatre, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. "Fertilisers and Chemical Industries in relation to the Ruhr Situation and present conditions": Monsieur Braun.

Apr. 12. The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "The X-Ray Examination of Materials," by A. G. Warren.

Apr. 12. Society of Chemical Industry, *Ottawa Section*, University Club, Elgin Street, Ottawa, at 8 p.m. "Electrolytic Iron," by R. J. Trail.

Apr. 12. Institute of Metals, *London Local Section*, Institute of Marine Engineers, 85-88, The Minories, Tower Hill, E. 1, at 8 p.m. Annual General Meeting, followed by a paper on "The Surface Tension of Metals," by S. W. Smith, D.Sc.

Apr. 16. Society of Chemical Industry, *Yorkshire Section*, at the Queen's Hotel, Leeds. "Some Notes on the Production of Alkali by Bacteria as Registered by Different Indicators," by J. A. Reddie.

NEWS FROM THE SECTIONS

NOTTINGHAM SECTION

A meeting under the presidency of Mr. S. F. Burford, F.I.C., was held on March 21, and a paper on "A new derivative of Salvarsan" was read by Mr. L. Anderson, M.Sc. The discovery of atoxyl by Béchamp in 1863 and of its use in experimental trypanosomiasis by Thomas and Breiul and the proof of its composition by Ehrlich and Bertheim in 1907 led to a great outburst of research directed to the preparation and use of both aliphatic and aromatic arsenicals. In attempts to combine a maximum toxicity towards protozoal diseases with a minimum injurious effect to the host Ehrlich prepared 605 compounds before salvarsan or "606" was discovered. On account of the insolubility of the free base in water, salvarsan was introduced in the form of the dihydrochloride, which had to be brought to the correct state of alkalinity before injection. The compound 914 or neosalvarsan, the sodium methylene sulphinate of salvarsan, was discovered in 1911. These two drugs have been widely used in the treatment of syphilis, but were somewhat unstable and variable in composition, the percentage of arsenic in 606 varying from 29 to 31 as against the 34·1 per cent. required by the formula; neosalvarsan was even more indefinite in composition. Fargher and Pyman showed that commercial samples of 606 contained a small amount of sulphur, which may be present in the form of sulphamic acid, but is more probably attached to the nucleus as a sulphinic acid (King). A pure sample free from sulphur was, however, more toxic than those containing this element (Fargher and Pyman). The preparation of 914 from 606 was then described. Samples of 606 and 914 prepared in 1918 by a standardised process were tested physiologically, but no definite connexion was traceable between chemical composition and toxicity. The newer salvarsan preparations such as the co-ordination compounds with metallic salts suffered from the same disadvantages, *i.e.*, variability in chemical composition which could not be connected with variability in toxicity and instability, and necessitated preservation in sealed ampoules with an indifferent gas.

In 1920 it was noticed that under certain conditions salvarsan could form a compound with glucose, with a composition corresponding with that of a compound containing two molecules of glucose to one of salvarsan. Quite recently Mons. Aubry published a description of a salvarsan diglucoside, which agreed substantially with the present compound. The therapeutic activity was tested upon mice, which had been given a standard infection of *Trypanosoma equiperdum*. These tests proved that the maximum dose tolerated (0·6 mgm. per gram body weight) was twice that of neosalvarsan. The minimum curative dose was only slightly greater than that of good samples of neosalvarsan, and the ratio of curative dose to tolerated dose was one-twentieth for the glucoside and one-fifteenth for neo-salvarsan. Extensive clinical tests with the new preparation, which had been called stabilarsan, had been equally satisfactory.

In the discussion which followed, Mr. Wilkie described a method of determining arsenic in organic compounds, viz., ignition with acid magnesium nitrate, which converted the arsenic into the quinquevalent form. This was followed by reduction with iodides and titration. Dr. Marshall referred to the discovery by Ehrlich of the phloroglucinaldehyde and resorcinaldehyde derivatives of salvarsan which, however, were found to decompose too slowly. The author, in reply, gave his reasons for supposing that one molecule of glucose was attached to each amino group.

Dr. E. B. R. Prideaux then read an abstract of two papers, one in conjunction with Mr. A. O. Bentley, Ph.C., on the theory of acid-alkali equilibrium as applied to salts of fairly strong but sparingly soluble acids, and the application to the determination of total alkali and total acid in benzoates and salicylates. After a brief survey of pharmacopœial and other methods in use, an account was given of the equations by which the acidity could be determined in the case of fully neutralised benzoates and salicylates of the alkalis and the free acids themselves in their saturation, and lower, concentrations. Methods had been worked out for determining separately both the total alkali and the organic acid in sodium benzoate and salicylate and ammonium benzoate The total alkali was checked by ignition to carbonate in the first two cases and some modifications in the ignition procedure were suggested. The salts might be decomposed with a known excess of standard acid, followed by filtration of the organic acid and its titration. The acid filtrate might be either extracted with chloroform and titrated, or both mineral acid and dissolved organic acid determined by titration with an acid insensitive indicator and phenolphthalein successively, using a factor calculated from the constants. A much quicker method was also described, in which the titration was carried out in the same flask with chloroform, using bromphenol blue with benzoates, followed by phenolphthalein.

The results showed that samples might appear correct by the ashing test but might really contain an excess of alkali over organic acid. The above titrations were not so exact with salicylates, but a procedure was given by which these also could be analysed.

In the discussion Mr. Wilkie referred to an improvement in the ignition method, consisting in titrating the liquid containing the dark carbonaceous residue with acid, iodide iodate mixture and thiosulphate and starch. He also described a method by which salicylic acid was quantitatively precipitated as tri-iodophenol.

The second lecture to commemorate the foundation of the Sir Jesse Boot chair of chemistry at University College, Nottingham, was given by Professor F. S. Kipping, F.R.S., at the College on March 23. The lecturer dealt with the evolution of the cellulose industry. The nature and purification of the raw material, the production and properties of collodion, guncotton and other cellulose nitrate products, and of the various forms of artificial cellulose threads were illustrated by numerous experiments and slides. The lecture terminated with an appeal to manufacturers to devote some proportion of profits to the payment of research chemists as a form of insurance against such periods of depression as had now overtaken an important branch of the local industries.

GLASGOW SECTION

The annual meeting was held on March 23, Mr. W. E. Moodie, F.I.C., in the chair. The Hon. Local Secretary presented his annual report and submitted a financial statement. Mr. Douglas A. MacCallum, the representative of the section on the Glasgow Chamber of Commerce, reported on the work done by the Chamber during the past year, and was re-elected as the representative of the section. The following office-bearers and members of Committee were elected: *Chairman*, Mr. W. E. Moodie, F.I.C.; *Hon. Local Secretary*, Dr. J. A. Cranston; *Members of Committee*, Prof. R. A. Berry, Mr. R. M. Clarke, Mr. W. M. Cumming, and Prof. T. S. Patterson. It was decided to hold the meetings of the section at 6.45 p.m. on the last Friday of each month during the winter months. After the business meeting a smoking concert was held, at which members of the local section of the Institute of Chemistry were present.

MEETINGS OF OTHER SOCIETIES

OIL & COLOUR CHEMISTS' ASSOCIATION

A discussion on Mr. A. de Waele's paper on "Viscometry and Plastometry," read at the February meeting, took place on March 8.

The author referred to a further conception of plasticity in heterogeneous systems, in that this property may be of two kinds: that due to flocculation of the disperse phase to form a definite aggregated structure, and the plasticity obtaining in deflocculated systems. Green (*J. Ind. and Eng. Chem.*, 1923, February, Vol. 15, p. 122) had ascribed plasticity in all cases to flocculation of the disperse phase to an aggregated structure, but the author pointed out that increased viscosity in a system on introduction of a solid or liquid disperse phase when the latter remained truly dispersed as primary particles would be accompanied by the manifestation of plasticity as shown by the diminution of the exponent ϕ of Q from unity to a fractional value. The increase of viscosity in this case was explainable by the increased shearing of the adsorbed layer around the dispersed phase as the "free" continuous phase diminished in amount relatively to the latter. This adsorbed layer immediately surrounding the dispersed particles might well be assumed to possess a higher viscosity than the "free" continuous phase that did not come under the influence of surface forces due to the adsorbing or attractive effects of the disperse phase. An analogy to the change in physical properties suffered by the continuous phase on adsorption was seen in the loss of vapour pressure which resulted by introduction of disperse phase in many instances familiar to paint technologists, *e.g.*, wax in turpentine. The retardation in the rate of evaporation was not so manifest in flocculated systems which obviously might not be expected to have a large proportion of the medium present otherwise than in a "free" condition, *i.e.*, not affected by adsorption. The author's experience led him to believe that plasticity in non-flocculated systems was always characterised by close or diagonal piling and also possibly the complete absence of the slippage *régime* on shearing. Flocculated systems, on the other hand, depended mainly for their plasticity on the interlocking of the particles of the disperse phase to form a structure. The characteristic of such a structure was its temporary breaking down on shear to a deflocculated system, thus resulting in defying any attempt to obtain agreement in ϕ and ξ values characteristic of its "consistency" by mere comparison of these values through two or more differently dimensioned capillaries. Extrapolation of such values might, however, result in cutting out the deflocculating effect of the capillary, but this had not yet been tried. It was thus obvious that in such flocculated systems a definite force necessary to overcome the coherence of the structure would be shown on shearing through a capillary, a force possibly identical with Hardy's conception of static viscosity in dry friction, but its direct recognition as in Bingham's plastic-flow law was impossible.

The static force of coherence in flocculated systems was probably identical with the coefficient of elasticity, a factor which would have the effect, actually experimentally realised, of resulting in a greater diameter in the plug of material extruding on shear through a capillary than that of the orifice of the latter.

OPTICAL SOCIETY

Two papers were read at the meeting held in the Imperial College of Science on March 8, with Sir F. Dyson, presiding.

Mr. H. D. Taylor contributed a paper on "Optical Designing as an Art," in which he showed that the best optical designing is more than the mere mathematical calculation and execution of a specification. The points raised in the paper were illustrated by reference to lenses such as those of Cooke, worked out entirely from algebraic formulæ.

In the second paper Mr. T. Smith, M.A., described the distribution of corrected duties in optical instruments.

SOCIETY OF GLASS TECHNOLOGY

Prof. W. E. S. Turner, D.Sc., presided at the meeting held in the University, Birmingham, on March 21. The papers presented were all contributions from the Department of Glass Technology, the University, Sheffield.

The first paper, entitled "A Rapid Method of Testing the Durability of Glassware," by Mr. H. S. Blackmore, Miss V. Dimbleby, and Prof. W. E. S. Turner, was read by Miss V. Dimbleby, who was thus the first lady to read a paper before the Society. The test provided a simple and rapid method for determining whether a sample of glass would withstand weathering sufficiently to enable it to fulfil certain purposes. When a solution of one part in 1000 of the alkaloid narcotine hydrochloride was heated to boiling in a glass vessel, the alkaloid was thrown out of solution, and could be seen as a fine precipitate if the glass was of poor quality. If this occurred after heating for 10 minutes, the glass was to be condemned; if within 20 minutes, the glass, although better, was still unsatisfactory. Good glasses should not show any deposit after heating at boiling point for an hour. This test differed from all others in that it required no special chemical knowledge, could be carried out with very simple apparatus, and could be applied in any factory; it had been proved thoroughly satisfactory by many trials on all kinds of glassware.

The two other papers contributed were "The Corrosion of Fireclay Refractory Material by Glass and Glass-making Materials," by Mr. Donald Turner and Prof. W. E. S. Turner, and "The Effect of Saltcake in Corroding Fireclay Materials," by Miss Edith M. Firth, Mr. F. W. Hodkin and Prof. W. E. S. Turner. These two papers were taken together and presented by Prof. Turner, who detailed experimental evidence showing that in glass melting the corrosion of the pots or of the tank blocks was most severe during the early stages of the melting of the batch. The corrosion due to the glass itself was proved to be very much less. Of the glass-making materials, sodium nitrate, potassium nitrate, and borax were particularly corrosive. Resistance to corrosion could be improved by firing the pots or blocks at 1400° C. before inserting the charge of batch. At about 800° or 900° C. saltcake was not nearly so corrosive as soda ash. At the temperature of the melting furnace, however, it appeared to be more corrosive, and it was found that as the proportion of saltcake increased, so did the extent of corrosion, even in batches in which coke, as a reducing agent for the saltcake, was present throughout.

CORRESPONDENCE

THE FORMULA OF PHOSPHORUS PENTACHLORIDE

Sir,—The formula of phosphine, according to the octet theory, is written $\begin{array}{c}\mathrm{H}\\ \cdot\cdot\\ \mathrm{H}:\mathrm{P}:\\ \cdot\cdot\\ \mathrm{H}\end{array}$ The formula of phosphorus trichloride may be written analogously as $\begin{array}{c}:\ddot{\mathrm{Cl}}:\\ :\underset{\cdot\cdot}{\ddot{\mathrm{Cl}}}:\underset{\cdot\cdot}{\ddot{\mathrm{P}}}:\\ :\underset{\cdot\cdot}{\mathrm{Cl}}:\end{array}$ The latter formula assumes that phosphorus trichloride is not an electrolyte.

The formula of phosphorus pentachloride may be written $\begin{array}{c}:\ddot{\mathrm{Cl}}:\\ (:\underset{\cdot\cdot}{\ddot{\mathrm{Cl}}}:\underset{\cdot\cdot}{\ddot{\mathrm{P}}}:\underset{\cdot\cdot}{\ddot{\mathrm{Cl}}}:)\\ :\underset{\cdot\cdot}{\ddot{\mathrm{Cl}}}:\end{array}^{+}\ :\underset{\cdot\cdot}{\ddot{\mathrm{Cl}}}:^{-}$ which is analogous to that of ammonium chloride $\begin{array}{c}\mathrm{H}\\ (\mathrm{H}:\underset{\cdot\cdot}{\ddot{\mathrm{N}}}:\mathrm{H})\\ \mathrm{H}\end{array}^{+}\ :\underset{\cdot\cdot}{\ddot{\mathrm{Cl}}}:^{-}$

If this is correct, phosphorus pentachloride should be an electrolyte. I hope to test this point if a suitable solvent can be found.

Phosphorus oxychloride may be regarded as the result of combination of $\begin{array}{c}:\ddot{\mathrm{Cl}}:\\ :\underset{\cdot\cdot}{\ddot{\mathrm{Cl}}}:\underset{\cdot\cdot}{\mathrm{P}}:\\ :\underset{\cdot\cdot}{\mathrm{Cl}}:\end{array}$ with $\underset{\cdot\cdot}{\ddot{\mathrm{O}}}:$ giving $\begin{array}{c}:\ddot{\mathrm{Cl}}:\\ :\underset{\cdot\cdot}{\ddot{\mathrm{Cl}}}:\underset{\cdot\cdot}{\ddot{\mathrm{P}}}:\underset{\cdot\cdot}{\ddot{\mathrm{O}}}:\\ :\underset{\cdot\cdot}{\mathrm{Cl}}:\end{array}$

The tertiary amine oxides would then be $\begin{array}{c}\mathrm{R}_1\\ \mathrm{R}_2:\underset{\cdot\cdot}{\ddot{\mathrm{N}}}:\underset{\cdot\cdot}{\ddot{\mathrm{O}}}:\\ \mathrm{R}_3\end{array}$

Now Meisenheimer has obtained free methylethylphenylamine oxide in optically active form, and it has been suggested that the two valencies of the oxygen are satisfied by two unlike valencies of the nitrogen (*Ber.*, 1908, 3971).

If we adopt the formula $\begin{array}{c}\mathrm{Me}\\ \mathrm{Et}:\underset{\cdot\cdot}{\ddot{\mathrm{N}}}:\underset{\cdot\cdot}{\ddot{\mathrm{O}}}:\\ \mathrm{Ph}\end{array}$ oxygen appears to be linked by one valency only and the asymmetry may resemble more closely that of asymmetric carbon, than has been supposed, for the case of the tertiary amine oxides.—I am, Sir, etc.,

G. W. F. Holroyd

Blackburn
March 23, 1923

AN EMPIRICAL RULE FOR SUBSTITUTION IN BENZENE DERIVATIVES

Sir,—In view of the attention which is now being given to the electronic theory of valency, I think the following contribution may be of interest to your readers.

You will see that negative and positive groups are clearly defined, and that the rule introduces an arithmetical consideration into the difficult theory of substitution in the benzene derivatives, which makes it very simple to use. For these reasons it is likely to be of service to chemists.

Several rules have been brought forward by different authors to explain the influence of different groups in mono-substituted benzene derivatives, which directs the new substituent to the ortho and para, or to the meta positions.

The best known of these rules is that of Crum-Brown and Gibson; others have been formulated by Hübner, Noelting, Armstrong and Vorländer.

The rule given in this paper is based on the model of the atom known as the Thomson and Lewis-Langmuir atom; that is a system of electrons in concentric shells round a positively charged nucleus. The outermost shell of electrons contains those which are concerned in chemical reactions and impart to the element its characteristic property of valency. They are known as valency electrons. Elements in the same group in the Periodic Table have the same number of electrons in their outside shells, although they have different inner shells and nuclei.

The number of valency electrons for the first element in each group is as follows:—He O, Li 1, Be 2, B3, C 4, N 5, O 6, Fl 7. Hydrogen is unique and has only one electron besides its inner positive nucleus.

In accordance with Sir J. J. Thomson's theory of valency, atoms tend to surround themselves with octets of electrons. An atom can do this by adding on to its own valency electrons those of other elements, and Langmuir has applied this conception successfully to explain the combination of elements in chemical compounds. Lapworth and Robinson have extended the ideas. In their respective papers on the polarity of atoms, they have given a very comprehensive survey of the ways in which this conception can be used to elucidate the problems of organic chemistry. The rule given in this paper furnishes a practical illustration of the application of these views. The rule is:—If the number of valency electrons in the atoms of the group present in the benzene derivative be added together and those groups which have one less electron than the number required to make a whole number of octets be called negative groups and those with one more electron be called positive groups, then *negative groups lead to ortho para substitution and positive groups to meta substitution.*

A glance at the following tables will show that this is true of the majority of simpler groups :—

Negative Groups	No. of Electrons	Difference from whole number of octets	Substitution
—Cl	7	8—1	o. p.
—Br			
—I			
—OH	7	8—1	o. p.
$-CH_3$, *i.e*, 4+3	7	8—1	o. p.
$-NH_2$ „ 5+2	7	8—1	o. p.
—CNS	15	16—1	o. p.
—CNO			
$-CH_2COOH$	23	24—1	o. p.
$-NH.CO.CH_3$	23	24—1	o. p.

Positive Groups	No. of Electrons	Difference from whole number of octets	Substitution
—CN	9	8+1	m.
—COOH	17	16+1	m.
$-NO_2$	17	16+1	m.
$-COCH_3$	17	16+1	m.
$-SO_3H$	25	24+1	m.
$-C\ Cl_3$	25	24+1	m.

A consideration of the arrangement of the valency electrons within each of the above groups is outside the present scheme.

The ethylene linkage forms a special case. It is recognised that when two carbon atoms are joined by a double bond, four valency electrons are held in common by the octets of these atoms and two octets are formed from 12 electrons. Four electrons must, therefore, be subtracted from the total number of valency electrons of any group containing an ethylene linkage before deciding whether the group is negative or positive. Thus, $-CH{=}CH\ COOH$ in cinnamic acid has 27 electrons. If four are substracted this gives 23. It is a negative group and gives orthopara substitution. The same reasoning can be applied to linked methylene groups. Two electrons are shared and two octets are formed from 14 electrons —so two electrons must be subtracted in this case before applying the rule.

There are many groups not included under these two headings whose sum total of valency electrons is nearly half way between the numbers required for 1, 2, 3, 4, etc., octets.

The aldehyde group,—CHO, has 11 electrons, and groups with 13 electrons are very common, *e.g.*, CH_2Cl, CH_2OH, OCH_3, etc.

These groups give all three derivatives or mixtures of meta with ortho or para derivatives, but ortho and para, or meta derivatives will predominate according to whether the group is more nearly negative or positive. The aldehyde group with 11 electrons is nearer to 8+3, than to 16—5 and will give mainly meta derivatives. Probably the group entering may exercise a directing influence as well in these cases.

No explanation is attempted here of cases where tri derivatives are formed instead of di derivatives as in chlorinating aniline and phenol, of cases where only side chain substitution occurs, or of changes brought about by varying conditions of temperature.

I am extending the inquiry to other benzene derivatives.—I am, Sir, etc.,

Dorothy Hoffert

The Lister Institute, London

March 26, 1923

"CHEMIST" AND OTHER TITLES.

Sir,—While I fully sympathise with the President of the Institute of Chemistry as regards the common abuse of the title "chemist," I should like to point out that the grievance does not end there. If we are to stop abuses of the English language, there are other and equally glaring inaccuracies that call for attention.

One of these is the constant misuse of the title " Doctor." A Doctor is a man who holds a *Doctor's* degree, whether it be in medicine law, science, music or philosophy. There is a distinct movement on the part of the medical profession to monopolise the title, whether they possess a Doctor's degree or not. Every M.B. and every L.R.C.P., or even L.S.A., now calls himself " Doctor," and I have known some of them to put " Dr." on their visiting cards. I saw on a garage the other day the sign, " —— and Co., Motor Doctors " ! Medical men sometimes go so far as to refer to Doctors in other faculties as " Mr.," merely adding the letters of their degree.

As a large number of chemists hold the degree of Doctor, either in science or in philosophy, it is desirable in their interests that this should be insisted on as well as the title of " chemist."—I am, Sir, etc.,

" Doctor of Science "

March 26, 1923

THE MEANING OF THE WORD " GAS "

Sir,—Your reference to the etymology of the word ' gas ' in the last number of *Chemistry and Industry* raises an interesting point. The question of the derivation of some of our chemical terms may not be regarded by the pragmatists of the profession as of great import, but to those who are interested in the historical development of chemistry (and what a fascinating story it is !) it matters much, as only by an exact interpretation of the language of the pioneers can a clear impression of their views be obtained. In this connexion it is remarkable how an error (or perhaps a half-truth) once established, will persist throughout generations of text-books. The word ' gas ' is a case in point. I do not remember any text-book (except Mellor) that gives what I feel must be the correct derivation of the term. It is usually supposed to be derived from the German ' geist,' spirit, and to be cognate with our word ' ghost.' This is certainly a very attractive and, at the same time, satisfying theory, but it would have been a simpler transition had van Helmont (who, by the way, was a Belgian) adapted the Old English ' gast ' from which 'ghost' is derived. The admirable summary of the evidence given in Mellor's treatise seems to me entirely convincing. The Greek 'chaos' signified the confused mass of elemental substance, and also space or atmosphere. Paracelsus used the word with a similar meaning. It must be remembered that van Helmont considered water to be the primal substance, and it was to the vapour rising from water (as well as to his 'gas sylvestre') that he gave the name 'gas,' at the same time pointing out its analogy with the 'chaos' of the ancients. The term 'spirit' had been used for centuries to denote aëriform elastic fluids, and in the seventeenth century the word was in common use for several well-known gases. It is not surprising, then, that some should seek, quite ingeniously, to associate the new word with the German or Dutch equivalent for 'spirit.' I should add that the Oxford English Dictionary makes no mention of the Teutonic derivation of the word.—I am, Sir, etc.,

Leslie N. Brown

West Kensington,
March 19, 1923

PERSONALIA

Mr. G. E. Foxwell, M.Sc., has been awarded the annual bronze medal of the International Metallurgical and Chemical Society for his researches on the path of travel of the gases in the coke oven and for his work on ammonia. Mr. Foxwell is the chief chemist and physicist to the Koppers Coke Oven Co., Ltd.

Dr. L. H. Cretcher has been appointed head of an industrial fellowship at the Mellon Institute, Pittsburgh, to investigate the synthesis of chemicotherapeutic products.

Mr. W. F. Lantz has succeeded Mr. A. D. Shankland as chief chemist at the plant of the Bethlehem Steel Co., Bethlehem, Pa., and Mr. D. K. Pattillo has become research chemical engineer to the Western Electric Co., Chicago.

Doctorates of Philosophy of London University have been conferred on Mr. F. H. Mosharrafa for a thesis on the "Quantum Theory of Spectral Series"; on Mr. W. S. G. P. Norris for his thesis on the "Formation and Stability of Spirane Hydrocarbons"; and on Miss E. H. Usherwood for her thesis on the "Formation of Heterocyclic Rings involving Reactions with the Nitroso- and Nitro-groups in their various Tautomeric Modifications," and "Experiments on the Detection of Equilibria in Gaseous Tautomeric Substances."

* * *

The death is announced at the age of seventy-nine of Dr. Ernst Salkowski, director since 1880 of the Chemical Division of the Berlin Pathological Institute. Dr. Salkowski had published numerous researches on the metabolism of the carbohydrates, and his treatise on Physiological and Pathological Chemistry is widely reputed.

NEWS AND NOTES

BRITISH INDIA

Forecast of the Groundnut Crop, 1922-23

The total area returned in the final forecast of the groundnut crop in British India is 2,530,000 acres, the total yield being estimated at 1,157,000 tons of nuts in shell, figures which represent increases of 18 to 21 per cent., respectively, over those given in the final forecast for last year. The forecast relates to the provinces of Madras, Burmah and Bombay, which comprise 99 per cent. of the entire groundnut area of British India.—(*Ind. Tr. J.*, *Mar.* 1, 1923.)

CANADA

Hydro-Electric Progress in 1922

The Water-Power Branch of the Canadian Department of the Interior has published figures showing that during 1922 the total water-power installation in Canada rose to approximately 3,000,000 h.p. of which 240,000 h.p. was installed during the year. This figure does not include 190,000 h.p. installed during 1921, but brought into operation in 1922. Schemes are in progress which will ultimately develop over 1,000,000 h.p., thus showing that the utilisation of the water-power resources of Canada is continuously progressing. Among the chief developments of recent date are schemes to increase the output of existing plants in British Columbia, the development of the Manitoba Power Co. at Great Falls on the Winnipeg river, where the first unit of 168,000 h.p. was put into service in December last, and the rapid increase of the plant installed by the Ontario Hydro-Electric Commission at Queenston, as well as immense developments on the Saguenay river, and at Gres Falls on the St. Maurice river in Quebec. Hydro-electric development is also progressing steadily in the Maritime Provinces.—(*Bd. of Trade J.*, *Mar.* 22, 1922.)

SOUTH AFRICA

Matsap Pan: A Potential Source of Nitrates

The February issue of the *South African Journal of Industries* contains a report contributed by the Director of the Geological Survey on the Matsap Pan, situated in the Hague district. This Pan is remarkable in that it consists of an underground store of nitrate-bearing brine. Analyses of the brine from several boreholes show that over 4½ tons of actual nitrates, mostly sodium nitrate, are to be found in every 20,000 gallons of brine. Nitrate also occurs in other waters in the district, and this shows that underground water in that locality carries nitrates, the accumulation of salts in the pan being due to concentration of the solutions. It is stated that if the supply of brine were large enough, it might be economically possible to recover the nitrates, but this could only be ascertained by continuous pumping. Brine is already pumped in quantity from the depths of many South African salt pans, *e.g.*, the Britten pan, which yields 250,000 gallons a day. The separation of the nitrates is being investigated by a German chemist at Stassfurt. South Africa imports nitrates to the value of about £300,000 annually for the manufacture of explosives, and this should stimulate the exploitation of this new source of nitrates.

UNITED STATES

Magnesite in 1921

Magnesite is produced in the United States chiefly in California and in Washington, but production has ceased in the latter State. Sales of crude magnesite during 1921 amounted to 47,904 short tons, as against 303,767 t. in 1920, whereas imports of crude magnesite totalled 51,993 t. and of calcined magnesite 6788 t., of which the greater part came from Italy and Austria, and smaller amounts from Germany and Greece. The average consumption of crude magnesite in the United States was about 300,000 short tons per annum prior to the war.

Magnesium in 1921

The United States Geological Survey states that only one company, the American Magnesium Corporation, of Niagara Falls, reported a production of metallic magnesium in 1921, the output being 10,044 lbs., much less than in previous years. This output, as in 1920, was obtained incidentally in experimental operation in furnaces, and was derived from Californian magnesite. Small amounts of magnesium alloys, castings, and ribbon were also sold, but stocks at the end of the year exceeded the production of new material. The average price during the year was $1·60 per lb. for metal and $2·25 per lb. for powder. Imports during the year amounted to 39,913 lbs. compared with 29,275 lbs. in 1920, and the average price was brought down to $0·77 by German competition. Progress was made during the year in improving the purity of the metal, which, it is now claimed, can be produced commercially with a purity of 99·98 per cent. Future developments would appear to depend on the increasing use of magnesium alloys for engineering purposes.

FRANCE

The Dyestuffs Industry

Before the war, the French dyestuffs industry was but little developed, requirements being obtained either from branches of German factories situated in France, or imported. During the war, however, every effort was made to develop the industry and in 1920, 7400 m.t. of various dyestuffs was manufactured, an increase of 4400 t. over the output in the previous year. Of the production in 1920, 40 per cent. consisted of indigo, 35 per cent. of Azo dyes, and 21 per cent. of Sulphur dyes. Although roughly 5900 t. was imported, yet over 3000 t., consisting chiefly of indigo, was exported. In 1921, the production was only 5900 t., including 45 per cent. of indigo, 32 per cent. of Azo dyes, 3 per cent. of Di and Triphenylmethane dyes, and 14 per cent. of Alizarin dyes, the last-named appearing for the first time in the French production. Imports during 1921 were reduced to 1200 tons, representing 16·4 per cent. of the total consumption. Exports were also reduced, falling to 2700 tons. The range of dyes manufactured considerably increased, and allowing for the economic crisis, the production was satisfactory. The situation improved considerably in 1922, the average monthly production (612 t. in 1920 and 488 t. in 1921) rising to 670 tons, the increase being due not to the heavier production of old dyes, but to the manufacture of new ones, especially of Di and Tri-phenylmethane and Alizarin dyes. Exports decreased, but imports in 1922 represented only 15·3 per cent. of the total consumption. Considerable progress has thus been made in establishing the dye-making industry in France, but the difficulties which it has had to face have not entirely disappeared, the chief one being the fiscal protection necessary for a young and growing industry. But even fiscal protection can do little when faced with the enormous depreciation of the currency in competing countries, and a solution has yet to be found—(*Chim. et Ind., Jan.*, 1923).

GENERAL

Research in Cambridge

The third report of the Board of Research Studies announces that the number of research students has risen to 179. Of these about two-thirds are working on scientific subjects, chemistry and physics having the largest number, followed by botany, agriculture and bio-chemistry.

New Oilseed from the Gold Coast

A sample of Kisidwe nuts was shown at the National Rubber and Tropical Products Exhibition held in London in 1921. As no detailed examination of these nuts had previously been made, the possibility of using them as an oilseed was investigated at the Imperial Institute. The nuts appear to belong to a species of *Allanblackia*, probably *A. floribunda*, and have an oil-content equivalent to 44·2 per cent. of the entire nuts. They should therefore be utilisable as an oilseed if available in sufficient quantities. The fat could probably be used for food and certainly for soap-making. The removal of the shell, which is thin, and forms only 38 per cent. of the nut, would present no difficulty. As the residual meal has a bitter taste, this prevents its employment as a feeding stuff. The meal contains no alkaloids or cyanogenetic glucosides, but a small amount of tannin, which accounts for the bitter taste. —(*Bull. Imp. Inst.*, XX, *No.* 4, 1922.)

REVIEW

Dyes and their Application to Textile Fabrics. *By* A. J. Hall. *Pitman's Common Commodities and Industries. Pp.* ix +118. *London: Sir Isaac Pitman and Sons, Ltd.*, 1923. *Price* 3*s. net.*

Structural organic chemistry is ill-adapted to popular treatment and to produce a book which the non-technical reader will find " interestingly instructive " is no light task. Mr. Hall is, therefore, to be congratulated on his achievement. The book, however, is badly described by the title, as out of the 116 pages of text only 31 pages are devoted to the dyes, and of these 11 pages deal with the history of the subject. The main portion of the book is devoted to the application of the dyes, and although the descriptions are necessarily very brief they are lucid and might be read with advantage by many chemists who have not specialised in the subject. The description of printing processes, however, is too short and might be extended in the next edition.

As the chapters dealing with the dyes could hardly be followed by a reader completely ignorant of elementary chemistry the rather laboured explanations of chemical formulae might be omitted. The explanation of the term " molecule " (page 14) would probably mislead a reader completely ignorant of chemistry and such a reader would probably get quite a wrong idea of the determination of structure from the explanation that " chemists are able by special methods to *look* as it were into the molecule of a substance and *see* how it is built up." (The italics are the reviewer's).

Very few misprints have been detected, the most obvious being the statement on page 45 that *aqua regia* is a mixture of nitric and sulphuric acids. The printing and general get-up are excellent and the literary style satisfactory except for an occasional split infinitive and the author's irritating habit of commencing his sentences with " So," " And " and " But."

E. de Barry Barnett

REPORT

Report on the Economic Situation of the Republic of Ecuador, September, 1922. *By* W. C. Graham, *Acting British Consul-General, Quito. Department of Overseas Trade. Pp.* 22. *H.M. Stationery Office*, 1923. *Price* 9*d.*

This report on Ecuador opens on an even more hopeless note than the last (*see* J., 1921, 317 r), the present bad state of the country being attributed not only to decreased trading but also to the large and increasing public debt, and to faulty methods of collecting and disbursing the national revenue. The Minister of Finance has put forward a scheme for improving matters. The Government monopolies on alcohol, tobacco, explosives, and salt are leased to corporations or individuals, generally with disastrous results. The alcohol monopolists have the power, which they exercise, of restricting sugar-cane cultivation, and, though sugar might be one of the principal exports of the country, it now has to be imported. Petroleum regions are held by the State and leased out, little work being anticipated under the terms of the leases; the present annual production is about 40,000 barrels. New industries are favoured in the matter of taxation, and some few are being established A cotton print works is being set up at Quito, and a new cement works at Guayaquil will, it is hoped, produce about 60,000 barrels per annum.

The detailed trade figures given are for 1920. Exports during this period amounted to £4,989,193 (at the nominal rate of 10 sucres to the £, though the present figure is nearer 20), of which the United States took 55 and the United Kingdom 17 per cent., compared with £4,322,055 in 1919 (U.S. 46%, U.K. 17%). In 1920 as usual cocoa made up the bulk of the export trade, 46,780 metric tons being sent out of the country. Other items were ivory nuts, 23,099 t.; coffee, 1588 t.; tobacco, 374 t.; cotton, 210 t.; rubber, 139 t. Imports increased from £2,400,769 in 1919 (U.S. 70%, U.K. 14%) to £4,017,451 in 1920 (U.S. 58%, U.K. 24%). In 1920 the imports included cement, etc., £28,239; china and glass, £62,476; candles, £51,590; drugs and chemicals, £131,758; minerals and fuels, £979,861; paints, varnishes and enamels, £51,763; perfumery, etc., £85,934. Estimates for 1921 indicate that exports remain higher than imports, the former being valued at £3,396,889 and the latter at £2,348,619.

PARLIAMENTARY NEWS

Production of Morphia and Heroin

Answering Captain J. Hay, Mr. Bridgeman said that during 1921, 147,790 ozs. of morphine was manufactured in this country and 77,364 ozs. exported; the corresponding figures for heroin were 12,385 and 14,107 ozs. No figures were available to show the amount used in this country, but the balance would be disposed of for medical and scientific purposes through dealers licensed under the Dangerous Drugs Act.—(Mar. 22.)

Imports of Glassware

Sir P. Lloyd-Greame, in reply to Major Kelley, said that the declared value of glass bottles and jars imported into the United Kingdom during the first two months of 1923 was £133,248, and of other glassware £554,855. He had no information regarding the value of the output of such articles in this country during the same period.—(Mar. 22.)

Plantation Rubber Industry

Mr. Ormsby-Gore, answering Sir B. Chadwick, said that the Government intended to continue the policy initiated by the Colonial Secretary to safeguard the plantation rubber industry.—(Mar. 19.)

German Reparation (Recovery) Act, 1921

A motion by Capt. W. Benn to suspend the operation of the German Reparation (Recovery) Act was defeated by 144 votes to 77. In the discussion, Mr. Baldwin said that up to the present rather over £10,000,000 had been received in duties paid under the Act, so that we were receiving between £7,000,000 and £8,000,000 per annum, the only cash now paid in any form of reparations, except for maintaining the Army of Occupation.—(Mar. 26.)

Dyestuff (Import Regulation) Act

Replying to various questions, Sir P. Lloyd-Greame said that benzoic acid was an organic intermediate, and so came within the scope of the Act. He had no power to exempt any particular product from the operation of that Act, but licenses were granted for importation of quantities of benzoic acid shown to be required for purposes other than dye manufacture. When any dye could not be procured in this country, licenses to import were always given. He was satisfied that the Dyestuffs Advisory Licensing Committee commanded the confidence of the consumers generally. The Committee asked importers to state why their clients could not meet their requirements from British firms in order to give proper consideration to applications for licenses. The British Dyestuffs Corporation stated that no reparation dyestuffs had been sold by them in any way in Spain.—(Mar. 27.)

Ammonium Phosphates

Sir P. Lloyd-Greame, replying to Mr. H. Simpson, said he did not agree that the material largely used for fire-proofing was generally known in commerce as ammonium phosphate. Ordinary grades of this compound were removed from the dutiable list owing to opinions expressed by the Referee. No complaint as to the inclusion of ammonium biphosphate was received within the prescribed period, and he had no power to remove it from the list. Since the Act became law, a large British production had become available, and the price was now much less than when there was no British manufacture.—(Mar. 27.)

Arc-lamp Carbons

In answer to Mr. Hogge, Sir P. Lloyd-Greame said that inquiries were being made as to the position and progress in this country of all the industries covered by Part I. of the Safeguarding of Industries Act, including arc-lamp carbons. As part of these inquiries, the views of representative users of both British and foreign carbons were being sought. The duty paid on imported arc-lamp carbons during 1922 under Part I. of the Act was £5170.—(Mar. 27.)

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for March* 29)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Austria, etc...	Rubber, asbestos, and other raw materials, pig iron, iron plates..	398
British East Africa	Disinfectants, wood preservatives ..	391
Bulgaria ..	Medicaments	10222/F.E./C.C./2
Canada ..	Druggists' supplies ..	392
" ..	Tinfoil, glass bulbs for electric lamps ..	393
Esthonia ..	Chemicals, oils, paint, varnish	401
France ..	Linseed oil	402
Netherlands ..	Refractories, earthenware	405
New Zealand	China, earthenware, glassware	396
Rumania ..	Porcelain insulators (tender for)	10335/F.E./E.C./2
South Africa..	Pyridine, Simonsen's oil, wood naphtha for denaturing alcohol ..	10856/E.D./C.P.
United States	Iron and steel material, tinplate, etc.	18677/F.W./E.C./B./2

TARIFF CUSTOMS EXCISE

Belgium.—The issue for March 29 contains a translation of the proposed new customs tariff.

Egypt.—Revised valuations have been issued for use in assessing the duties on imports of non-ferrous metals.

France.—The exportation of molasses is prohibited.

Germany (*Occupied*).—A summary of the regulations concerning trade control and tariffs in force in the occupied territory is given in the issue for March 29.

Mauritius.—An increased import duty is payable on tinctures not prepared according to official formulæ.

Poland.—The surtax on the duties payable on blown glass, acetic acid, wood spirit, and acetone has been increased to 299,900 per cent.

South Africa.—Preparations containing one-fifth or more per cent of anhydrous morphine are now classed as habit-forming drugs under the regulations controlling the importation and sale of such drugs.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acid Acetic, 40% tech. ..	£23-£25 per ton. Very firm with little available. Complete absence of German supplies.
Acid Hydrochloric ..	4s.-5s. carboy.
Acid Nitric	£24 per ton. No signs of improvement.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d.-£8 per ton. Steady demand. Continental inquiries more frequent.
Arsenic (White) ..	£70-£75 per ton. Market steady.
Bisulphite of Lime ..	£7 per ton. Packages extra.
Bleaching Powder ..	£10 10s. d/d. No change. Spot demand poor.
Calcium Chloride ..	£6 per ton d/d.
Copper Sulphate ..	£27 per ton. Somewhat firmer.
Potash Caustic, 88/90%	£35 per ton. Considerably advanced in value. No German supplies.
Potass. Bichromate ..	5¾d. per lb. d/d. buyer's works.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton. Normal.
Soda Caustic, 76% ..	£20-£21 per ton. Demand good, especially for the Continent.
Soda Crystals	£5 5s. carr. paid. No change. Demand quite good.
Sod. Bicarbonate ..	£10 10s. per ton.
Sod. Acetate, 97/98% ..	£25 per ton.
Sod, Bisulphite Powder, 60/62%	Ton lots. £19 .. 10 £19 10s. 5 £20 .. 2 £20 10s. 1 F.o.b. or f.o.r. London, 1-cwt. iron drums incl'd.
Sod. Chlorate	3d. per lb. Demand not quite so brisk with better supplies.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, conc. ..	£15 conc. solid carr. paid. Better demand.
Sod. Sulphite— Pea Crystals	Ton lots. £17 .. 2 £17 10s. 1 1-cwt. wooden kegs included.

WOOD DISTILLATION PRODUCTS

Acetate of Lime Brown	£10 per ton d/d.
,, ,, Grey ..	£20 per ton d/d.
Acetate of Lime Liquor	9d. per gall., 32° Tw.
Iron Liquor	1s. 6d. per gall., 32° Tw. 1s. 2d. per gall., 24° Tw.
Red Liquor	1s. 3d. per gall., 14/15° Tw.
Wood Creosote	2s. 6d. per gall., unrefined. Lower prices, however, are asked in some quarters.
Wood Naphtha—	
Miscible	6s. 6d. per gall., 60% O.P.
Solvent	5s. per gall., 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead ..	£39 per ton d/d.

TAR PRODUCTS

Acid Carbolic, crystals..	1s. 7d.-1s. 8d. per lb. Practically no change. Market well maintained for next two or three months.
,, ,, crude 60's	4s.-4s. 4d. Demand good. Business still being done at lower figure, but higher prices spoken of in some quarters.
Acid Cresylic, 97/99 ..	1s. 11d.-2s. 3d. Fair enquiries for forward delivery.
,, ,, pale 95%	1s. 10d.-2s. 2d. Moderate enquiry.
,, ,, dark ..	1s. 6d.-1s. 11d. Fair demand.
Anthracene Paste, 40%	4d. per unit per cwt. Price still nominal. No business.
Anthracene Oil—	
Strained	9¾d.-11d. gall. Fair enquiries.
Unstrained	9d. per gall.
Benzole, crude, 65's ..	1s. 1d. per gall.
Benzole, standard motor	1s. 6½d.-1s. 8d. per gall.
Benzole, pure	2s.-2s. 3d. per gall.
Toluole, 90%	1s. 9d.-1s. 11d. per gall. Little demand.
Toluole, Pure	2s. 2d.-2s. 6d. per gall. Market firm.
Xylol	3s. 3d. per gall.
Creosote—	
Cresylic, 20/24% ..	11d.-1s. 1d. Prices still steady.
Middle Oil	8¾d.-9½d. per gall. Good demand.
Heavy..	
Standard specification	
Naphtha, crude.. ..	9d.-9¼d. per gall.
,, Solvent 90/160	1s. 7d.-1s. 9d. Very little business doing.
,, Solvent 90/190	1s. 6½d.-1s. 7½d. Market still steady.
Naphthalene—	
Crude, drained Creosote salts	£7-£9. Good demand, market firm.
Crude, whizzed or hot pressed	£11-£12. Numerous enquiries for forward delivery.
Pitch, medium soft ..	185s.-200s. per ton. Market active.
Pyridine, 90/140 ..	11s.-12s.
,, heavy.. ..	8s.-9s. per gall. Price still nominal—no business.

INTERMEDIATES AND DYES

Acetic Anhydride ..	1s. 5d. per lb.
Acid H.	5s. lb. 100% basis d/d.
Acid Naphthionic ..	2s. 7½d. lb. ,, ,, ,,
Acid Neville & Winther .	6s. lb. ,, ,, ,,
Acid Sulphanilic ..	1s. 6d. lb. ,, ,, ,,
Aluminium Chloride anhydrous	1s. per lb. d/d.
Aniline Oil & Salts ..	9½d. lb. naked at works.
Antimony Pentachloride	1s. 1d. lb.
Benzidine Base	6s. 6d. lb. 100% basis.
Benzyl Chloride ..	1s. 4½d. ,, ,, ,,
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. lb. 100% basis.

p-Dichlorbenzol	£55 per ton.
Dinitrobenzene	11d.-1s. lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene 48/50	8d.-9d. naked at works.
66/68	1s. 2d.-1s. 3d. naked at works.
Diphenylamine	3s. 2d. lb. d/d.
Dichloraniline	2s. 2d. lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. lb. d/d. packages extra.
Metanitraniline	5s. 6d. lb. d/d.
Monochlorbenzol	£70 per ton.
α-Naphthol	2s. 9d. lb.
β-Naphthol	1s. 1d. lb. d/d.
α-Naphthylamine	1s. 6½d. lb. d/d.
β-Naphthylamine	4s. lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d.-8d. per lb.
Nitronaphthalene	1s. lb. d/d.
o-Nitrochlorbenzol	2s. lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. lb. 100% basis.
p-Nitro-*o*-amidophenol	4s. 6d. lb. 100% basis.
m-Phenylene Diamine	5s. 6d. lb. d/d.
p- „ „	12s. 6d. 100% basis d/d.
Sod. Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. lb. d/d.
m-Toluylene Diamine	5s. lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid Acetic 80%	£52 10s. Position firm.
Acid Acetyl Salicylic	2s. 11d.-to 3s. 3d. per lb. Now quoted on a firmer market. Supplies restricted.
Acid Benzoic	2s. 3d. per lb. Steady and in good demand.
Acid Boric	Unchanged.
Acid Citric	1s. 8½d. per lb., less 5%. Market steady.
Acid Gallic	3s. per lb. for 2-cwt. lots. 3s. 3d. per lb. for 56 lb. lots.
Acid Pyrogallic, cryst.	5s. 9d. per lb. Price advanced.
Acid Salicylic	2s.-2s. 6d. per lb. Very firm. Several makers cannot book further orders for some time.
Acid Tannic	3s. 3d. per lb. is the present limit.
Acid Tartaric	1s. 2½d.-1s. 3d., less 5%. Tendency continues to be upward and the volume of business is greater. Foreign makers are following the English market and have raised their prices.
Acetanilide	1s. 6d. per lb. Unchanged owing to lack of any considerable demand.
Ammon. Benzoate	3s. per lb. This price will soon have to be advanced in common with other benzoates.
„ Carbonate, B.P.	£37 10s. per ton. nett.
Atropine Sulphate	12s. 6d. oz. Steady.
Barbitone	14s.-17s. 6d. per lb. Very much advanced. Some holders are asking still higher prices.
Benzonaphthol	3s. 3d. per lb. Still further reduced.
Bismuth Salts	Unchanged. Good steady market.
Bromides	All very firm. Prices on the Continent continue to advance.
Calcium Lactate	2s. 3d. per lb. with prices hardening upwards.
Chloral Hydrate	4s. 3d. per lb.
Chloroform	2s.-2s. 3d. per lb.
Creosote Carbonate	10s. per lb.
Formaldehyde 40%	£88 to £90 per ton.
Guaiacol Carbonate	7s. 6d.-8s. 6d. per lb. now quoted in view of more demand having arisen.
Hexamine	4s. 6d. per lb. would now be wanted for quantity.
Homatropine Hydrobromide	30s. per oz.
Hydroquinone	3s. 3d.-3s. 6d. per lb.
Iron Ammon. Citrate	2s. 5d. per lb. for 1-cwt. lots.
Iron Perchloride	£20 to £22 per ton.
Magnesium Carbonate	
Light comml.	£38 per ton.
Magnesium Oxide—	
Light comml.	£85 per ton.
Heavy comml.	£28 per ton.
Menthol	32s. for original cases. Smaller quantities 33s. per lb.
Methyl Salicylate	2s. 6d.-2s. 8d. per lb. in glass containers.
„ Sulphonal	13s. 6d. per lb. now quoted.
Mercurials	Unchanged but still very firm
Paraformaldehyde	4s. per lb., advanced.
Paraldehyde	1s. 6d.-1s. 8d. per lb.
Phenacetin	6s. 6d. per lb. is now quoted being an appreciable advance on previous rates.
Phenazone	7s. 6d. per lb., now wanted.
Phenolphthalein	5s. per lb. firming up again.
Potass. Bitartrate 99/100% (Cream of Tartar)	95s.-98s. per cwt. less 2½% demand good.
Potass. Ferricyanide	4s. per lb.
Potass. Iodide	15s. 8d. per lb. for cwt. lots. Good steady demand.
Potass. Permanganate	10d. per lb. is now the minimum price for quantity.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz.
Resorcin	5s. per lb.
Salol	2s. 6d.-3s. 3d. per lb. now quoted.
Silver Proteinate	9s. 6d.-10s. per lb.
Sod. Benzoate	2s. 3d. per lb., with greatly increased quotation from Germany.
Sod. Citrate	U.S.P. quality 2s. 2d. for cwt. lots.
Sod. Hyposulphite, Photographic	£14 15s. for 5-ton lots.
Sod. Potass. Tartrate (Rochelle Salt)	80s.-82s. cwt. Poor demand.
Sod. Salicylate	2s. 5d. per lb. for powder, 2s. 6d. for crystal. The position remains unaltered.
Sod. Sulphite Anhydrous	£27 10s.-£28 10s. per ton according for quantity, f.o.r. London drums included.

Sulphonal	13s. per lb. is the present value.
Tartar Emetic ..	1s. 4d. per lb. Unchanged.
Thymol	19s. per lb. for good white crystals. Lower prices would be accepted for quantity.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	12s. ,, ,,
Amyl Acetate	2s. 6d. ,, ,,
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate ..	3s. 6d. ,, ,,
Anethol (melting point 21/22°C.)	4s. 3d. ,, ,,
Benzyl Acetate from chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate, 19.5°C.	3s. ,, ,,
Cinnamic Aldehyde—	
98/100% Natural ..	14s. 9d. ,, ,,
Coumarin	16s. ,, ,, advanced.
Citronellol	22s. 6d. ,, ,,
Citral, 100%	9s. 6d. ,, ,,
Ethyl Cinnamate ..	18s. 6d. ,, ,,
Ethyl Phthalate ..	4s. 3d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa) ..	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	7s. 6d. per lb.
Iso Eugenol	17s. ,, ..
Linalol ex Bois de Rose ..	21s. .. ,,
Linalyl Acetate	22s. 6d. ,, ,,
Methyl Benzoate ..	8s. 6d. ,, ,,
Musk Ketone	35s. ,, ,,
Musk Xylol	9s. ,, ,,
Phenyl Ethyl Acetate ..	10s. ,, ,,
Phenyl Ethyl Alcohol ..	17s. 6d. ,, ,,
Rhodinol	45s ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	24s. 6d. ,, ,, advanced.

ESSENTIAL OILS

Almond Oil, foreign, S.A.P.	13s. 6d.-16s. per lb.
Anise Oil	2s.-2s. 1d. per lb. spot, 1s. 10½d. c.i.f. forward. Very quiet indeed.
Bergamot Oil	12s. 6d. per lb. spot. Will probably advance with the improvement in the lira.
Bourbon Geranium Oil ..	28s. per lb. spot. Substantial grounds for the advance difficult to find. Will probably decline when new crop comes to hand.
Camphor Oil, White ..	82s. 6d. per cwt. Quiet.
Cananga Oil, Java ..	9s.-10s. 6d. per lb. Quiet.
Cinnamon Oil, leaf, Ceylon	4d.-4½d. per oz.
Cassia Oil	8s. 3d. per lb.
Citronella Oil—	
Java	3s. 10d.-4s. 1d. per lb. Very firm.
Ceylon	3s. 4½d. per lb.
Clove Oil	7s. 9d.-8s. 6d. per lb. Quotations vary daily owing to fluctuations of the spice.
Eucalyptus Oil	1s. 6d.-1s. 9d. per lb. Steady but not much doing.
Lavender Oil—	
Mont Blanc	12s. 6d.-13s. per lb. for high grade oil. Expected to go dearer.
Lemon Oil, spot ..	3s. per lb., 3s. c.i.f. forward.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet, spot ..	10s. 6d. per lb. Distinctly a good market.
Otto or Rose Oil ..	20s.-32s. per oz., according to quality. A large quantity of very inferior otto offering.
Palma Rosa Oil ..	17s. per lb. Steady.
Peppermint Oil—	
English	70s.-80s. Quiet.
Wayne County ..	13s.-13s. 6d. spot, easier forward.
Japanese	6s. 6d.-6s. 9d. per lb.
Petitgrain Oil, Paraguay	7s. per lb. Flat.

TRADE NOTE

Sale of Plant

We call the attention of our readers to the important sale of plant and machinery announced on p. viii. The sale is to be held on the 24th, 25th and 26th inst. by direction of the Disposal and Liquidation Committee, which has appointed Mr. M. Marshall, of Glasgow, as auctioneer.

PUBLICATIONS RECEIVED

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Mineral Resources of the United States in 1921 (Preliminary Summary). *Introduction by* G. F. Loughlin. *Statistics assembled by Martha B. Clark. Pp.* iv+1a—101a.

Peat in 1921. *By* K. W. Cottrell. II:3. *Pp.* 13—14.

Phosphate Rock in 1921. *By* K. W. Cottrell. II:12. *Pp.* 65—68.

Platinum and Allied Metals. *By* J. M. Hill. I:15. *Pp.* 143—149.

Potash in 1921. *By* M. R. Nourse. II:11. *Pp.* 51—63.

Quicksilver in 1921, with a Supplementary Bibliography. *By* F. L. Ransome. I:12. *Pp.* 107—120.

Salt, Bromine, and Calcium Chloride in 1921. *By* K. W. Cottrell. II:20. *Pp.* 117—123.

Sand and Gravel in 1921. *By* L. M. Beach. II:24. *Pp.* 147—154.

Secondary Metals in 1921. *By* J. P. Dunlop. II:16. *Pp.* 151—166.

Slate in 1921. *By* G. F. Loughlin and A. T. Coons. II:7. *Pp.* 23—30.

Sulphur and Pyrites in 1921. *By* H. A. C. Jenison *and* H. M. Meyer. II:26. *Pp.* 169—173.

Talc and Soapstone in 1921. *By* E. Sampson. II:17. *Pp.* 97—103.

Tin in 1921. *By* B. Leroy Johnson. I:10. *Pages* 71—73.

Zinc in 1921. *By* C. E. Siebenthal *and* A. Stoll. I:5. *Pp.* 21—33.

Cement in 1921. *By* B. W. Bagley. II:28. *Pp.* 215—228.

Gold and Silver in 1921 (General Report). *By* J. P. Dunlop. I:26. *Pp.* 429—466.

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EDITORIAL

THE title " Chemist " will form a splendid topic for a discussion, and a round-table conference such as is suggested by the President of the Society of Chemical Industry, should disclose a great variety of opinions. A preliminary exchange of views in these columns would, perhaps, save a little time. As no one can foretell the occasion when Parliament will, at the end of a session, adopt a hastily drafted phrase, including this term, as a compromise which will enable a bill to be rushed through in two or three crowded hours of a glorious life, the point is one not merely of metaphysical interest. There are at least two alternatives ; an effort may be made to put the word " chemist " into the same sort of category as " barrister-at-law," " solicitor," " civil engineer," or " dentist " ; on the other hand, some would like the word to be comparable with geologist, mathematician, or physicist. There are both advantages and disadvantages associated with either alternative, but the confusion between the two main uses of the word is at the moment less than might be expected. The chemists who are our readers form a social society, apart from the chemists, who dispense drugs, cough mixtures, and fragrant dentifrices. Each society uses the word in the particular sense usual in the circle and the two but rarely meet.

* * *

There are three bodies very intimately concerned in the skill and responsibility of the chemist who does not keep a shop. Such chemists are usually (i.) teachers ; (ii.) persons employed by a firm, or (iii.) consultants and analysts accessible to the public, and employed by a variety of firms or individuals. The requirements of these three are very different. Our universities commonly elect chemists on to their staffs either because they can make great discoveries which will bring renown to the university, or because they have the divine and rare art of teaching. It matters but little to the academic world whether the word " chemist " is rightly or wrongly applied to the professor, or to the vendor of patent medicines. Nor is it a matter of much consequence by what title a man is designated who is employed by one firm, whether in the most important, or an inferior capacity. If Messrs. A. B. and Co. employ as a chemist a man who has so little knowledge that no professional certifying body would admit him, that is primarily the concern of Messrs. A. B. and Co., and the man himself and we can imagine circumstances where the genius, tact, shrewdness or commonsense of the man would make him very valuable in a works. It is where the chemist is brought into contact with the public that the matter becomes of importance.

* * *

Any member of the public who consults a solicitor, and any solicitor who consults a barrister, can rely on a certain degree of professional knowledge. Negligence on the part of the lawyer is promptly punished. But no rules can ensure the existence of industry, sound judgment or skill in advocacy. Surely it must be the same in other professions in which men engage ; a title or a degree is strong presumptive evidence that a man has that minimum degree of knowledge, or that excellence of memory which enables him to pass a qualifying test, it is no guarantee of the power of looking into the future, of devising some ingenious way of evading an insuperable difficulty, or of that long experience which doth attain to something like prophetic strain. It is not quite apparent from the communications we have received, whether the true chemists wish to have for their own gratification, the title " chemist," implying some specified degree of knowledge, or whether they are desirous that the druggist shall cease to call himself a chemist or whether their real purpose is not that the man in the street, and especially the journalist, shall realise that there is a large and increasing body of chemists who are not concerned in any way with drugs, nor interested in infallible corn-plasters or blue pills. There are, of course, many important considerations we have not alluded to, and we think a full discussion of the matter, where a great variety of diverse opinions would be represented, would be full of interest.

ARTIFICIAL FATS AND FATTY ACIDS

By REX FURNESS

The problem of the technical production of fatty acids by true synthesis or by the oxidation of mineral oil fractions continues to attract interest, although the application of such fatty acids in the production of synthetic fats is perhaps not so energetically pursued to-day as it was at a time when edible fats were relatively scarce. The artificial production of a natural raw material in the factory always possesses an attraction for the chemist, and he automatically associates the problem of the manufacture of artificial fats and fatty acids with those of artificial silk, synthetic indigo and other triumphs of chemical technology. It might be as well, at the outset, to ask him to keep in mind also artificial or synthetic rubber, artificial cotton and similar materials, which, although undoubtedly capable of production, are outside the realm of economical technical manufacture.

There are four main considerations which must be discussed in the survey of the possibility of manufacturing fat substitutes and artificial fatty acids, namely :—

1. Truly synthetic fatty acids—made, say, from ethylene, acetylene, etc., or by the Grignard reagent from chloro derivatives of mineral oil fractions—cannot be manufactured at a sufficiently low cost. (*Cf.*, the analysis made by the writer, J.S.C.I., 1921, p. 63 R.)

2. The composition of mineral oils is still obscure, but recent investigations point very clearly to the relative absence of straight chain hydrocarbons from which to obtain fatty acids such as stearic, palmitic, oleic, etc., by cracking and oxidation. Empirical and opportunist investigation has indeed produced a fatty acid mixture from paraffin wax, and many are the contradictory claims made in this connexion. Practical scale production has not, however, been realised in Germany.

The problem is now being attacked in a more rational and scientific manner, and the laborious task of characterising the constituents of mineral oils, paraffin wax, etc., is well begun. Oxidation of definite hydrocarbons or hydrocarbon mixtures may lead to acids, which even if not identical with commercial straight chain acids, may find useful industrial applications.

3. Granting, for the moment, that artificial fatty acids could be produced economically, there still remains the question of esterification to produce fats, or fat substitutes. It is true that the esterification itself presents little difficulty, whether glycerin, glycol, ethyl alcohol, or a carbohydrate be employed, but the physiological value of the war-time German "esterol," or of the mannitan dioleate of Lapworth and Irving is indeterminate, as yet. Moreover, cost considerations again become vital, and it is clearly impossible at present to use glycerin, glycol or carbohydrates, for the production of fats from artificial fatty acids, at a price comparable with that at which natural oils and fats can be sold.

It should here be remembered that fatty acids themselves are not required to the same extent as are their esters, the glycerides, in modern industries. The glycerides or their equivalents are used in the paint and varnish industry, in the linoleum industry and in the leather industry, whilst compound lubricating oils require glycerides and not fatty acids, except for the small amount consumed in making compound oils by the Wells-Southcombe process, where a fraction of the amount of glyceride formerly employed is taken in the form of fatty acid. The edible oil trade demands glycerides, of course, and although soaps can be made from fatty acids by direct neutralisation by soda ash, the general public demands the brighter looking soap produced from the glycerides in the ordinary soap boiling pan. Fatty acids are required, however, in the candle-making business and in textile manufacture.

Thus, without going into a detailed examination of the matter, it will be clear that the main consumers of fat products demand the glycerides, and a successful process for fatty acid production from hydrocarbons would necessarily have to be followed by an equally successful and economic process of esterification. It may be possible to utilise fatty acid anhydrides—as edible products, but even so, technical production is difficult, and anhydrides could not be applied to the linoleum, paint or soap trades.

4. The production of natural oils and fats can be almost indefinitely increased. Improvements in seed selection, plant culture, fertilisers, insecticides, fungicides and germicides, and in all the phases of the art of arboriculture are constantly being made, and the price at which a natural oil or fat can be produced is steadily decreasing as oil yields increase. The supply is, moreover, annually reproduceable.

The technique of refining processes, hydrogenation processes, and other methods of transformation of natural oils is sound, and its scope is extending. Thus, it is claimed that drying oils can be made from semi-drying oils by dehydrogenation.

The supply of refined and unrefined, vegetable and animal, including marine animal, oils is capable of so great an economic expansion as to provide an almost insuperable barrier to the synthetic glyceride process, particularly if the fatty acids used in the latter process are to be made artificially.

It is proposed to discuss in some detail the second and fourth phases of the question, as indicated above, since the production of suitable fatty acids from such a cheap and plentifully available raw material as mineral oil is fundamental, and the solution of this problem must precede any attempt to manufacture cheap glycerin—say, by fermentation of sugar-glycol, ethyl alcohol; or "power" alcohol from ethylene, acetylene, or by fermentation of biologically saccharified cellulose, or of cheap starch-bearing plants.

The maximum extent to which production costs in respect of natural oils and fats can be lowered is also basic and relevant to the whole problem.

FATTY ACIDS BY HYDROCARBON OXIDATION

The lure of the cheap and plentiful petroleum oil fractions as a starting material for the manufacture of fatty acids by oxidation has been responsible for much sporadic experimentation. No practicable process has yet been evolved, although the published results of some investigations would appear to be promising.

The problem of the composition of natural mineral oils and waxes and of paraffin wax is now receiving careful study, and the investigations only serve to emphasise the difficulty of technical fatty-acid production from this source.

Several primary obstacles stand in the way of the development of a technical process for fatty acid production from mineral oils and similar materials, namely :—

1. The relative absence of straight chain hydrocarbons, and the differences in the behaviour of different components upon oxidation.
2. The apparent impossibility of stopping the oxidation at a stage when fatty acids alone are present or at a stage approximating to this sufficiently nearly.
3. The physical properties of fatty acids and fatty acid mixtures at present in use in soap making, candle making, etc., are known, following close investigation, and it is clear that unless identical acids and mixtures become available, that is, unless straight chain acids can be produced artificially, the natural acids will continue in favour.

THE COMPOSITION OF MINERAL OILS

It is becoming more and more realised that mineral oils, flowing from wells in different parts of the world, contain complex mixtures of hydrocarbons amongst which normal paraffins form but a small proportion. Even such a traditionally "straight-chain" petroleum as Pennsylvania crude has been shown by Mabery to contain a relatively small proportion of normal paraffin constituents. Naphthenic and polynuclear hydrocarbons are present, so that bromination number tests which indicate different degrees of unsaturation do not necessarily indicate the presence of easily oxidisable olefinic, straight chain hydrocarbons. Dunstan has indicated the impossibility of hydrogenating unsaturated mineral oils by the Sabatier-Senderens method, which, of course, is universal in its applicability to the ethylene bond compound. "Cracked" petroleums can, however, be hydrogenated, but the position of the double bond already existent in mineral oils or produced in an attempted cracking-oxidation process is so indeterminate that hope of the production of definite fatty acids by oxidation at the double bond can scarcely be entertained at present.

Francis (*J. Chem. Soc.*, 1922, pp. 496, 1529 and 2804) has demonstrated, after laborious experiments, that paraffin wax probably contains considerable amounts of hydrocarbons which are certainly not the normal, straight chain paraffins of our text-books.

Similarly, Granacher (*Helv. Chim. Acta*, 1920, 3, 721) finds the behaviour of paraffin and synthetic hendecane so different upon oxidation, that he concludes that paraffin wax contains forked chain hydrocarbons.

If, moreover, the enormous task of defining the various constituents of mineral oils be achieved, and a definite starting material be available for oxidation, the fatty acid product of this treatment could only become economically available if progressive oxidation were prevented. The splitting off of one carbon atom after another, and the production of heterogeneous mixtures, would lead to loss in the form of undesirable, low molecular, products, and to expense in the separation of the "sheep from the goats." Thus, the experimental results now to be indicated are relevant, and indicate the complexity of the product of the oxidation of simple compounds.

THE PROGRESSIVE OXIDATION OF HYDROCARBONS

Solway and Williams (*J. Chem. Soc.*, 1922, p. 1343) obtained the same products of oxidation from both hexadecane and stearic acid by air oxidation at 120°—130° C., in the presence of manganese stearate as catalyst. Fatty acids of the normal series, dibasic acids of the malonic series, lactones, lactonic acids, formic acid, CO_2, etc., were obtained, and it is concluded that the first product of paraffin oxidation is a fatty acid, which is obtained by oxidation at the double bond formed in the paraffin chain. Further, simultaneous action occurs, leading to products of lower molecular weight and of widely different nature.

An examination of the papers of Francis (*loc. cit.*) will indicate very forcibly the complex mixture of products, acids, oxygenated non-acid products, etc., which are obtained upon even a mild oxidation of paraffin wax. If it be borne in mind that technical production would demand a higher reaction velocity than can possibly be attained at temperatures about 100° C. (Francis), the complexity of the oxidation product can be well imagined. The many attempts reported from German laboratories to produce fatty acids during the war years demonstrate the number of acids, esters, waxes, oxy acids, etc., produced when temperatures of, say, 120°—150° C. are employed in order to attain a reasonable rate of hydrocarbon oxidation.

Hence, if the first difficulty be overcome and definite hydrocarbons are won from petroleum crudes—and it is apparent that careful and costly fractionation would be essential—the oxidation of these materials to definite acids is not a solved problem. The acceleration of a particular reaction is by no means impossible, but it is a problem in the scarcely trodden field of preferential catalysis—*cf.* the writer's article, *Chemistry and Industry*, 1923, p. 196.

NATURE OF THE FATTY ACIDS

It would be unwise to dogmatise in this matter of the nature of the fatty acids capable of production by an oxidation process. Results already published reveal several inconsistencies. The production of such straight-chain acids as stearic, palmitic, arachidic and oleic, as well as others of the odd carbon atoms series in apparently good yield, has been variously reported, and it can scarcely be believed, in the light of recent work on the composition of paraffin wax and petroleum hydrocarbons, that the starting materials were preponderatingly straight-chain in nature.

If, then, further research shows the economic impossibility of fractionating mineral oil so as to obtain normal paraffins or suitable unsaturated hydrocarbons, and if it be proved that poly-nuclear and forked chain hydrocarbons cannot yield straight chain acids of a sufficiently high molecular magnitude, even a definitely controlled oxidation can only lead to an acid or acids differing essentially from the fatty acids now available to industry. The physical properties of the olein grades used in the textile industry and of the stearin employed in candlemaking are definite, and artificial acids will have to approximate very closely in their physical properties to those found by experience to be most satisfactory. Similarly, in the soap industry, if it be conceded for the moment that fatty acids will be accepted in place of the glycerides now almost universally employed, the many eutectic mixtures of natural fatty acids and the physical properties which govern surface tension, emulsive and absorptive phenomena can probably not be imitated without a wide range of artificially produced acids with which to work. The considerable research which was essential before the acids of a simple hydrogenated oil could be applied in soap and candle manufacture may be noted as an approximate parallel.

Moreover, as indicated above, the fat industry demands far more glycerides than acids, and, assuming economic esterification possible, the nature of the glycerides or esters produced would probably be widely different from that of natural fats and oils. (The question of mixed glycerides cannot be discussed in short space, and must be left with a mere notice.)

It is difficult to imagine that a synthetic glyceride mixture, prepared from non-straight-chain acids, would approximate in its drying properties to linseed oil, for instance, unless a vast number of experiments were made, and a large number of fatty acids were available for esterification.

Difficulties, however, exist only to be overcome, and the application of scientific research to the above problems is the only manner by which success can be won. It is not merely a question of changing a terminal methyl group of a simple normal paraffin into a carboxy group, as was vaguely imagined at first, but demands a wealth of study upon mineral oil constitution, before a real start can be made. If economic reasons prevent the adoption of the process, the value of the research can never be lost. Hydrocarbon investigation is already proving fruitful in connection with lubrication problems, whilst oxidation of low grade oils is leading to the production of an "oxidised kerosene," which is claimed to be of great value in kerosene engines, and for the prevention of "knock" in the internal combustion engine generally. The stimulus to the study of preferential catalysis and the increase in our knowledge of the relationships between constitution and physical constants of fatty acids, which must necessarily follow a scientific attempt to solve the problem of fatty acid production from mineral oils, will benefit science and industry even if the original problem remain unsolved technically.

THE SUPPLY OF NATURAL OILS AND FATS

The relation between the supply of and demand for natural oils and fats, and the extent to which production costs can be lowered in case of competition, are questions which must be touched upon when discussing the economics of artificial fatty acid and fat manufacture.

In normal times the supply of natural oils and fats is quite equal to the demand, and it can be increased when required to an almost illimitable extent. It will only be possible here to discuss briefly the two following phases of this matter, namely:—

1. The examination of some figures of increased production of oil seeds, etc., in various countries.
2. The indications that specialised attention to plant culture will be able to reduce production costs considerably by reason of much greater oil yields.

No account will here be taken of the large supplies of animal fats—butter, lard, tallow, etc.—nor of marine animal oils—whale, seal, herring, sardine, menhaden, yellow tail fish oil, etc. The potentialities of yeast fat can but be referred to, and the biological fermentation of sugar to produce fat, and the interesting experiments at St. Andrews on the utilisation of non-carbohydrates in this biological synthesis must be left with mere mention, although they represent the possibility of an alternative "artificial" fat process.

Oil Seed Production

The production of oils, seeds and nuts is recovering to pre-war dimensions, and the total export figures for the various countries in respect of copra, palm kernels, cotton seed, arachis, sesame, maize, poppy, mustard, linseed, hemp, rape, soya bean, castor and non-classified seeds, in the years 1913, 1918 and 1919 were respectively seven, three and five million tons. These large figures do not include large quantities of cotton seeds crushed in the country of production—for instance, 400,000 tons in the United States—nor the home consumption, say, of soya bean, the 1919 production of which in Manchuria was 2·3 million tons.

It may be interesting to quote figures of increased production, as indications of the way in which the supply of oil seeds can be increased in case of necessity. Thus, the cottonseed crop of the U.S. has increased fourfold in less than fifty years, and linseed almost ninefold. Canadian linseed production has increased eighty-fold in thirty years, whilst the areas under cultivation in British India and the Argentine have increased in fifty years from 100 acres to 3·6 million acres. Arachis production in Senegal is a dozen times that fifty years ago, and Indian arachis is grown three times as extensively as in 1910. Similar figures might be quoted with respect to arachis and soya bean in the United States, and the cultivation of the latter product in China has increased tenfold in the last twenty years. Ceylon is exporting almost two hundred times as much copra as she did sixty years ago, and the Dutch East Indies have risen rapidly to a production of 400,000 tons per annum of coconut oil.

Finally, the West African palm oil and palm kernel production shows similar increases. Nigerian outputs of palm oil and palm kernels have risen in the period 1913-1918 from 83,000 to 86,000 tons, and from 174,000 to 205,000 tons respectively, whilst the total West African output is about 130,000 tons of palm oil and 400,000 tons of palm kernels.

Statistics are often meaningless, especially those referring to abnormal periods, such as the war years covered in the last figures quoted, but the whole series, selected from a mass of collected information, serves to prove the possibility of crop increases in suitable countries. The time-war production of castor seed in America, India and Australia also indicates the possibility of growing oil seeds extensively whenever necessary.

The potential value of tropical and South America as an oilseed producing locality must not be forgotten, when the better known countries—West Africa, the Indies, etc.—are being discussed.

Scientific Cultivation

A growing interest is being taken in scientific cultivation, and the experience of many colonial departments of European Governments is proving that much greater yields of palm and coconut products are obtained from cultivated trees, as compared with the wild varieties. By clearing brushwood, and by thinning and dressing, palm trees yield a double crop in the first year and a four-fold crop in 3 to 4 years. By the application of fertilisers, and the careful use of insecticides and fungicides, and by general careful cultivation, a great deal may be achieved.

Seed selection is an important question, and although trees do not always breed true to type, a great deal has been accomplished here. It may yet be possible to breed a high-yielding palm, producing a heavily oil-laden pulp with a large weight of kernels, thinly covered with protecting shell. At present, all the virtues cannot be found in a single species, any more than the cotton plant can be trained to give both a high yield of seed and of good fibre.

Experimental results may be selected at random from Malaya and Sumatra, showing greatly increased yields of palm fruit. Thus, twelve bunches, and an average weight of about 200 lbs. of fruit, were obtained per tree, a much greater average than that for West Africa. Some bunches weighed 100, 120 and 130 lbs. each, and it is believed that finality has not been reached.

The cultivation of oilseeds and oilseed bearing trees is relatively easy—although many factors, such as labour, transport and climate, enter into cost considerations—and a great increase in production and yield can be foreshadowed. Thus the palm will grow throughout a wide belt, north and south of the equator, at elevations up to 3000 feet (in some instances), with a mean annual temperature varying between 22° and 30° C., and will adapt itself to a rainfall varying between 40 and 250 inches per annum.

The point cannot be laboured, but it is evident that plant culture in all its ramifications will enable oil yields to be increased and price reductions to be made. The potential death-struggle of the natural oils and fats in a possible economic fight with artificially produced rivals is reminiscent of Samson, and it demands that the scientific pillars upon which a synthetic process is founded shall be stronger than the stone pillars of Gaza.

THE ROYAL WEDDING

The North British Rubber Co., Ltd., inform us that one of the boys in their employment will have the honour of being present at the wedding of the Duke of York as the representative of the boy workers of the industry. As the company is the largest rubber manufacturer in the British Empire this is a suitable choice.

THE GROWTH OF PLANTS

By L. A. JORDAN, D.Sc.

Many must have read with very great interest in your issue of March 16 Prof. Baly's reply to your previous contributor, Mr. White, who, in speaking of the growth of plants, asked a very innocent-looking question, "Does the plant make the chemical or the chemical make the plant"?

For my own part, as the question was asked in so gentle and disarming a manner, I hoped that Prof. Baly might have been induced to tell us how his work, following the fundamental syntheses now so well established, is likely to develop, and how far this road will take us towards the complete revelation of Nature's processes in living cells, whether of animal or plant origin. Science in these matters is fumbling with the mechanism, but will it be possible ever to reach the ultimate "vital force" itself?

Prof. Baly did approach the subject by saying that, in his view, photosynthesis is the real driving force behind all life and that the plant is the living mechanism developed from photosynthetic beginnings. I should like to hear Prof. Baly develop this idea, and if possible not confining himself to the plant world, for whilst animal and plant life appears in the bulk to be markedly dissimilar, there is a remarkable connexion between the operations of their respective living cells.

In view of the admitted value of sunlight for the maintenance of health, and the value of sunlight and X-rays in curative medicine, it would appear that photo-effects are important in animal cells, although not apparently in so fundamental a manner as in plant cells.

The plant cell acts as a conservator of energy; it absorbs carbon dioxide, water, a little nitrogen compound and the energy of sunlight which initiates the processes for making and storing up highly energised chemical products.

On the other hand, animals, which ultimately feed upon plant products, take these highly energised products and pass out lowly energised products as carbon dioxide and nitrogen compounds, the balance of energy being found as body heat or the power to do work. Neither plants nor animals produce new matter or new energy; they merely assimilate existing material and transform it into new forms.

Thus, considering the whole range of plant and animal life, the formation of formaldehyde from CO_2 and H_2O with its 130,000 calories per gram molecule, or at least the formation of the sugar by condensation from the formaldehyde, appears to be the peak of nature's energy curve.

The vital process in animal cells is clearly some sort of oxidation which produces substances with a gradual loss in energy content, and yet the materials oxidised, carbohydrate, protein and fat are about as insensitive to the oxygen of the air as carbon dioxide is disinclined to unite with water in ordinary circumstances to form formaldehyde.

Presumably in both cases there must be some agent to do this work; photo-synthesis, for the plant processes especially, and the conception of enzymes which may be described as a sort of organic catalyst. Enzymes, whilst themselves the product of a living cell—*i.e.*, vital force, can initiate the processes for which they are considered to be responsible, quite independently of the living cell which produced them. Enzymes are known as products of both animal and plant cells, but is the function of plant enzymes, as affecting the plant economy, as clear as in the case of the animal product, and are they sufficient to explain everything?

Another point of connexion between plant and animal cells is the wide range of mineral salts found therein which seem to be necessary for a normal life development.

Certain functions have been identified with the presence of mineral salts, such as the maintenance of the osmotic conditions proper for the cell; chlorophyll has been identified as a magnesium compound and the presence of iron in haemoglobin noted.

In plant life certain colour effects are associated with certain mineral salts, but can one be sure that the meaning of the presence of of these salts is fully understood? In animal life it is certain that mineral salts have a definite position in the normal body and that when they become dislodged disease follows.

Considering the widely different nature of the chemical processes undertaken, is it not astonishing that the agencies used should be so similar? Professor Baly and his collaborators have supplied a complete laboratory parallel to Nature's fundamental synthesis. It is a step by step development like this that will trace the sequence of the intermediate steps involved, and the manner of their development and connexion one with the other through the whole of Nature's cycle—from CO_2 to CO_2 again.

CHEMISTRY IN RELATION TO TINPLATE MANUFACTURE*

By H. J. BAILEY, O.B.E., F.I.C.

Inspector of Alkali etc. Works for Wales

It is the object of this paper to deal briefly with some of the chemical problems involved in this industry. The engineering side of the manufacture has been highly developed in the past, and no one can visit a modern tinplate plant without marvelling at the way the plates go through the various processes with a minimum of human handling, but the chemical part of the manufacture is largely carried on by methods handed down from the past, without any organised chemical research directed to elucidate the mechanism of the various processes. The object of the manufacture is to provide sheets of mild steel suitable for making up into drums or containers for all sorts of materials, and protected from corrosion by a surface coating of tin, which should be as thin as possible, in order to keep down the cost. In considering the chemistry of the manufacture it is always necessary to bear in mind this prime object, namely, a pliable plate of steel covered with a sheet of tin, uniform as far as possible in thickness, free from spots or blemishes, which will stand stamping or shaping without either the plate itself or the protective tin covering showing any signs of cracking.

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* Read before the Swansea Technical College Metallurgical Society on December 16, 1922.

The industry in this country dates back to the 17th century, and the following data have been kindly furnished by the Welsh Plate and Sheet Manufacturers' Association :—The tinplate trade of South Wales ranks amongst the foremost industries in the country, because it is chiefly an export trade, about 90 per cent. of the output being exported. Board of Trade figures issued for the nine months ending September 30, 1922, show that while other trades of the country were still going through a period of stagnation, 334,452 tons of tinplates were exported during this period, amounting in value to £7,281,305. These figures also show how the tinplate trade is recovering from the slump of 1921, as for the nine months ending September 30, 1920 (a good year for the tinplate trade), exports of tinplates amounted to 265,925 tons. A greater amount of labour in South Wales is dependent upon the tinplate trade than might be generally supposed. The output of the steel trade of South Wales is largely consumed by the tinplate trade ; the bulk of the output of the South Wales acid works goes into the pickling tanks of the tinplate works, and the engineering works of South Wales are to a large extent engaged in manufacturing machinery for tinplate works or on repair, so that it is no exaggeration to state that about 50,000 operatives are directly or indirectly dependent upon the tinplate trade for their existence. The trade is singularly free from strikes and is very proud of its Joint Industrial Council, as, although now classified as coming under the Whitley Council Scheme, such a Council was in force in 1899, and was then called "The Tinplate Conciliation Board." Mr. Whitley publicly announced that his schemes was based entirely upon the principles underlying the old Tinplate Conciliation Board.

The present practice consists in rolling the steel bars to the required thickness in hot rolls, doubling, shearing, etc., until the required size of plate is arrived at. In this process the plates, which are finally rolled in thicknesses of eight sheets, often stick together, and have to be opened up by hand, and separated. The plates are then pickled to remove the surface scale, this "black pickling" being done in crates which move the plates up and down in a tank of hot weak sulphuric acid, three to five minutes being allowed for the completion of this process. The sheets of clean steel are then washed in water and piled up wet in the covered pots for the "black annealing" process, in which the pots are heated for 10 to 12 hours in an annealing furnace with a reducing flame. The annealed sheets are then rolled in cold rolls, usually through four sets, in order to give them a fine polished surface, the rolling being done across the plates as compared with the initial hot rolling of the steel. In this cold-rolling the sheets become hardened, which necessitates a further period of annealing commonly called "white annealing," an operation which is usually complete in about seven hours. These processes produce a further thin layer of scale, which is removed by a second pickling ("white pickling"), a process similar to the black pickling, except that the acid bath is not so strong and the time during which the plates remain in the acid is usually shorter. The white sheets then pass to the tinning pots, being kept wet to prevent rusting, until the tin-man is able to plunge them into the tinning bath. There are various styles of tin pots in use, but in each the chemical processes are essentially the same. The wet plate passes through a layer of strong zinc-chloride solution into the molten tin, and is guided by rolls until it emerges again from the tin-bath through a bath of palm oil. From the tinning pot the plates pass through the mechanical cleaning devices, any adhering palm oil being removed by bran or powdered earthy bodies, then to the sorting room, to be packed ready for market.

ANNEALING

The usual practice is to run the covered pots full of plates into long low brick chambers, fired by coal fires, fed with a long-flame coal, in order to have a reducing atmosphere. The firing and the time necessary to bring the whole mass of sheets up to the critical point (about 850° C.), are largely a matter of experience. The pots are then taken out and allowed to cool in the open shed. The base of the pot is of heavy cast iron provided with cast iron feet, and the covers, which are usually of wrought iron, fit over the plates on to the bed plate and are luted with sand. It is of interest to note that continuous annealing furnaces are coming into use, which do away with much of the labour of wheeling the pots in and out of the furnaces, the pots being placed by means of cranes on to cars, which become the moving base of the furnace. These continuous furnaces lend themselves to better control of temperature, and must reduce the fuel consumption considerably. Also, furnaces fired with producer gas and with properly regulated secondary air are on the market, and will, no doubt, in time commend themselves to manufacturers as more economical in fuel with greater ease of control. In the annealing of steel sheets it is only necessary to bring the whole of the sheets up to the proper heat and then to cool slowly. The cooling should be done in a reducing atmosphere, as much of the blue effect on the edge of annealed sheets is due to slight oxidation of the plates by the air drawn in through the sand lute on cooling. The object of annealing black plates wet is probably to check the tendency of the sheets to weld together, or, possibly, to prevent rusting when drying.

Pickling

The pickling of the plates, both the " black " and the " white " pickling, is now done with a weak solution of sulphuric acid reasonably free from arsenic. A fairly rapid action is desired as the cradles full of plates standing on edge are moved up and down in the solution for a few minutes only. Control of time and strength of acid are usually left to the " pickler," who likes to see a good seething from the plates, and has steam available to liven up his bath if the process appears sluggish. In some cases acid is run in from time to time to strengthen the bath, in others, the bath is used until the available acid is nearly all spent, the spent liquor being then run to the " copperas " plant or to the drain. Although generally the experience of the " pickler " is relied upon for correct conditions, in a few works tests have been instituted and the working conditions checked. For the black plate pickling strengths of acid equivalent to 5 to 8 per cent. of H_2SO_4 at the start are used, whilst for pickling the white plates from 2 to 4 per cent. of free acid is found satisfactory. The strength of the bath when exhausted varies greatly in different works, but in some cases is under 1 per cent. of free acid.

The addition of " sharps " to the acid bath is a long standing practice in many works, and after observing its use the author endeavoured to discover what exactly was its action. At first it was thought to be a purely physical action, namely, that of providing a great number of small points for the evolved hydrogen to escape from, and after an initial boil to leave the bath more or less quiescent until further solution of the iron gave rise to a fresh boil, but this explanation did not explain the continued quiescent action which persisted for some time after the sharps had been thrown in, or the equally satisfactory use of a clear solution made from sharps. Certain proprietary articles were found to be in use for the purpose of saving acid, and it was apparent that conditions could be set up in the pickling bath which reduced the evolution of hydrogen without apparently interfering with the removal of the scale. The problem seemed to be of such interest that an investigation of the reactions incidental to the pickling process was carried out in the laboratory of the Chief Inspector of Alkali Works, who has furnished me with some of the data. Results indicate that when a weak solution of sulphuric acid is used for pickling, say, 5 to 6 per cent. H_2SO_4, the scale is not *burst off*, as is so often supposed, by the evolved hydrogen produced by the action of the acid on the iron beneath, but is first reduced to FeO by the nascent hydrogen and subsequently *dissolved off* [equations I (*a*) (*b*) below]. Further, that in addition to these reactions, necessary for the proper cleansing of the plates, a secondary action occurs, whereby the clean iron is attacked by the acid, with evolution of hydrogen which can be measured. The reactions can be represented as follows :—

I (*a*) $Fe+H_2SO_4=FeSO_4+H_2$.
(*b*) $FeO, Fe_2O_3+H_2=3\ FeO+H_2O$.
(*c*) $3\ FeO+3\ H_2SO_4=3\ FeSO_4+3\ H_2O$
II $Fe+H_2SO_4=FeSO_4+H_2$.

In the presence of size, dextrin, etc., Reaction I proceeds quietly to a finish, leaving the surface of the metal smooth and bright, and Reaction II will occur to a very limited extent. Under ideal conditions Reaction I should occur alone ; and it is worthy of note that with size in use, no appreciable quantity of hydrogen is evolved for some minutes. For purposes of illustration the " scale " is regarded as FeO, Fe_2O_3 (Fe_3O_4), or magnetic oxide ; actually, however, scale is a compound or mixture of ferrous and ferric oxides in varying proportions, and the under layers are not magnetic, but approximate in composition to $6\ FeO, Fe_2O_3$. Direct estimation of the scale by reduction at red heat in hydrogen and determining the loss of weight is impossible, as the actual relation of oxygen to scale is unknown, but by calculation from such loss of weight, the percentage of scale can be determined for different assumed compositions.

The suitability of a given substance added to the pickling bath as " restrainer " would, from this point of view, be measured by its effect in reducing the action of the acid on the clean metal (Reaction II) to a minimum, whilst leaving Reactions I (*a*) (*b*) and (*c*) to proceed unchecked to completion. The " efficiency " of such a " restrainer " would, therefore, be in inverse ratio to the volume of hydrogen evolved measured under standard conditions of temperature and pressure. Check experiments were therefore made (*a*) by reducing the scale at a red heat in hydrogen and determining the loss in weight, (*b*) by determining the volume of hydrogen evolved, and the total loss in weight of the steel strips after pickling, and the weight of the ferrous iron in the pickle solution after the test. From these check experiments it was found that the attack of the acid on the clean iron was directly proportional to the hydrogen gas evolved within the limits of experimental error ; the whole of the scale being found in solution as ferrous sulphate save an insignificant amount of carbon. A standard test was then devised to determine the amount of such hydrogen evolved under controlled conditions of temperature, acidity, and amount of restrainer, and the results showed that, of the restrainers employed, size is one of the most efficient at all temperatures, and that it appears to work equally well with both sulphuric and hydrochloric acids.

The question of how "size," etc., acts as a "restrainer" in Reaction II without interfering with Reaction I had still to be determined. Size and similar materials reduce the surface tension of the liquor, and microscopic examination showed that when such materials are used the surface of the metal becomes coated with a fine layer of tiny bubbles of hydrogen, which act as a protective coating to the metal. The protective action of this layer of hydrogen is at a maximum where it covers clean metal, but is absent, or at a minimum, where scale or oxides of iron are present to react with the nascent hydrogen, and thus a protective layer comes into action automatically as the cleansing process proceeds. The possible advantages of the use of such a restrainer in the pickling process would be :—(*a*) Saving in acid used. (*b*) Less iron dissolved in the process. (*c*) Improved conditions at the pickling tanks, in reduction of acid mist rising with the hydrogen evolved. (*d*) A better surface on the plate, with the avoidance of pitting or sponging of the plate in pickling. (*e*) A reduction in the amount of tin required, by reason of the better surface.

On the basis of the former calculations it would appear that from 4 to 5 lbs. of commercial acid per box of tinplates should be sufficient to remove all the scale ; whereas a fair average figure for the trade appears to be from 8 to 9 lbs. per standard box, some works at periods use up to 14 lbs., and at a few works, the consumption is as low as 6 lb. per box. For every lb. of acid used above that which is necessary approximately ½ lb. of iron is dissolved according to Reaction II. One box of standard plates consists of 112 sheets, weighing from 106 to 108 lbs., the plates being 20×14 inches, or 436 square feet of tinned surface. The tin used is about 30 oz. per box, at about 1d. per oz. on present prices, roughly 0·07 oz. per square foot of tinned surface. At present prices steel represents roughly 0·8d. per lb., and from 130-140 lbs. of steel bars are required per box. The possibility of effecting a saving of, say, 4 lbs. of acid at ½d. per lb., 2 lbs. of iron and possibly 2 oz. of tin per box deserves attention.

Tinning

The process of tinning appears to be the formation of an iron-tin alloy on the surface of the sheet to which a layer of tin adheres, this layer being regulated in thickness by the temperature of the tin bath, and by the squeezing of the steel rolls through which the plates pass out through the palm oil surface bath. The use of zinc chloride as a flux preparatory to the entry of the plates into the molten tin has been developed in modern times ; formerly the plates were dipped into molten palm oil before being dipped into the tin bath. The exact action of the flux has not, so far as I am aware, been fully explained, but there is no doubt it acts as a dehydrating agent, and possibly as a cleanser, and there may be some action at the point of contact of the flux with the surface of the tin, though whether this action is chemical or merely one of surface tension is not known.

During the tinning process a certain amount of dross rises to the surface of the tinpot which, with the charred palm oil and scum on the surface of the flux, is commonly called scruff, and this is removed from time to time. This scruff contains a considerable amount of tin, which is recovered by heating in a small reverberatory furnace. One would like to see tinpots fired by producer gas, the temperature being regulated by a thermometer or pyrometer. There is usually a weekly clean-out of the tinpots when the pots are emptied, the rolls, etc., cleaned, and an accumulation of "hard metal" from the bottom of the pots removed. This hard metal is usually found to consist of iron and tin. By melting at a low temperature some tin can be recovered nearly pure. In recent years a tinning pot has come into use which combines the processes of white pickling, washing and tinning, in one mechanical operation ; as an engineering feat it is certainly a marvel of skill, and has reduced the labour required to a minimum. Whether it will be possible to extend the principles adopted in this machine is difficult to foretell, but if one could separate the plates after hot rolling, then cold roll, and anneal, it might be possible to pass the plates to a pot of the Melingriffith type, and with one pickling operation obtain a sufficiently good surface to tin right away. This will appear to be but a flight of the imagination, but given a suitable steel and proper temperature and chemical control at each stage of the operations, it may be a realisable dream in years to come.

In conclusion, reference may be made to a few of the problems on which research should be of great advantage to the manufacture.

(*a*) The most suitable temperatures and strengths of acid to be used in black and white pickling, and time of contact of the sheets with the acid, and the effect of the restrainers under controlled conditions.
(*b*) Cause of blisters, especially pepper blisters, streaks.
(*c*) Cause of hard or thick metal and recovery of tin from it.
(*d*) The problem of tin contained in the "list."
(*e*) The recovery of tin from waste plates.
(*f*) The action of the flux and the best strength to use on the tinning pot.

These would well repay investigation by the trade, and if this paper shows the value of research in one of the apparently simple parts of the process, namely, in pickling, and stimulates inquiry into the other chemical problems, the author will be well repaid. Thanks are due to Dr. Lewis Bailey, the Chief Inspector of Alkali, etc., Works, for assistance and to Mr. E. Linder for valuable data on pickling tests.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

DR. DUISBERG'S SPEECH

a few weeks ago, a report of which has just reached me, throws some light on the position of German Chemical Industry at the time he spoke. From it I gather that not only is Ludwigshaven closed down, but the Badische Anilin und Sodafabrik and the Oppau Works are in a similar plight, owing to shortage of fuel. Hoechst is only working partially, and the position in Elberfeld is also very difficult. The one bright spot would seem to be at the Leverkusen works, which are not only themselves within the British zone, but can obtain brown coal which is also within the British territory. The real point of great importance however, to the Dyestuffs Industry, is the amount of stocks which are held in Germany and elsewhere. These are said to be large, and may be sufficient to cover requirements for six months, and I see no reason to question this statement. No doubt what little production can be made will have to be put into stock owing to the shutting off of exports as the result of the French demand of a tax. At the moment there seems little chance of a settlement of the deadlock between France and Germany, and the trouble at Essen last week only makes things more difficult.

THE LEIPZIG FAIR

this year does not appear to have been a great success, and this must be attributed partly, I think, to the unsatisfactory manner in which contracts made at the 1922 Fair were carried out. No doubt the French occupation of the Ruhr had some effect, but the fluctuation of the exchange which fell to 200,000 in January, and rose to 100,000 in March, had much more effect in prejudicing the chances of success which the Fair may have had. German prices are now approximating to world prices, and unless there is a further slump in the mark, it appears unlikely that buyers will any longer rush to Leipzig in the hope of picking up bargains.

PROFESSOR H. E. ARMSTRONG

is, I hear, in Italy; but not, I hope, out of reach of the newspapers. He will be most interested in the Report of Sir Henry Norman's Committee on the use of lead paints. It should strengthen his somewhat slender faith in human nature of the governmental kind, or alternatively, should give him pleasure in having won a good fight against odds. This struggle is an interesting example of how we do things in our typically British fashion. It began in the International Labour Office in Geneva in 1921, when a draft convention was published which would have prohibited after 1927 the use of lead paints in the internal painting of buildings. I do not know whether Prof. Armstrong characterised this as "nonsense," but he might quite reasonably have done so. Now we arrive at the point where British commonsense comes into play. Lead paints are more economical than other paints; they are only dangerous when "dry rubbing down" is practised; therefore, prohibit "dry rubbing down" and not the use of lead paints. Simple, is it not?

DEFINITIONS

have a wonderful fascination for us Britishers. The subject receives as much attention in the Correspondence Columns as those headed "What is a . . . ?" Think how long we spent on "What is a fine chemical?" and now "What is a chemist?" has us in its grip. Judging from a letter in last week's issue, this is to be followed by "What is a doctor?" I saw in the *Glasgow Herald* a reply by Mr. J. Rutherford Hill to Mr. Chaston Chapman's letter on the question of the title "chemist." From it I gather that the main argument in favour of the retention of the title "chemist" is that "pharmacist" does not cover all the functions which the holder of that title is called upon to perform. In all these discussions I hope we shall not forget what is the main reason for the adoption of a particular appellation by any body of persons. It is certainly not to confer a dignity on any particular person in a class. It is only justifiable when it is in the interest of the public. If the restriction of a particular title to a certain ascertained number of persons enables the public to be protected from the unqualified practitioner in any calling, it is justified, and not else. I hope we shall not overlook this.

THE "CHEMICAL PUNCH"

is a title which I heard conferred on this paper by a distinguished scientist not long ago. I am not sure that this was intended to be entirely complimentary, but in some ways it is very apposite. It is evidence that the paper is now widely and quickly read. I sometimes hear its contents being discussed as early as Friday evenings. Advertisers have, no doubt, noted the growth in number of the letters in its correspondence columns, which is an excellent barometer. A week ago the editor showed me a letter, pointing out a slight error in the Market Report, which, I think, he was right in regarding as evidence of the minute scrutiny which readers give to the information the paper contains. My only grumble is that there is not enough healthy criticism from members of the Society.

FORTHCOMING EVENTS

Apr. 16. Society of Chemical Industry, *Yorkshire Section*, at the Queen's Hotel, Leeds. "Some Notes on the Production of Alkali by Bacteria as Registered by Different Indicators," by J. A. Reddie.

Apr. 16. Royal Society of Arts, John Street, Adelphi, W.C. 2, at 8 p.m. "Nitrates from Air," by E. Kilburn Scott, M.I.E.E. (Second Cantor Lecture.)

Apr. 18. The United Alkali Co., Ltd. Dinner in the Midland Adelphi Hotel, Liverpool, at 7.15 p.m., on the occasion of the One Hundredth Anniversary of the Establishment of the Alkali Industry in Great Brittain.

Apr. 18. The Royal Microscopical Society, 20, Hanover Square, W. 1, at 7.30 p.m. (1) "The Protozoa of the Soil," by D. W. Cutler, M.A. (2) "The Use of the Microscope in Palæobotanical Research," by Prof. A. C. Seward, M.A., F.R.S.

Apr. 19. The Chemical Society, Burlington House, Piccadilly, W. 1, at 8 p.m. Ordinary Scientific Meeting. (1) "The Influence of Nitro-groups on the Reactivity of Substituents in the Benzene Nucleus. Part VII. Reactions of 2:5- and 4:5-Dinitro-m-xylene," by K. Ibbotson and J. Kenner. (2) "The Chemistry of the Three Carbon Systems. Part I. The Influence of the *Cyclo*hexane Ring on the $\alpha\beta$-$\beta\gamma$ Change," by S. F. Birch, G. A. R. Kon, and W. S. G. P. Norris. (3) "On the Promotion of Catalytic Reactions. Part I.," by S. Medsforth.

Apr. 20. Royal Society of Arts, at 4.30 p.m. "A Review of the Base Metal Industry, with Special Reference to the Resources of the British Empire," Sir R. A. S. Redmayne, K.C.B., M.Sc.

Apr. 20. The Society of Dyers and Colourists *Manchester Section*, at 36, George Street, Manchester, at 7 p.m. (1) "The Mechanism of Diazo-Coupling Reactions," by Dr. T. K. Walker, M.Sc. (2) "The Evolution of Bleaching," by S. H. Higgins, M.Sc.

Apr. 20. Society of Chemical Industry, *Newcastle Section*, and the Institute of Chemistry (Newcastle Section). First Joint Annual Dinner, to be held at the Royal Turk's Head Hotel, Grey Street, at 7.30 p.m.

Apr. 23. The Faraday Society. Meeting at Burlington House, Piccadilly, W. 1, at 8 p.m. (1) "On the Properties of Powders.—the Variation of Pressure with Depth in Columns of Powders," by J. H. Shaxby and J. C. Evans. (2) "The Properties of Powders." Part. VI. "The Compressibility of Powders." Part VII. "The Distribution of Densities in Columns of Compressed Powder," by E. E. Walker. (3) "On the Rate of Hydrogenation of Cinnamic and Phenylpropiolic Acids," by E. K. Rideal. (4) "The Temperature and Maximum Density of Aqueous Solutions," by A. Taffel. (5) "Note on the Coagulation of Milk by Acid," by L. Anderson.

SOCIETY OF CHEMICAL INDUSTRY

ANNUAL GENERAL MEETING, 1923

The Annual General Meeting will be held on Thursday, June 21, at 11 a.m., in the Arts School, Benet Street, Cambridge, and will be preceded by a meeting of the Council at 10 a.m. At the former, members will be welcomed to Cambridge by the Vice-Chancellor of the University, and the President of the Society, Dr. E. F. Armstrong, F.R.S., will deliver his address. The Vice-Chancellor will hold a reception to the Society at the Fitzwilliam Museum at 5 o'clock, and in the evening there will be a reception and dance in the Guildhall.

On the Monday, Tuesday and Wednesday of the same week, the International Union of Pure and Applied Chemistry meets in Cambridge, and the President of the Union extends a welcome to members of the Society to attend any of the public meetings of that body.

On Friday, June 22, the Society's Medal (1923) will be presented to Dr. C. C. Carpenter, who will then give an address. On the afternoon of the same day there will be an address by Dr. F. W. Aston, F.R.S., on "Isotopes," and in the evening the Annual Dinner of the Society, which ladies may attend, will be held.

On Saturday there will be a visit to Ely.

A programme of the meetings, with information regarding hotel accommodation, will be sent to members shortly.

ANNUAL REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY

Volume VII of these Reports covering the year 1922 will be ready shortly and an order form with full particulars will be sent to every member of the Society as soon as the book is published.

NEWS FROM THE SECTIONS

BIRMINGHAM AND MIDLAND SECTION

The meeting on March 27 was held in the University of Birmingham, Dr. E. B. Maxted presiding, and three papers were read.

In the first paper, entitled "Some Studies in Catalytic Hydrogenation," the author, Mr. E. T. Lush, M.A., showed how the physical conditions of the addition of hydrogen to oils, by means of a nickel catalyst, lent themselves naturally to continuous working; the catalyst being a solid, the oil a liquid, and the substance producing the desired change, viz., hydrogen, a gas, it should be possible to distribute nickel throughout a closed vessel, keep the vessel full of hydrogen and allow oil to run in at one end and out at the other—the speed of flow regulating the degree of hydrogenation.

It was pointed out why porous supports, such as pumice, or asbestos, were unsuitable and why pure nickel was chosen. Various forms of nickel, such as wool and ribbons, were shown and some experimental evidence was briefly referred to showing that surface alone was not the factor of first importance, but rather surface activity.

After reviewing various methods of activation, anodic oxidation was described in detail. The activity of "activated" nickel surfaces, such as turnings, was shown by experiments to reside solely on the surface, but the possibility that the mass of nickel might act as a hydrogen reservoir received some experimental support. The course of hydrogenation, as measured by the analysis of samples taken at intervals, varied with the conditions of the operation. When the oil filled the vessel, completely covering the turnings, the proportions of the fatty acids present—more especially the ratio of oleic to iso-oleic acids—agreed with those published by Moore, except that the saturated acids increased regularly from the beginning. When, however, the oil flowed over the turnings as a film different results were obtained, the iso-oleic acid content being reduced. This difference was believed to be experimental evidence of the view of Moore that the formation of iso-oleic acid was the result of dehydrogenation of stearic acid since in the film method conditions were less favourable for dehydrogenation.

A small model plant holding 5 lbs. of oil was shown on the screen, and an example typical of a number of trials carried out in this plant was given :—Groundnut oil was run through continuously for 77 hours, leaving the plant at the rate of 5 lbs. per hour, with an average iodine value of 57—58, without any appreciable loss of activity on the part of the nickel, a sample of which as taken from the plant was shown. The author expressed his thanks to Technical Research Works, Ltd., in whose laboratories the investigation had been undertaken.

The Chairman observed that catalytic hydrogenation had fascinated many investigators, but the disintegration of the catalyst always seemed to crop up. If Mr. Lush were able to show, as he seemed to do, a catalyst, which, whilst possessing much activity did not disintegrate, he had taken an important step forward. It seemed very remarkable that nickel in any form should retain its activity for so long a time. He took it that the oil used was extremely pure and comparative figures in relation to the two forms of nickel (in the compact activated form and the finely-divided form) of what one might call the equivalent life would be of interest. If it could be shown that the equivalent life of nickel in the compact activated form was greater than nickel in the finely-divided form, an important economic step in oil hardening would have been taken. Dr. Hilditch congratulated Mr. Lush upon his work, which appeared to have broken fresh ground in the subject of oil hydrogenation. The recovery process seemed simple and effective. Mr. A. W. Knapp said he too was much impressed by the simplicity of the model plant; it was not only continuous but practically automatic. Mr. Thomas said the method, compared with existing methods, was alike simple and novel. It represented an advance in the ease with which the catalyst could be reactivated. With regard to nickel suboxide, in his experience this oxide or suboxide only acted as a catalyst in conditions under which it was, at least, partially reduced to metallic nickel. So-called oxide or suboxide catalysts increased in activity with repeated use, a fact obviously due to progressive reduction to metallic nickel.

A paper on "The Reaction between Ammonia and Sodium Hypobromite," by Messrs. D. R. Nanji, M.Sc., and W. F. Shaw, M.Sc., was read by the former. On adding ammonia to excess of an alkaline solution of sodium hypobromite at ordinary temperature it was decomposed. That this reaction was not the only one that occurred had not been recognised by certain investigators, for it had been suggested as the basis of volumetric methods for estimating ammonia. In the authors' experiments a modification of Willard and Cake's method was adopted, viz.: To determine the excess of sodium hypobromite the method employed was based on the well-known reaction between hypohalogenites and arsenious acid : $2\ NaOBr + As_2O_3 = As_2O_5 + 2\ NaBr$. To the solution containing the excess of sodium hypobromite was added excess of an approximately 2 per cent. solution of pure sodium bicarbonate and subsequently excess of a standard solution of sodium arsenite. The solution was then neutralised with dilute sulphurous acid, using methyl orange as indicator. It was then again rendered alkaline with 2 per cent. sodium bicarbonate solution and the excess of the arsenite titrated with standard iodine solution, using starch as indicator. The object of neutralisation was to remove any normal carbonate formed by the reaction of sodium bicarbonate with the free alkali in the hypobromite, before titrating with iodine. The accuracy of this method of determining hypobromite was beyond all doubt. They had found it possible to use much more dilute solutions of sodium hypobromite than those employed by Willard and Cake, and the authors' results showed that the reaction between ammonia and sodium hypobromite was not affected by employing solutions of that salt 20 times as dilute as those recommended by the authors mentioned. Taking into account the whole of their experiments, and the observations of other workers they submitted they were justified in advocating the rejection of the hypobromite method of estimating ammonia when the greatest possible accuracy was required.

Professor A. R. Ling said the contribution might not be of the highest importance because it was more on the negative than the positive side, but it was nevertheless necessary to put the investigations on record for the purpose of preventing research workers falling into error or doing needless work. Dr. Maxted said he regarded the information as most important from the latter point of view.

Mr. J. H. Bushill, B.Sc., read a paper describing work on "The Estimation of Acetone and of Ethyl Alcohol in a Mixture of the Two." The object of this work was to estimate these substances in comparatively small quantities in the products of bacterial fermentation. The disadvantages of the method of Northrop, Ashe and Senior (*J. Biol. Chem.*, vol. 39, 1) were pointed out, and preference was given to the method of estimating acetone devised by J. Rakshit (*Analyst*, 1916, p. 245), as by using lime water instead of caustic soda the method became quantitive as long as the ratio of alcohol to acetone did not exceed 10 : 1. The author preferred to estimate the specific gravity of the mixture, from which, together with the acetone content, the alcohol present could be calculated. For this calculation acetone gravity tables up to 1 per cent. had to be constructed.

The method was summarised as follows : a known volume of the liquid under investigation is made slightly alkaline with soda and distilled, the distillate being made up to a definite volume. The gravity of this solution is then taken and the acetone estimated by the method of J. Rakshit. By means of the acetone tables the gravity of the acetone present can be found and from this and the gravity of the mixture the gravity of the alcohol is estimated. The percentage of alcohol is then found from alcohol tables.

OTTAWA SECTION

At the meeting on January 11, a paper was read by Ross E. Gilmore under the title of "Some Notes on Denatured Alcohol in Canada."

Of the total of over 4 million proof gallons of ethyl alcohol produced in Canada in 1921 only about a third was classed as "Industrial, non-potable alcohol." Of this third roughly 60 per cent. was taxable and the remaining 40 per cent. was sold as denatured alcohol. There are 10 different grades of denatured alcohol authorised in Canada as compared with 3 in Great Britain and 81 in the United States. In Canada three grades are for unrestricted sale and represent roughly 30 per cent. of the total denatured alcohol sold. One of the remaining 7 restricted grades, namely, No. 1 Benzine, has a sale of over 50 per cent. of the total denatured alcohol produced, leaving only about 20 per cent. for the 6 other grades. The uses of the three unrestricted grades, viz., No. 2 Standard, No. 2 Benzol and No. 2 Pyridine, are mainly for burning, anti-freezing, paint and varnish. No. 1 Benzine, denatured with 9 per cent. wood alcohol and 1 per cent. benzine is used for the manufacture of varnish and shellac, drugs such as aspirin, phenacetin, etc. The uses of the remaining six grades are for special preparations, such as tincture of iodine, collodion, etc.

Methyl hydrate (wood alcohol) is the best denaturant, but its uses for special purposes are limited by the impurities required to be present in order to make it an effective denaturant. The lowest amount of methyl hydrate allowed as sole denaturant in Canada (*e.g.* No. 1 special for Hospitals and Universities, representing only 2 per cent. of total consumption) is 10 per cent. United States formula No. 1 specially denatured alcohol and also the Grade 1 industrial methylated spirits authorised in Great Britain contain only 5 per cent. of wood alcohol as sole denaturant. Other denaturants used in the Canadian Grades are benzine (kerosene), pyridine, benzol, nitrobenzol, pine oil, iodine, potassium iodide, ether, cadmium iodide, ammonium iodide, brucine sulphate and diethylphthalate.

Commercially pure industrial alcohol (not denatured), is allowed in the chemical industries at excise-duty rates ranging from \$0·15 to \$2·43 per proof gallon. Under the 15 cent rate comes alcohol used for collodion, tooth paste, ethyl chloride, chloroform, and soap. That for vinegar pays 27 cents duty per proof gallon, perfumed spirits 75 cents and proprietary medicines, pharmaceutical preparations, and extracts and essences \$2·40 to \$2·43.

There is as yet no specially denatured grade in Canada for motor fuel, but two grades containing benzol and gasoline respectively are authorised in the United States and one in Great Britain. After giving a short history of denatured alcohols in Canada and showing why the sale price in Canada of denatured alcohol was double that in United States and Great Britain, the speaker commented on the importance of the quality of the ethyl alcohol used to make the different grades.

MONTREAL SECTION

At the meeting held on March 19. at the Queen's Hotel, an address on "Recent Advances in the Rubber Industry," was given by Prof. G. S. Whitby, who also presented a paper in collaboration with Messrs. A. Cambron and A. R. Winn, on "The Acidity of Raw Rubber and the Influence of Bases on the Activity of Vulcanisation Accelerators." The meeting, which was presided over by Dr. A. R. M. MacLean, was preceded by a dinner, and was attended by 73 members, including Mr. S. W. Bridge, B.Sc., of London, who is in Montreal on a business visit. Prior to the delivery of the evening's address certain aspects of the Patents Bill now under consideration at Ottawa were discussed, and a Committee was appointed to draft a resolution, to be sent to the Government, emphasising the desirability of search prior to the granting of patents.

Prof. Whitby, in introducing his subject, said that the rubber industry had become an industry of the first magnitude only during the last decade or so. With this change of rank in magnitude there had been going on a change or rank in character, a change, not yet by any means completed, from an industry based on tradition and empiricism to one based on scientific technology and systematic investigation. The most substantial advances in the industry during recent years had been the use of organic accelerators of vulcanisation and improvement in compounding practice, particularly in regard to the use of new and more finely-divided substances. Good progress had been made in both the theory and practice of these subjects: the mechanism of the action of accelerators had been partially elucidated, and the cause of the effect of pigments had been formulated, at least in part, by Wiegand.

The term " accelerator " was used rather than the term " catalyst " to describe a substance which when added in small proportions to rubber mixtures hastened vulcanisation, because it was known that in many cases the substance introduced underwent change, and that not it, but a substance derived from it, by reaction with a metallic oxide, sulphur, or hydrogen sulphide, was the actual catalyst. Bedford had sketched out the types of reaction which accelerators might undergo, and according to him the most active accelerators functioned by the formation of polysulphides from metallic mercaptides. The accelerators generally employed industrially were comparatively mild ones, and were represented by hexamethylenetetramine, thiocarbanilide, aldehyde ammonia, diphenylguanidine, and anhydro-acetaldehyde-aniline. Extremely powerful accelerators were designated ultra-accelerators: a term which was defined by the speaker as indicating an accelerator of such potency that it would bring about vulcanisation under conditions of temperature and sulphur ratio such that vulcanisation would be substantially impossible in its absence. An example of an ultra-accelerator was piperidonium piperidyl dithiocarbamate; one part of which would in the presence of zinc oxide increase the speed of vulcanisation to 300-400 times its usual rate. An ultra-accelerator recently discovered by the speaker was zinc α-dithionaphtholate. Ultra-accelerators were already finding application in vulcanising rubber goods at room temperature. Under such curing conditions organic dyes could be satisfactorily used in rubber mixings.

A chemical examination of the resin of rubber made by the speaker and his co-workers had revealed the presence in the resin of a large proportion of acids, and the significance of this hitherto-unrecognised acid-content was pointed out. It was shown that if the acid was neutralised the activity of many accelerators was greatly enhanced. It was also pointed out that, as the acid-content of different samples of raw rubber varied considerably, this variation was probably an important factor in causing the variation in vulcanising behaviour displayed by different samples of crude rubber. A new and rapid method of examining the effect of organic substances on the rate of vulcanisation was described. One of the resin acids, hevëic acid, was found to retard vulcanisation, but its ammonium salt was found to be without such effect; the significance of this in regard to the behaviour of latex which has been preserved with ammonia was pointed out.

The speaker described recent developments, involving the direct use of latex; in particular, the process in which parallel threads were passed through latex in such a way that they were at the same time rubberised and converted into cord fabric. The method of building tyres, flat, on a drum, to which such fabric was adapted, was also described.

MANCHESTER SECTION

The annual meeting was held on April 6, Dr. E. Ardern, F.I.C., being in the chair. There were six nominations for membership on the committee, and as there were only five vacancies a ballot was held, Messrs. J. Allan, C. J. T. Cronshaw, G. D. Elsdon, S. H. Higgins, F. G. Jackson, and F. S. Sinnatt being elected. Messrs. Melling and Pettigrew acted as scrutineers of the ballot papers. Mr. H. C. Clanahan was appointed auditor. As there had been no nomination actually received for the appointment of the second auditor, the matter was left in the hands of the committee to deal with at a later date.

The hon. sec. of the section (Mr. L. Guy Radcliffe) read his annual report for the session 1922-1923. The report stated that the activities of the session commenced on October 6, when a large audience listened to an address by Dr. E. F. Armstrong, F.R.S., the president of the society. The second meeting, held on November 3, was held jointly with the Manchester Sections of the Institute of Chemistry and the Society of Dyers and Colourists, together with the Manchester Literary and Philosophical Society. The last-named society selected the lecturer, Dr. F. W. Aston, F.R.S., who gave an address on " Isotopes " to an audience numbering nearly 300. Soon after this lecture it was announced that Dr. Aston had been awarded a Nobel Prize and a Royal Society Medal for his researches. Prof. W. L. Bragg, representing the Literary and Philosophical Society, presided at this joint meeting. During the first two or three months of the session a special effort was made to increase the membership of the section, but, so far as could be ascertained, the results were not too satisfactory. At present the total number of members on the Manchester Register was about 550, and no less than 25 resignations from the society and of members on the Manchester List became effective on December 31, 1922. It was undoubtedly to the interest of every member of the society to do all he could to bring the advantages of the membership of the society to the notice of every eligible chemist. The Hospitality Fund had been well supported, but by comparatively few members, from whom the actual amounts contributed had been far in excess of the 2s. 6d., which every member was invited to subscribe.

The Chemical Engineering Group was invited to be present at the meeting held on December 1, when Mr. W. G. Fraser read a paper, entitled "The Chemical Engineering of Paper Manufacture," and there was a good attendance of members of the section, of the group, and of representatives of the Papermaking Societies. The fourth meeting, held on January 6, introduced an innovation in that the programme consisted of short papers by members, including one by Mr. E. F. Morris, which was read before the section under the arrangement made with the Chemical Society. There were three other papers, and it should be recorded that Dr. E. F. Ehrhardt's paper on "Patents for Chemical Products" (*cf. Chem. and Ind.*, March 29, p. 314) was regarded as being a very notable contribution to the subject. The arrangement by which several short papers with diverse subject matter were presented at the one meeting was generally approved by the members, and on February 2 the meeting again heard three papers read.

The sixth meeting, held on March 2, was a joint one with the Liverpool Section, and the proceedings commenced with a luncheon at the Queen's Hotel. The chairman and committee entertained a number of guests, including Sir Wm. Kay (chairman of the Corporation Gas Committee), the honorary officials and members of committee of the Liverpool Section, Dr. E. F. Armstrong (the president), E. V. Evans, Esq. (the hon. treasurer), Mr. W. J. U. Woolcock (of the Association of British Chemical Manufacturers), together with Dr. Longstaff and Dr. S. Miall. The Lord Mayor of Manchester (Councillor Cundiff, J.P.), and Dr. Clayton, M.P., the chairman of the Liverpool Section, wrote expressing regrets at being unable to be present. Altogether about 60 members and guests assembled at the luncheon, and brief speeches were made by Dr. E. Ardern, Sir Wm. Kay, Mr. John Allan, Dr. E. F. Armstrong, Mr. E. V. Evans and Dr. Holt. At the conclusion of the luncheon about 125 members of the Society availed themselves of the kind invitation of the Manchester Corporation Gas Committee to visit the Bradford Road Gasworks. In the evening, the usual meeting was held, at which about 130 members listened to an address from Dr. H. Levinstein (*cf. Chem. and Ind.*, Mar. 16 and 23, pp. 259-262, 294-297).

Dr. H. Levinstein has been elected chairman of the section for 1923-1925, and Dr. E. Ardern vice-chairman, whilst Mr. L. Guy Radcliffe has again undertaken the duties of hon. sec., these appointments being made by the committee in accordance with the rules of the section.

About 70 members attended the annual supper held on March 9, and the evening was very successful.

The ordinary general monthly meeting of the section was then held, about 75 members being present. Two papers were read by Dr. E. Ardern, the titles and authors being as follows: (1) "The Recovery of Nitrogen from Sewage by the Activated Sludge Process," by Edward Ardern, D.Sc., Clarence Jepson, M.Sc., and Percy Gaunt. (2) "The Activated Sludge Process, Withington Works," by Edward Ardern, D.Sc., and William T. Lockett, M.Sc.

In the first paper, the authors stated the result of investigations carried out some three years ago, both under laboratory and large-scale conditions, with the view of ascertaining what proportion of the total seawage nitrogen is recovered in the resultant sludge, when the sewage is treated by the activated-sludge process. The question of possible losses of nitrogen and the source of the high nitrogen content of activated sludge were also dealt with. It was claimed that under favourable operative conditions, as much as 30 per cent. of the total sewage nitrogen could be recovered in the sludge. No evidence was obtained of the fixation of atmospheric nitrogen or of the absorption and assimilation of ammoniacal salts. The results indicate that the high nitrogen content of the sludge must be ascribed chiefly to the flocculation of the sewage colloids which were richer in nitrogen than the gross suspended solids.

In the second paper a detailed account was given of a prolonged study of the operation of the activated-sludge plant at the Withington Works of the Manchester Corporation designed with the view of ascertaining the various factors influencing the complete and successful control of the process. As the result of information afforded by careful attention to the character of the sludge in circulation and the dissolved-oxygen content of the mixed liquor in the aeration chamber, it had been possible to increase the maximum effective capacity of this plant by some 25 per cent. The summary of analytical returns for the past 15 months showed that entirely satisfactory purification was maintained throughout this period, with the production of effluents readily complying with the standard recommended by the Royal Commission on Sewage Disposal, and the table of operating costs indicated that with the new air-compressing plant which was shortly to replace the existing compressor, such results would be obtained at a very reasonable cost, especially having regard to the relatively low capital expenditure involved in the adoption of the process. In conclusion, the authors stated that an additional unit of some five or six times the capacity of the existing activated-sludge plant was now under construction at these works.

MEETINGS OF OTHER SOCIETIES

THE BIOCHEMICAL SOCIETY

Three papers were read at the meeting held in the Lister Institute on March 12 :—

(1) "The Reversibility of the Action of Urease," by H. D. Kay. By continuous extraction, with butyl alcohol under reduced pressure, of a mixture of active urease and strong ammonium carbonate solution (containing carbamate) at room temperature, the author found urea to be present in the extract in small but definitely recognisable quantities. It was detected and estimated by a micro-urease method and by xanthhydrol precipitation. No urea was produced unless both active enzyme and ammonium carbonate were together present in the reaction mixture.

(2) "The Effect of an Air irradiated with the Mercury-vapour Quartz Lamp upon the Growth of Rats fed upon a Diet deficient in Vitamin A." by Miss E. M. Hume and Miss H. H. Smith. Rats receiving a diet deficient in vitamin A, and exposed for 10 minutes daily to the radiation of a mercury-vapour lamp, showed prolongation of growth for several weeks. Control animals on the same diet showed no such prolongation of growth.

(3) "The Possible Significance of Hexose-phosphoric Esters in Ossification," by R. Robison. Ossifying cartilage of young animals was found to contain an enzyme which rapidly hydrolysed hexose monophosphoric ester with formation of free phosphoric acid. Of the other tissues examined only the kidney contained the enzyme in comparable degree. In particular non-ossifying cartilage was almost inactive. The suggestion was made that this reaction may possibly play a part in the process of ossification. There is evidence that part of the phosphoric acid in the blood is present in the form of an acid-soluble ester and the hydrolysis of this would lead to an increase in the concentration of phosphate ions and the deposition of calcium phosphate.

(4) "The Storage in the Rat of the Growth-Promoting, Fat-Soluble, Organic Dietary Factor," by H. Goldblatt and Miss K. M. Soames. A very small amount (0·25 g.) of the liver of rats which had received cod-liver oil in their diet, and 0·5 g. of that of rats which had received butter, was found to be active when tested for the fat-soluble, growth-promoting factor by the biological method of Zilva and Miura. The liver of rats that had ceased growing after about 8 weeks on a diet very deficient in the fat-soluble organic factor was found to be inactive in doses of 0·5 g., and even 1·0 g. But 0·5 g. of the liver of rats that had been irradiated with the mercury-vapour quartz lamp for at least 4 weeks after they had ceased growing on a diet very deficient in fat-soluble A, was moderately active. This was perhaps further proof that the radiant energy of the mercury - vapour quartz lamp effected an economy of the growth-promoting fat-soluble factor in the body. Total darkness had no effect whatever on the growth of rats fed on a diet adequate in vitamin A content.

SOCIETY OF PUBLIC ANALYSTS

Mr. P. A. Ellis Richards presided over the meeting held in the Chemical Society's Rooms on April 4, when three papers were read.

(1) A paper on "Physiological Standards" was read by Dr. S. White, who observed that as many important drugs used in medicine did not lend themselves to chemical standardisation, it was necessary to adopt physiological standards. A number of individual drugs, including digitalis, ergot and *Cannabis indica* were dealt with, and a method described of arriving at the minimum lethal dose for frogs, and so establishing a heart tonic unit. The standardisation of Pituitrin was discussed, as were physiological methods for determining the presence of the three vitamins. The paper was illustrated by numerous slides.

(2) Dr. G. Monier-Williams described "The Estimation of Boric Acid in 'Liquid Eggs' and other Foodstuffs," and drew attention to the irregular results sometimes obtained with Thompson's method, owing to loss of boric acid by precipitation as calcium borate during the removal of phosphates. A method was described in which phosphoric acid was removed by precipitation as magnesium ammonium phosphate, the subsequent titration of the boric acid being carried out by Thompson's method.

(3) An account of "An Investigation into the Chemistry of the Reinsch Test for Arsenic and Antimony, and its extension to Bismuth" was presented by B. S. Evans, M.B.E., B.Sc. After giving a summary of the literature relating to the reaction, a method was detailed for determining the velocity of the reaction, and a number of curves given showing the influence on the reaction velocity of varying chloride, acid strength or arsenic (antimony, etc.), also the effect of adding cupric or cuprous salts. The products of the reaction are :—For arsenic—the compound Cu_5As_2; for bismuth—the element bismuth ; for antimony — the compound Cu_2Sb, followed by deposition of the element antimony. In all cases cuprous chloride went into solution. An attempt was made to elucidate the mechanism of the reaction, and experiments were outlined leading to the conclusion that it was due to reduction of the arsenic (or antimony, etc.) by a film of hydrogen on the surface of the copper. Under certain given conditions, the test used qualitatively could be made sensitive to less than 0·01 mgm. per 100 c.c. It was suggested that a determination of the reaction velocity carried out in any doubtful liquid would readily show whether any substance was present which would interfere with the test.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

At the meeting held on March 28, a paper was presented by Mr. Lenglen on "The Role and Importance of Lime in Agriculture." The lecturer, who is a director of the syndicate which is engaged on propaganda for the greater use of fertilisers, first discussed the part played by lime in the soil, and showed the effects it produces on plants and on livestock. The action of lime in rendering potassic and phosphoric fertilisers more available was discussed, and it was pointed out that lime accelerates the conversion of nitrogenous fertilisers into ammonia, and favours the action of nitrifying bacteria which always develop more abundantly in a slightly alkaline soil. After remarking on the destructive action of lime on certain soil parasites, Mr. Lenglen observed that the acidity of soil was of several kinds—direct acidity, such as that of marshes, and which is directly injurious; indirect acidity, due to humic acids which, in the presence of a base of a fertiliser, yield free acidity owing to the formation of an alkaline humate, liberating free mineral acid; and "exchange" acidity, produced when the soil is treated with a neutral salt such as a potassic or nitrogenous fertiliser, an acidity which forms through the exchange of the base of soil silicates with that of the compound introduced. If the silicates contain much iron or aluminium, salts are formed which are distinctly acid and toxic to plants. The decalcification of the soil must therefore be avoided by adding lime, calcium carbonate, or marl, etc. In conclusion, the lecturer remarked that if these theories were applied, it would be possible to say "à pere pauvre succéderont des fils riches."

Monsieur Chaudron communicated the results of his researches on the preparation of devices for obtaining high temperatures in the laboratory, and described a furnace which he had designed to attain 2000° C. and which worked in a vacuum. The furnace consisted of three essential parts, lying on each other and held together merely by their own weight. The lower part was utilised to provide the electrical connexions, the central part was the working area, and the upper part the cover. A perfect vacuum could be obtained in this apparatus. which was provided with a heating element composed of an alundum cylinder containing titanium wires; the crucible was placed inside this cylinder. The furnace was easy to manipulate.

INSULIN

The technical difficulties of manufacturing insulin have already been overcome by The British Drug Houses, Ltd., who, working in conjunction with Messrs. Allen and Hanburys, Ltd., have now put the product on the market. Insulin is the new specific for diabetes, which was discovered by two Canadian physiologists, Messrs. Banting and Best.

CORRESPONDENCE

THE TITLE "CHEMIST"

Sir,—It would appear desirable to support the plea recently so admirably stated by Mr. Chaston Chapman, the President of the Institute of Chemistry, in your columns for the restriction of the word "chemist" to those who practise chemistry in the full sense of the word. Surely the time has arrived when we can come to an amicable agreement with our friends, the pharmacists, on this point, and I venture to suggest that much would be gained if it were possible to hold a round-table conference officially representative on the one side of the Pharmaceutical Society, the retail Pharmacists' Union and any other bodies concerned, and on the other side, of the leading chemical Societies.

The object of such a conference would be to discuss the possibility of agreeing as a point of professional etiquette to the limitation of the terms "pharmacist" and "chemist" in the sense defined by Mr. Chapman.

If this could be achieved the rest would follow and with the support of the Press the public would soon learn the proper meaning of the terms.—I am, Sir, etc.,

E. Frankland Armstrong, F.R.S.,
President of the Society of Chemical Industry

BAYBERRY OIL

Sir,—In answer to the inquiry, "Bayberry Oil," in the issue of *Chemistry and Industry* for March 9, p. 241, the following work was done in this laboratory on material known as Bayberry Tallow that was extracted from a berry growing on a small bush found along the Atlantic Sea Coast at New Jersey, U.S.A. The fat was obtained by placing the berries in boiling water, and skimming off the fat that came to the top. The material extracted was a greenish yellow fat of very hard consistency with a very pleasant aromatic odour, and had the following constants:—

Saponification value, 207·3.
Free fatty acids, 2·10 per cent.
Unsaponifiable matter, 0·39 per cent.
Iodine number, 3·7.
Acid value of the fatty acids, 217·0. Titre 56·7.

Charles J. Gundel
Laboratory of Fels and Co.,
Philadelphia, U.S.A.
March 26, 1923

AL-RĀZĪ AS A CHEMIST

Sir.—The interesting article on Al-Rāzī in your issue of February 16 contains one or two points which call for comment. (1) A manuscript of the *Kitab sirr al-Asrar* (not "assar"), *i.e.*, the Book of the Secret of Secrets, was described by Naumann in 1838 in his catalogue of the MSS. in the City Library at Leipzig. This differs in some respects from that at Göttingen, and also from a third which was investigated by Prof. Stapleton. (2) A Latin translation of the work is preserved in the Bibliothèque Nationale (MS. 6514)—a fact which is of importance inasmuch as up to the present very few Arabic originals of mediæval Latin alchemical books which profess to be translations from Arabic have hitherto been unearthed. (3) Surely it is incorrect to say that the Greeks of Al-Rāzī's time were not acquainted with sal-ammoniac ? The earliest Muhammedan chemists, Khabid and Jabir, knew sal-ammoniac well, and their chemistry was directly derived from the Greek school at Alexandria. The earlier Greeks certainly employed sal-ammoniac in preparing various forms of *thion hudor*. (4) I find no justification for the statement that "most of the names of . . . apparatus found in his (Al Rāzī's) books are of Persian origin." *Tabistan* is admittedly Persian, but most of the other names are Arabic. As for the names of "rocks, earths and artificial products," while many are Persian a great many are directly derived from the Greek. (5) "Zarruch" is presumably a misprint for *zarnīkh*.—I am, Sir, etc.,

E. J. Holmyard

Clifton College
April 7, 1923

PERSONALIA

The Secretary for Mines has appointed Sir Frederick L. Nathan, K.B.E., Mr. J. D. Morgan, M.Sc., M.I.E.E., A.M.I.C.E., Mr. W. Rintoul, O.B.E., F.I.C., and Prof. R. V. Wheeler, D.Sc., to be a sub-committee of the Explosives in Mines Research Committee to investigate the means employed for firing explosives.

Mr. F. Fairbrother, M.Sc., has been appointed lecturer in chemistry in Manchester University.

Dr. W. Rosenhain, chief of the Metallurgical Department of the National Physical Laboratory, is at present lecturing in America on metallurgical subjects, and Sir J. J. Thompson, Professor of Physics in Cambridge University, is now lecturing at the Franklin Institute, Philadelphia, U.S.A.

* * *

The death is announced of Sir John Watney, for many years clerk of the Mercers' Co., and long associated with the City and Guilds Institute for Technical Education.

With regret we record the death of Prof. E. W. Morley, well known for his association with Prof. A. A. Michaelson in their experiments on the velocity of light. Prof. Morley also published classical papers on the atomic weights and densities of oxygen, hydrogen, etc.

From Germany the death is announced of Dr. A. Scholl, a well-known worker in the field of food chemistry.

NEWS AND NOTES

BRITISH INDIA

Second Forecast of the Winter Oilseeds Crop

Estimates based on reports received from provinces containing 98·7 per cent. of the total area under rape and mustard and 99·2 per cent. of the total area under linseed in British India indicate that the acreage (excluding the mixed crops of the United Provinces) under rape and mustard totals 3,693,000 and under linseed 2,499,000. These figures represent increases of 6 and 21 per cent., respectively, above the areas estimated at the same time last year. The present condition of the crops is reported to be good, except in Bengal, where the plants were adversely affected through continued absence of rain.—(*Ind. Tr. J., Mar.* 15, 1923.)

CANADA

Mineral Production in 1922

The value of the Canadian mineral output in 1922 was $183,000,000, an increase of $11,106,000 over the value recorded in the previous year. The value of the metal output was $61,000,000, of non-metals $82,500,000, and of structural material and clay products $39,300,000. An outstanding feature of the metal production was the increased output of gold in Ontario and British Columbia, the total Canadian production for the year increasing by 31 per cent. to 1,230,985 ozs. Silver advanced 30 per cent. in quantity, and 40 per cent. in value, whilst lead showed an increase of 41·2 per cent. in production and over 77·3 per cent. in value. Nickel and copper declined compared with 1921, but the advanced price of copper checked the decline in value to 2·6 per cent., the decrease in quantity being 9 per cent. The increase in the output of zinc by 6 per cent. was emphasised by higher prices. Cobalt production revived, 443,000 lbs. being produced, an increase of 76 per cent. in quantity and 91 per cent. in value. Coal production totalled 15,000,000 tons, valued at $66,486,025. The output of natural gas was 14,954,097 thousand cubic feet, valued at $5,468,963. A total of 136,657 tons of asbestos ($4,664,106) was produced, thus showing a large increase. The decline of $5,260,343 in the output of non-metallic minerals was due to labour troubles. On the whole, the state of the mineral industry may be considered as satisfactory, the total values attained having been exceeded only in 1920, 1919 and 1917.

UNITED STATES

The Organic Chemical Industry

The second annual meeting of the Synthetic Organic Chemical Manufacturers' Association was held in New York on March 8. Dr. C. H. Herty, President of the Association, reviewed events during the past year, and said that it had been a most remarkable period, as the industry had had to struggle for protective legislation, and at the same time protect itself against attacks upon the holding of patents authorised by the Government. In the course of the year the industry enjoyed, however, much more public understanding, relations between producers and consumers were more cordial, and sufficient orders were being placed to suggest that more prosperous times were ahead. Mr. F. P. Garvan, President of the Chemical Foundation, spoke of the endowment of research that had resulted from the campaign conducted by the Foundation in order to educate the public as to the value of chemistry, and pointed out that chemical manufacturers should also do their share in providing for the utilisation of the results of these efforts on a commercial scale. The necessity for co-operation between American manufacturers in order to produce a wider range of products, particularly dyes, was emphasised by pointing to the policy of the Interessengemeinschaft of accumulating profits in America from the sale of materials imported to compete against American industry.

FRANCE

A "Laboratory Day"

A "Laboratory Day" will be held in France on May 27, on the occasion of the centenary of the birth of Pasteur, and contributions then received will be utilised to equip research laboratories with apparatus, and to encourage research work.

A New Liquid Fuel Institute

The Minister of Public Instruction and of Fine Arts has issued a decree dated March 27, approving the decision of the Council of the University of Montpellier to establish an Institute for Liquid Fuels in the faculty of science at that university. It is interesting to note that a Petroleum Institute in the science faculty of the University of Strasbourg has already been working for nearly two years under the direction of well-known scientists and industrial leaders, and that extremely useful results have been obtained.

GENERAL

A New Alloy for Firebars

The burning of cast-iron firebars is one of the difficulties with which the engineer has to contend, as a set of bars can quite possibly be melted in a few weeks, and the troubles thus caused in connexion with mechanical stoking have been one of the serious disadvantages of this method of firing during the past century. Much light on the subject, however, has recently been thrown by researches of the International Combustion Corporation, Ltd., of Derby, as a result of which a new alloy, known as "Usco," a special variety of cast-iron, has been devised to overcome most of the difficulties. The action of the furnace consists of two distinct operations: (1) the melting of the iron, and (2) oxidation, but about 90 per cent. of the trouble is due to oxidation. Ordinary foundry iron contains, as chief impurities, phosphorus and sulphur, which, at the high temperature of the furnace, form phosphides and sulphides of iron. These melt at about 1740° F., so that as soon as a cast-iron firebar reaches this temperature it becomes porous, and the phosphides and sulphides melt and run out, leaving an expanded mass of pure cast-iron. This porous mass oxidises rapidly at about 1830° F., *i.e.*, at a lower temperature than ordinary non-porous cast-iron, the outer layers of the bar being converted, in turn, into purer cast-iron, steel, pure cast-iron and, finally, iron oxide. Graphitic carbon and silicon also add to the trouble, but the main cause is the phosphorus and sulphur. The new alloy is stated to have overcome all these troubles, as it consists of a special form of purified cast-iron with a much higher melting point and tensile strength. Its life is claimed to be from 3 to 10 times that of ordinary cast-iron, and it pours without difficulty and does not crack. The cost is only about 50 per cent. more than that of ordinary cast iron, and the qualities of the new alloy can thus easily be tested at little expense.

Italo-American Agreement for the Sale of Sulphur

Negotiations have been proceeding between the American and Italian producers of sulphur for some time past to obviate competition and to improve the position of the industry. It is now announced that a selling agreement has been reached, and it appears that, although no particulars have been issued, prices have been fixed for a period of 18 months or until the end of September, 1926. The agreement will be renewed automatically for a further period, unless cancellation is requested six months previously. It is understood that American producers will be restricted to the North American market and the Sicilian industry to Italy, other markets being allocated on the basis of the respective outputs of the two industries. The fixed allocation for export from Italy is 145,000 tons per annum, but the Italian producers can sell to any country an amount not exceeding 65,000 tons per annum of raw sulphur for the manufacture of sulphuric acid, making a total agreed export of 210,000 tons per annum. Details of the price arrangements will be awaited with interest, as American prices have been much smaller than the Italian ones. Further, the Italian production in 1922 was only 137,640 t. compared with 240,089 t. in 1921; exports from Italy in 1922 were 133,264 t. compared with 147,640 t. in 1921 or more than 200,000 tons below the pre-war average; and it is stated that large stocks still exist in Sicily. The head offices of the combine will probably be established in London under the management of representatives of both interests.

REPORT

Report of the Departmental Committee Appointed by H.M. Home Office to Re-examine the Comparative Efficiency, Cost and Effects on the Health of Workers of Lead and Leadless Paints. *Pp.* 66. *H.M. Stationery Office,* 1923. *Price 2s. 6d.*

(Specially Contributed)

This Committee, consisting of the Rt. Hon. Sir Henry Norman, Bart., M.P. (Chairman), Messrs. C. Bellhouse, C.B.E., O. J. Kauffmann, M.D., T. M. Legge, C.B.E., M.D., A. Munby, F.R.I.B.A., A. Scott, F.R.S., D.Sc., and H. O. Weller, M.I.C.E., A.R.I.B.A., has just issued an interesting document.

The introduction refers, at some length, to the reports (in one case a majority report) of the earlier House-Painting Committee and Coach-Painting Committee, and gives reasons why the findings of these committees have not been accepted by the new Departmental Committee, the main reason being the experience of substitutes for white lead used during the last ten years. After reviewing the determinations by Mr. C. A. Klein of the amount of dust, and of the lead contained in it, in the air breathed by painters engaged in the dry-rubbing down of old paint and in the wet-rubbing down, the Committee recommends "that dry-rubbing down be prohibited."

The allegation that poisoning by turpentine and turpentine substitutes is responsible for much of the so-called lead poisoning amongst painters is dealt with in detail, and is not substantiated to the satisfaction of the Committee whose report on this point is as follows: "We conclude that there is not sufficient ground to warrant us in accepting the view that turpentine poisoning is the cause of the leading symptoms commonly attributed to either acute or chronic lead poisoning, nor in attributing to the inhalation of the fumes of turpentine and other thinners the occurrence of chronic Bright's disease." But the Report recognises the injurious effect of some of these fumes and recommends ventilation of confined spaces during painting.

The evidence of the Director of Works in H.M. Office of Works was carefully considered. His Department had since about the year 1913 made considerable use of zinc base paints, and one gathers—though it is not definitely stated—that this practice was the result of some external pressure, for all the officials responsible for the large maintenance services of the Department spoke of the serious depreciation and lack of durability of the zinc paints in use. It was "practically a universal opinion on the part of fifty or sixty such officers that zinc base paints did not stand externally at all well." Analyses of paint scrapings, taken from exposed surfaces last painted with zinc base paints were made by the Government chemist showing the zinc content in the scrapings to be very small. In many cases it seemed the new zinc paint had almost entirely disappeared, and the scrapings mainly consisted of white lead paint applied many years ago. It is interesting to note that the Director of Works felt unable to make the proper economies in his estimates, unless allowed to return to the use of white lead, and appealed to have such government buildings as post offices and county courts excluded from the principle of prohibition of lead paints for internal painting if the Geneva Convention was applied to this country.

The conclusions reached by the Committee on the question of the painting of buildings are definite. "We are satisfied that for outside painting, and for certain kinds of internal painting, there is at present no efficient substitute for lead paint." The Geneva Convention is recommended for legislative sanction with some modifications, and regulations to deal with the continued use of lead paint are recommended for adoption at an early date. The Committee states: "We have to point out, however, that the evidence placed before us shows that, at present, any prohibition of the use of lead paints for certain purposes is likely to involve an increase of cost. This conclusion is based on the consideration of the total outlay required to maintain, respectively, lead and existing leadless paints in comparable condition over a reasonable period of years."

Other recommendations deal with coach painting, notification of lead poisoning among house painters, and the need for further research in paint technology.

At the urgent request of the Office of Works the Committee considered the policy of using leadless paints on Government buildings: "The cumulative effect of all the new evidence was obviously that there was a marked increase of cost involved in the maintenance of external surfaces painted with non-lead paint. . . . We are satisfied, however, that the dangers attendant upon the use of lead paint can be minimised by means of Regulations providing for the abolition of dry rubbing down, for adequate arrangements for personal cleanliness, and where necessary for medical examination of the workers." The Report also refers to the degree of solubility of lead sulphate, and the poisonous character of this and some other pigments, but without going into these matters in great detail. Analyses of paint scrapings, statistics, particulars of the state of various government buildings, draft regulations and certain documents are found in the Appendix.

* * * * *

It is not often that one Departmental Committee comes in so definite a manner and after so short an interval to conclusions which are so subversive of the labours of previous Committees. The perusal of this report, and some other reports on this rather difficult topic, leaves on one's mind the impression that some of the earlier Committees were chosen not to investigate the policy which was most desirable in the interests of the community, but how a particular policy, which seemed to someone in authority a proper one, could most conveniently be put into operation. Complaints were freely made as to the methods of some of the earlier Committees, and if the above surmise is well-founded the divergence of view between the old Committees and the latest is not surprising. Sir Henry Norman's Committee included, besides an experienced Chairman, two Home Office officials, two men with medical knowledge, two architects, and two with chemical knowledge adequate for the subject to be investigated. The details of evidence given in the report, though scanty, appear to justify the main conclusions arrived at, and the verbatim evidence will be read by many with a good deal of interest. There is no obvious background of bias or prejudice in the report; the members of the Committee, indeed, appear to have considered the evidence with impartiality and a desire to get at the facts. It will be a surprise if some of the witnesses complain as a certain eminent Austrian complained when he was invited to give evidence before an earlier Committee. It is hardly to be expected that this report will be as fiercely attacked as was a "questionnaire" mentioned in it. Yet this report will not be entirely satisfactory to any of the parties most intimately affected; the lead industry and the zinc industry will each feel they could have better brought out some pertinent fact, the employers and the workers will each anticipate some troublesome times to come, but perhaps the severest critics of all will be the officials of the International Labour Office at Geneva, whose strongly partisan attitude on this question finds no reflection in this almost judicial report. Lord Askwith's recent letter to the *Times* suggests that already some of the chiefs at Geneva are preparing an onslaught, nursing their wrath to keep it warm, and it may be they will again disinter the lead emanation and furnish the unwary with cinema shows of dubious origin and suitable extracts from the writings of Monsieur Souris. Whether the Department of Scientific and Industrial Research would be wise in undertaking a thorough investigation of painting conditions is a matter of opinion. Proper paint tests would take many years and involve the expenditure of many thousands of pounds. It is no slight task to paint under carefully measured conditions, surfaces of wood, iron and other substances, with half-a-dozen pigments, both in external and internal situations, in the pure air of the country, the salt air of the coast and the acid air of the towns, in dry and in very wet climates, and to inspect these at suitable intervals with necessary repaintings, and then to know what each has cost in labour and materials. Some persons think that the money could be better employed in other ways.

THE NORMAN COMMITTEE REPORT

By PROF. H. E. ARMSTRONG, F.R.S.

Although a proper course would be to await publication of the evidence upon which it is founded before discussing the Report of the Home Office Departmental Committee on Lead Paints, yet in view of the obligation our Government is under to ratify *or otherwise* treat the Draft of Convention "adopted" at Geneva in November, 1921, on or before the 19th of May proximo, a few remarks may be permitted.

To one who, like myself, has had the nightmare of white lead upon him during a dozen years past, it is satisfactory to be at last able to deal with a rational document. Those of us who have fought consistently and persistently against the false statements and views prevailing from 1911 onwards may at last claim to have been justified in their resentment of the treatment lead has received at Government hands. The present Report clearly nullifies the findings of the two previous Committees.

Misrepresentation is not yet stayed, however. At a meeting recently held in Paris (March 3), referred to in the *Times* last week by Lord Askwith and Sir Claude Hill, the latter a Red Cross Knight, apparently with small qualification to deal with the subject of lead in any shape or form (unless, perhaps, it be dum-dum bullets), the old attempt was made, following the tactics adopted by Monsieur Thomas and his myrmidon at the Geneva Labour Office, to prejudice the issue by sensational, misleading and unwarrantable statements. The lecturer, Monsieur H. L. Breton, quoted experiments which he asserted gave proof of the issue from lead paint of poisonous plumbiferous vapours. I would give the lie direct to such ancient vintage of false observation. Mr. C. A. Klein, and I, over and over again have examined the statements made by various observers here and abroad, that lead is volatilised during the drying of paint. We have proved that they have been in error in every case. The Government Chemist has corroborated us. When, in giving evidence to the Norman Committee, I began to refer to this matter, I was at once stopped by Dr. Legge with the remark, "that question is quite closed."

The Norman Committee, in fact, has reduced the issue to very simple dimensions—to a question of dust. It is now admitted that the one real danger is that arising from the dust produced when paint is rubbed down dry—further, that the production of such dust may be obviated by wetting the surface and then rubbing down with a wetted waterproof sandpaper.

To make painting an ideally healthy occupation, indeed, one to be sought after and preferred, it is only necessary to provide that painters always wet—I will not say with what or what. Otherwise, No Prohibition!

The Committee, however, have not had the courage of their convictions, the courage to be logical and say to Government: Let Monsieur Thomas and Co., and all the maladroit machinery of Geneva, go hang. There is no longer need to fear lead paint. Don't hamper industry, rather seek to promote it. They have treated the Convention seriously, whereas it was a farce (see my article in Nos. 2 and 3 of *Chemistry and Industry*). Dr. Legge, being a member of the Committee, could not well do otherwise, I imagine, than advocate the acceptance of the Convention which was of his promotion; had he not intervened at Geneva, there would have been no Convention voted of any kind. In fact, Sir Montagu Barlow, just before the vote was taken, made the cryptic statement: "The position of Great Britain has been plain all through. Great Britain has declined to take part in the matter so far as it is contentious." It never was otherwise. Not having voted at the early stages when their votes would have changed the issue, the British delegates should have abstained to the end. The decision taken was pure Quixotism.

Is, then, a most serious blow to be delivered at the lead industry in Australia and elsewhere? Are British householders generally to be denied the use in their homes of the most effective paint known, merely because a wave of madness passed over an inconsiderate polygot sentimental assembly in Geneva? If industries are to be subject to such influence and interference, the sooner the influence be removed the better. That we should contribute £40,000 a year to maintain in luxury an institution in Geneva engaged in the brewing of such wickedness is Gilbertian, the more as we are starving our home institutions.

PARLIAMENTARY NEWS

Trade in Carbon Black

Answering Mr. R. Young, Lt.-Col. Buckley said that the quantity and value of imports of carbon black during 1920, 1921, and 1922 were 59,020 cwts. (£284,507), 49,320 cwts. (£200,350), and 77,606 cwts. (£278,384), respectively. In 1922 the imports originated as follows:—Netherlands 948 cwts., Germany 6646 cwts., United States 68,467 cwts. and other countries 1545 cwts. Re-exports during the three years in question were 1146 cwts. (£7181), 775 cwts. (£4792), and 1201 cwts. (£5081). In 1922 Denmark took 213, Netherlands 76, France 538, and other countries 375 cwts.—(Mar. 28.)

Dangerous Drugs (Imports)

Mr. Bridgeman, in a written answer to Mr. Gilbert, gave the imports of opium as 423,530 lb. in 1920, and 58,161 lb. in 1921. Imports of morphine and morphine salts during the two years amounted to 320 and 1100 oz. respectively and of cocaine and cocaine salts to 7227 and 24,663 oz. respectively.—(Mar. 28.)

Imports of Dyestuffs from the United States

Replying to Mr. G. White, Lieut.-Col. Buckley gave the following figures of imports of intermediates and coal-tar dyes from the United States during the three past years, the value being shown in parentheses: *Coal-tar intermediates*, including aniline oil and salt and phenylglycine:—1920, 2226·3 long tons (£736,221); 1921, 66·2 t. (£27,891); 1922, 1 cwt. (£8). *Finished coal-tar dyes*:—1920, 781·8 t. (£532,897); 1921, 60·9 t. (£35,576); 1922, 7·5 t. (£1444).—(Mar. 26.)

Safeguarding of Industries Act

Sir P. Lloyd-Greame informed Mr. Rose that the available facts did not support the suggestion that the Act tended to encourage importation of Belgian and other glassware at the expense of German, and failed to protect the British manufacturer. He was not prepared to cancel the Glassware Order under Part II of the Act.—(Mar. 27.)

Adjournment of the House

The House adjourned from March 29 till April 9.

COMPANY NEWS

THE BRITISH ALUMINIUM CO., LTD.

The annual meeting was held on March 27. Mr. A. W. Tait, who presided, said that the net profit for the year was £229,235 as against £221,506 in the previous year, and the trading profit £195,231 compared with £183,041. As the demand was small at the beginning of the year the aluminium works in Norway and the alumina works in this country were closed, but were re-opened later on in the year. The output at the works in Scotland and Vigelands, Norway, was greatly increased, reaching full capacity in the autumn. A small aluminium works at Stangfiord, Norway, was brought into operation this year. Trading conditions during the past year were abnormal and, owing to competition, prices were low. At present the company could not compete in Continental markets owing to the exchange and to other restrictions. Since the beginning of 1923, demand had improved and all the company's works were producing at capacity, but prices had not materially improved. Owing to the improved situation, an interest had been secured in a company owning two factories in Norway, which had been shut down for some time, and one of these works would come into operation very shortly. The company was not proceeding with the Lochaber water-power scheme owing to the industrial conditions and the high cost of labour and material. No progress had been made with the Orsrères Power scheme, and in view of the present conditions, the company's interest in it might be disposed of. A final dividend of 5 per cent. per annum was paid on the ordinary share capital, leaving a carry-forward of £15,777.

REVIEWS

TONWARENERZEUGUNG. *By* Professor W. RUDOLPH. *Second edition. Pp.* 210. *Leipzig: Max Jänecke*, 1923. *Price* 4*s*. 3*d*.

This is a type of book which has long been popular in Germany, but has only lately been recognised in this country. It is one of a large series of small technical volumes, which are more than 'primers,' but not large enough to be 'handbooks.' They appear chiefly to be read by people who wish to gain rapidly a general idea of the technology of the industry concerned, without troubling themselves with a great amount of detail.

The present volume, which deals with the manufacture of clay-wares, is typical of others in the series. It commences with a very brief introduction, followed by a history of pottery manufacture, which occupies about one-tenth of the volume. Nearly half the volume is devoted to very brief notes on substances used in pottery manufacture, arranged under their respective elements, the latter being in alphabetical order, and the remainder of the volume is occupied with brief descriptions of various methods used in the manufacture of clay-wares.

The notes on each subject are so brief as to be of little or no value to manufacturers or users of pottery, or to chemical engineers engaged in the design or supply of machinery, kilns, etc. for these industries. The volume may, however, be useful as an elementary textbook if used by a good teacher, or as a "reader" for students of ceramics who wish to gain a greater familiarity with the German language.

In several instances the author shows a lack of acquaintance with recent investigations outside Germany, and he appears to favour the Schulze elutriator in preference to the much more accurate one devised by Schoene. He does not appear to have realised the misleading nature of the results of a "rational analysis.' There are unfortunate defects in a book by the Director of a State Pottery School. Colloids are described as substances which swell in water like glue, but no explanation of colloidal sols and gels or of their essential characteristics, is given. Yet plasticity is attributed to the formation of colloids by the action of water on clay! The constitutional formula he uses for kaolinite is an unusual one (though this is not stated), and that for sillimanite—the chief product of the calcination of kaolinite—cannot be derived from it in any simple manner. There is a copious index.

A. B. SEARLE

A TEXT BOOK OF INORGANIC CHEMISTRY. *By* G. S. NEWTH, F.I.C. *New and enlarged edition. Pp. xiii*+772. *London: Longmans, Green and Co.*, 1923. *Price* 8*s*.

It may be assumed that Newth's Inorganic Chemistry has been one of the most successful of such text-books. It will be remembered that the book is divided essentially into two sections: first, a consideration of the fundamental theory, and second, an encyclopædic account of descriptive chemistry. Throughout the tendency is to give definite statements: final conclusions rather than a review of the evidence upon which these conclusions are based. Thus the book loses something of the romance of chemistry and becomes dull and prosaic. It may also be questioned whether the modern teacher does not find that this divorce of theory and practice is wrong. Thus, for example, the underlying principles of the Haber synthetic-ammonia process are not dealt with; and in passing it may be said that there is no reference to the other modern methods, such as the Serpek process.

This didactic method requires rigid accuracy, and such statements as the following are misleading: "a temperature of −260° C. has been obtained, which is the lowest degree of cold ever reached"; "the exact ratio of the weights of an atom of hydrogen and oxygen is not known with certainty" (Burt and Edgar's work is not mentioned); no bismuth hydride is known; "Moissan's recent success in the isolation of fluorine"; carbon dioxide "is largely manufactured from these materials"—sulphuric acid and chalk. In many places the nomenclature and symbolisation are not those in common use to-day.

These, and similar errors of revision, suggest that the new edition is really only a reprint with additional chapters; which is hardly sufficient if the book is to maintain its position amongst modern text-books. Of the new chapters, that on the Phase Rule is on the whole good and deals well with some common difficulties; but it contains a bad statement (p. 171), that in the water diagram "at the (invariant) point z, *and at that point alone*, is ice in equilibrium with water." The diagram on p. 174 is not correct, for it does not show that, when such an unsaturated salt solution is cooled, ice first separates. The chapter on Atomic Structure is inadequate, omitting as it does all reference to the work of Bohr, Moseley and the Braggs; and having said (p. 186) that the nucleus contains "cementing" electrons, it necessarily follows that the statement (p. 187), "the atomic number also expresses the number of electrons in an atom" is wrong.

The revision might have been more thorough; but certain chapters, particularly of the introductory section, are very well written, and the book probably still remains the most satisfactory text-book available at this price.

A. WESTON

MARKET REPORT

This market report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acid Acetic, 40% tech.	£23-£25 per ton. Very firm with little available. Complete absence of German supplies.
Acid Hydrochloric	4s. per carboy.
Acid Nitric	£24 10s. per ton. No signs of improvement.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw., is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Steady demand. Continental inquiries more frequent.
Arsenic (White)	£70-£75 per ton. Market steady.
Bisulphite of Lime	£7 per ton. Packages extra.
Bleaching Powder	£10 10s. d/d. No change. Spot demand poor.
Calcium Chloride	£6 per ton d/d.
Copper Sulphate	£27 per ton. Somewhat firmer.
Potash Caustic, 88/90%	£35 per ton. Considerably advanced in value. No German supplies.
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton. Normal.
Soda Caustic, 76%	£20-£21 per ton. Demand good, especially for the Continent.
Soda Crystals	£5 5s. carr. paid. No change. Demand quite good.
Sod. Bicarbonate	£10 10s. per ton.
Sod. Acetate, 97/98%	£25 per ton.
Sod. Bisulphite Powder 60/62%	Ton lots: £19 .. 10 £19 10s. 5 £20 .. 2 £20 10s. 1 F.o.b. or f.o.r. London, 1-cwt. iron drums incl'ded
Sod. Chlorate	3d. per lb. Demand not quite so brisk with better supplies.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide	£15 conc. solid, carr. paid. Better demand.
Sod. Sulphite—	Ton lots.
Pea Crystals	£17 .. 2 £17 10s. 1 1-cwt. wooden kegs included.

RUBBER CHEMICALS

Antimony Sulphides—	
Golden	8d.-1s. 3d. per lb.
Crimson	1s. 7d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6½d. per lb.
Sulphur, Finest	£11 10s. per ton.
Arsenic Sulphide	2s. per lb.
Chromium Oxide	1s. 5d. per lb.
Lead Hyposulphite	8d. per lb.
Zinc Sulphides	7½d. per lb.
Carbon Bisulphide	£28 per ton.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Thiocarbanilide	2s. 6d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£10 per ton d/d.
Grey	£20 per ton d/d.
Liquor	9d. per gall 32° Tw.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. per gall. 24° Tw.
Red Liquor	1s. 3d. per gall. 14/15° Tw.
Wood Creosote	2s. 6d. per gall. unrefined. Lower prices, however, are asked in some quarters.
Wood Naphtha—	
Miscible	6s. 6d. per gall. 60% O.P.
Solvent	5s. per gall. 40% O.P.
Wood Tar	£5 per ton d/d.
Brown Sugar of Lead	£39 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 7d.-1s. 8d. per lb. No change.
Crude 60's	4s.-4s. 6d. per lb. Market firm.
Acid Cresylic—	
97/99	2s.-2s. 3d. More inquiry for prompt and forward delivery.
Pale 95%	1s. 10d.-2s. 2d. Market steady, with slightly improved inquiry.
Dark	1s. 6d.-1s. 11d. Moderate business passing.
Anthracene Paste, 40%	4d. per unit per cwt. Price still nominal.
Anthracene Oil—	
Strained	9⅝d.-11d. per gall. More inquiry. Supply limited.
Unstrained	9d. per gall.
Benzole—	
Crude 65's	1s. 1d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall.
Pure	2s.-2s. 3d. per gall. Fair inquiry.
Toluole—90%	1s. 9d.-1s. 11d. per gall. Fair demand.
Pure	2s.-2s. 6d. per gall. Little business moving.
Xylol	2s. 9d.-3s. 3d. per gall.
Creosote—	
Cresylic, 20/24%	11d.-1s. 1d. per gall.
Middle Oil	8¾d.-9½d. per gall. Market firm.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d.-9¼d. per gall.
Solvent, 90/160	1s. 5d.-1s. 9d. Market somewhat weaker.
Solvent, 90/190	1s. 6d.-1s. 7½d. per gall. Little business doing.
Naphthalene, Crude—	
Drained Creosote Salts	£5-£9 per ton. Supply still scarce. Good demand.
Whizzed or hot pressed	£10 15s.-£13 10s. per ton. Supply short.
Naphthalene—Crystals	£17 per ton.
Flaked	£16 per ton.

Pitch, Medium Soft	190s.-200s. per ton. Market steady.
Pyridine—90/140	11s.-12s. Fair enquiry.
Heavy	8s.-9s. Price nominal.

INTERMEDIATES AND DYES

Acetic Anhydride	1s. 5d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 7½d. lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. lb. 100% basis d/d.
Aluminium Chloride, anhydrous	1s. per lb. d/d.
Aniline Oil and Salts	9½d. per lb. naked at works.
Antimony Pentachlorine	1s. 1d. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlor Phenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
p-Dichlorbenzol	£55 per ton.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene—48/60	8d.-9d. naked at works
66/68	1s. 2d.-1s. 3d. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d. Packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Monochlorbenzol	£70 per ton.
a-Naphthol	2s. 9d. per lb.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d.-8d. per lb.
Nitronaphthalene	1s. per lb. d/d.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
Sod. Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	13s. ,, ,,
Amyl Acetate	2s. 6d. ,, ,,
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol, melting point 21/22° C.	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehydo free from Chlorine	3s. ,, ,,
Benzyl Benzoate, 19.5° C.	3s. ,, ,,
Cinnamic Aldehyde—	
98/100% Natural	14s. 9d. ,, ,,
Coumarin	15s. 6d. ,, ,,
Citronellol	22s. 6d. ,, ,,
Citral, 100%	9s. 6d. ,, ,,
Ethyl Cinnamate	18s. 6d. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	7s. 6d. per lb.
Iso Eugenol	16s. 6d. ,, ,,
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	22s. 6d. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Ketone	35s. ,, ,,
Musk Xylol	9s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	24s. 6d. ,, ,,

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil, Red Ship Brand	2s. 1d. per lb.
Bergamot Oil	12s. 6d. spot, 13s. 6d. forward.
Cananga Oil, Java	9s. per lb.
Cinnamon Oil, Leaf	4¼d. per oz.
Cassia Oil, 80/85%	8s. 3d. per lb.
Citronella Oil—	
Java, 85/90%	4s. per lb.
Ceylon	3s. 4½d. per lb.
Clove Oil	8s.-8s. 6d. per lb.
Eucalyptus Oil, 70/75%	1s. 9d. per lb.
Lavender Oil, Mont Blanc, 38/40%	13s. per lb.
Lemon Oil, spot	3s. per lb. Higher prices are asked for forward delivery.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet, spot	11s. 6d. Higher prices are asked for forward delivery.
Otto of Rose Oil—	
Anatolian	24s.
Bulgarian	26s.
Palma Rosa Oil	17s.
Peppermint Oil—	
English, Mitcham	80s. per lb.
Mayne County	13s. per lb.
Japanese	6s. 6d. per lb.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid Acetic, 80%	£50-£52 10s. per ton.
Acid Acetyl Salicylic	3s. 3d. per lb. In fair demand at previous quotation.
Acid Benzoic	2s. 3d. per lb. still quoted, but spot supplies are much shorter.
Acid Citric	1s. 8½d.-1s. 9d. per lb. Demand improving.
Acid Gallic	3s. per lb. for 2-cwt. lots, 3s. 3d. per lb. for 56 lb. lots.
Acid Pyrogallic, cryst.	5s. 9d. lb. Price advanced.
Acid Salicylic	2s. 2d.-2s. 6d. per lb. firmly held.
Acid Tannic	3s. 3d. per lb. for a good light quality.
Acid Tartaric	1s. 3d., less 5%. Demand continues to increase. Owing to the cutting off of supplies from Germany, the U.S.A. is reported to be buying largely from Italy. This has stiffened Italian prices, and raw materials still advancing,

	and a further rise in the price of the finished product must of necessity follow.
Amidol	9s. per lb.
Acetanilide	1s. 6d. per lb. Demand still poor.
Amidopyrin	14s. per lb.
Ammon. Benzoate	3s. 3d. per lb. Slightly higher.
Ammon. Carbonate B.P.	£37 10s. per ton.
Barbitone	17s. 6d. per lb. Higher prices are quoted by some holders.
Benzonaphthol	3s. 3d. per lb.
Bismuth Salts	Unchanged Steady market.
Bromides	Very firm. Will probably advance as foreign stocks become depleted.
Calcium Lactate	2s. 9d. per lb. for best English makes.
Chloral Hydrate	4s. per lb. Slightly weaker.
Guaiacol Carbonate	10s. per lb. is the present value. Higher prices being quoted on heavy demand from abroad.
Hexamine	4s. 6d. per lb. for present stock. This price will have to be advanced when stocks get lower, as the prices quoted from the Continent for forward delivery are on a much higher level.
Iron Ammon. Citrate	2s. 5d. per lb. for 1-cwt. lots. Market rather quiet.
Magnesium Oxide, Heavy	2s.-2s. 3d. per lb. Good demand.
Menthol	32s. per lb. for original cases. Smaller quantities 33s. lb.
Methyl Salicylate	2s. 6d.-2s. 7d. per lb. for glass containers.
Methyl Sulphonal	13s. 6d. per lb.
Mercurials	Slightly weaker on the reduction in the price of the metal.
Paraformaldehyde	4s. per lb.
Paraldehyde	1s. 7d.-1s. 8d. per lb. Very firmly held at this figure.
Phenacetin	6s. 6d. per lb. is the present advanced rate.
Phenazone	7s. per lb. would probably be accepted, although higher rates are expected in the future.
Phenolphthalein	5s. per lb. Unchanged.
Potass. Bitartrate—99/100% (Cream of Tartar)	98s. per cwt., less 2½%. Price tending to advance owing to continued rise in raw materials.
Potass. Iodide	15s. 8d. per lb. for cwt. lots. Good demand.
Potass. Permanganate	10d. per lb. still wanted.
Potass. Sulphoguaiacolate	5s. 6d. per lb. Firming up.
Quinine Sulphate	2s. 3d.-2s. 4d. Steady.
Resorcin	5s. per lb. Quiet at this figure.
Salol	2s. 9d. per lb. In short supply.
Silver Proteinate	10s. per lb.
Sod. Benzoate	2s. 3d. per lb. Very firm.
Sod. Citrate	U.S.P. quality 2s. 2d. per lb. for cwt. lots.
Sod. Hyposulphite—Photographic	£15-£17 per ton according to quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. per cwt. Demand poor.
Sod. Salicylate	2s. 5d. for Powder, 2s. 6d. for Crystal. Very firm at these figures, which are based on a lower price for phenol than the present market cost.
Sod. Sulphite, anhyd.	£27 10s.-£28 10s. per ton f.o.r. London, 1-cwt. wooden kegs included.
Sulphonal	13s. per lb.
Tartar Emetic, B.P.	1s. 3d. per lb. Demand small.
Thymol	18s. per lb. for White Crystals. A synthetic product is being offered at lower figures.

TRADE NOTE

Wages in the Heavy Chemical Trade

Workers in the heavy chemical trades are to vote this week on the employers' proposals to reduce wages. Some 50,000 workers are involved, the chief centres affected being London, Manchester, Birmingham, Leeds, Stafford, Newcastle, and large areas in North and South Wales. The employers insist on reducing the pay of shift workers by ½d. an hour. Two rates of pay are in force, time workers receiving 1s. per hour, and process or shift workers 1s. 2d. per hour. A meeting of the Joint Industrial Council for the Chemical Trades, representing both parties, will meet on April 19 at the Ministry of Labour.

PUBLICATIONS RECEIVED

The Phase-Rule and its Applications. *By* Prof. A. Findlay. *Text-Books of Physical Chemistry, edited by* Sir W. Ramsay *and* Prof. F. G. Donnan, F.R.S. *Fifth edition. Pp. xvi*+298. *London: Longmans, Green and Co.*, 1923. *Price* 10*s*. 6*d*.

Surface Tension and Surface Energy and Their Influence on Chemical Phenomena. *By* R. S. Willows, M.A., D.Sc., and E. Hatschek. *Text-books of Chemical Research and Engineering, edited by* W. P. Dreaper, O.B.E. *Third edition. Pp. viii*+134. *London: J. & A. Churchill*, 1923. *Price* 6*s*. 6*d*.

Industrial Organic Chemistry. *By* Dr. S. P. Sadtler *and* Dr. L. J. Matos. *Fifth edition, revised, enlarged, and in part rewritten. Pp. xvi*+691. *London: J. P. Lippincott Co.*, 1923. *Price* 35*s*.

Laboratory Manual of Physical Chemistry. *By* Prof. A. W. Davison *and* Prof. H. S. van Klooster. *Pp. viii*+182. *London: Chapman and Hall, Ltd.*, 1922. *Price* 10*s*.

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EDITORIAL

PROFESSOR MORGAN'S Review of the Synthetic Vat Colours by Professor Thorpe and Dr. Ingold, which appears in this issue, directs our attention to an interesting book and an important British industry. Professor Morgan's reference to Tyrian-purple caused us to turn to the book. There is a flavour attached to such names as Tyrian-purple and purple of Cassius which should be a valuable asset, and we are surprised that no enterprising advertiser converts to his own advantage a name which has such a history and romance as Tyrian-purple. Dibromo indigo which forms a large proportion of the colouring matter of the shellfish purple, can be made synthetically. But for every one who would buy dibromoindigo there must exist scores who would like to possess a fabric dyed with Tyrian-purple, and if judicious steps were taken it might for a season or two be the fashionable colour. The difficulties of the vat dye industry are, however, too great for an idle speculator to solve and too important to be neglected. We are glad to note that Professor Morgan will shortly deal with these in a serious manner in these columns, and we look forward to an article from him, knowing that such a contribution to the solution of the problem will deserve close consideration.

* * *

Justus von Liebig, who died fifty years ago, on April 18, 1873, at the age of seventy, is remembered to-day not only as the greatest chemist of his time, but as the author of theories of plant physiology that had far-reaching effects. Briefly, his main theory was that the plant built up its tissues solely from atmospheric carbon-dioxide and nitrogen, and that if it were supplied with the equivalent of its ash constituents, nothing else need be added. It is of interest to note that Liebig's pupil, Dr. J. G. Gilbert, in conjunction with Sir J. B. Lawes, started the series of experiments to test the validity of Liebig's theories that are still being continued at the Rothamsted Experimental Station.

THE ALKALI CENTENARY

The Centenary Celebration of the foundation of the Alkali Industry in this country directs our attention to an interesting and important piece of national history. To develop a new chemical manufacture, requires two kinds of talent which are very rarely found in one individual; scientific talent, capable of making use of chemical discoveries as they are made known and of improving and supplementing them, and business talent, sagacious in knowing when and where to start a business, how to organise sales, how to make the greatest profits in good times, and the smallest losses in bad times. The Alkali Industry in this country was founded so long ago that the scientific discoveries were vastly simpler then than they are at present.

It was not until the second half of the eighteenth century that the manufacture of chemicals became of importance, although prior to that time, alum, saltpetre, soap, white lead and some other pigments were made here and there in small quantities, and sulphuric acid was manufactured on a fairly large scale at Preston Pans by Roebuck since the year 1746. The investigations of Black, Cavendish and Rutherford, the discovery of oxygen by Priestley in 1774, the discovery of oxygen and chlorine by Scheele in the same year, and the establishment of chemistry as a science shortly afterwards by Lavoisier, brought the manufacture of chemical compounds into considerable prominence. It was in 1775 that the Académie des Sciences offered a prize of 2400 livres for the best process for producing soda from common salt, and during the last years of the century many French chemists devised processes of which the only one which need be mentioned here was that of Nicholas Leblanc, projected in 1787 and patented in 1791. This process was the treatment of salt by sulphuric acid to form sodium sulphate and hydrochloric acid; the operation was usually carried out in two stages represented by the following equations :—

$$NaCl+H_2SO_4 = NaHSO_4+HCl$$
$$NaCl+NaHSO_4 = Na_2SO_4+HCl$$

The hydrochloric acid, according to Leblanc's process, should be absorbed by ammonia, but in practice a good deal of it was allowed to escape into the air. The sodium sulphate or salt-cake was heated with carbon and limestone, and the operation, which like the first was conducted in two stages, is represented as follows :—

$$Na_2SO_4+C_4=Na_2S+4CO$$
$$Na_2S+CaCO_3=Na_2CO_3+CaS$$

The carbon monoxide was allowed to escape, the mixture of sodium carbonate and calcium sulphide was treated with water which dissolved the sodium carbonate, whilst the calcium sulphide was thrown away. Leblanc, although his process was once extensively used, did not receive the coveted prize and had a miserable end.

The Leblanc process was tried on a small scale by Mr. Losh, who started a works in Newcastle-on-Tyne in 1796, and by Tennant at the St. Rollox works about 1817, but it was not developed in this country until James Muspratt in 1823 commenced its manufacture on a serious scale at Liverpool.

Closely associated in these early days with the manufacture of alkali was the manufacture of bleaching powder. It was in 1785 that Berthollet first used chlorine water for bleaching purposes and three years later Charles Tennant, then a bleacher at Darnley, near Paisley, used a solution of chloride of lime for this purpose. He took out a patent for the manufacture of this "bleaching powder" in 1799 and commenced the manufacture of it at the St. Rollox works in Glasgow which he had founded in 1797. Bleaching powder fitted in with the manufacture of alkali very conveniently, for it was made by passing chlorine gas over dry slaked lime and the chlorine gas was made by treating manganese dioxide with hydrochloric acid, which is one of the by-products of the manufacture of salt cake. The various equations which epitomise these reactions are as follows :—

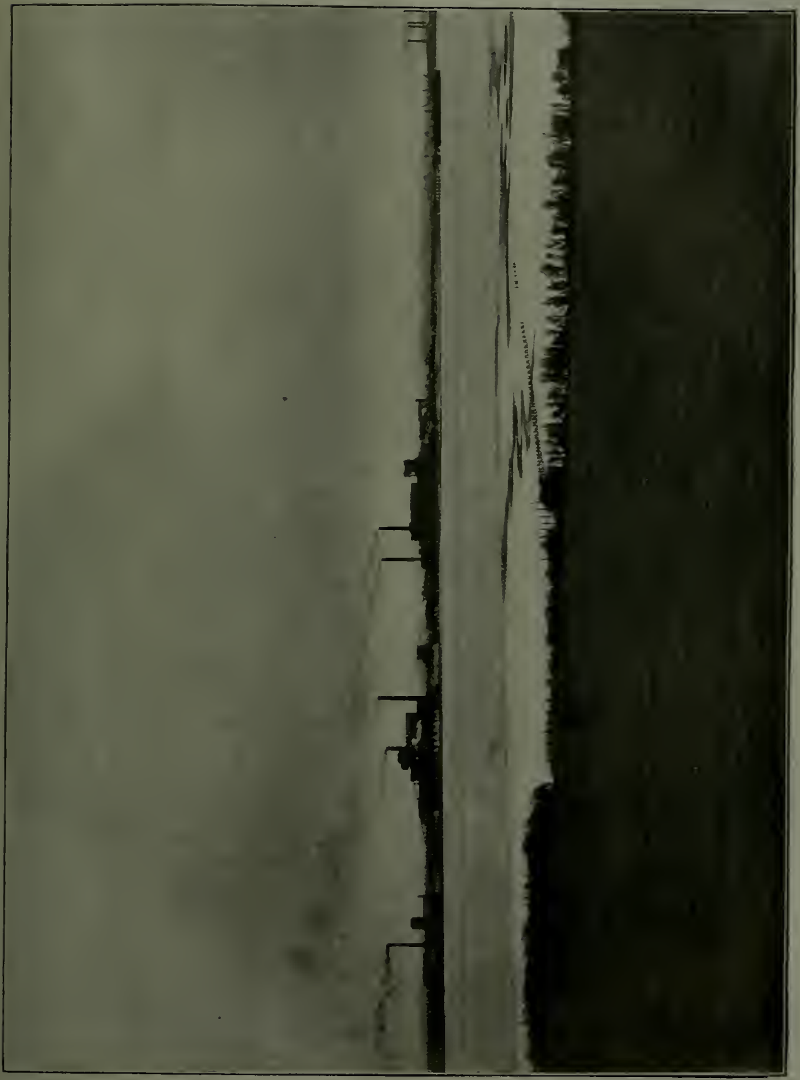
$$4HCl+MnO_2=Cl_2+MnCl_2+2H_2O$$
$$3Ca(OH)_2+2Cl_2=2Ca\left\{\begin{matrix}OH\\OCl\end{matrix}\right.+CaCl_2+2H_2O$$

where bleaching powder is considered to be a mixture of $Ca\left\{\begin{matrix}OH\\OCl\end{matrix}\right.$ and $CaCl_2$. The utilisation of by-products is, of course, essential to the economical manufacture of any chemical compound, and by combining the manufacture of alkali with that of bleaching powder the by-products left available were (1) a quantity of hydrochloric acid escaping into the air; (2) carbon monoxide from the black-ash process; (3) calcium sulphide; and (4) manganese chloride from the chlorine gas process. Some of these products were successfully dealt with in later years. Meanwhile, chemical works were from time to time started in various places; in 1809, Josiah C. Gamble commenced the manufacture of bleaching powder in Monaghan, and in 1815 he set up a works for the manufacture of this and sulphuric acid in Dublin; in 1820 Andreas Kurtz started the manufacture of chromate of potash in Manchester; and in 1823 John Mercer started a works for making dry stannate of soda in the same district. But an event of greater importance to the industry also took place in that year. The heavy salt tax which had greatly burdened the industry was repealed in 1823, and immediately thereafter James Muspratt saw the possibilities of the manufacture on a large scale of alkali in Lancashire in the vicinity of the salt deposits of Cheshire and the coalfields of Lancashire. James Muspratt was a manufacturer of prussiate of potash near Dublin who in 1822 came to Liverpool and started a small sulphuric acid factory there. The repeal of the salt tax gave him his opportunity and he took it. The manufacture under his management was prosperous, and in 1828 he was joined by Josias Gamble and the two set up a larger works at St. Helens. The partnership was dissolved after a couple of years. Muspratt set up a works at Newton near Liverpool, and Gamble remained in St. Helens. In 1836 Gamble and the Crosfields started another works at St. Helens for the manufacture of alkali, and about the year 1842 Andreas Kurtz began to work the Leblanc process in another works at St. Helens. The manufacture of alkali on a large scale soon showed the necessity for improvements and modifications, and many of these and some alternative processes were tried. Of the latter the ammonia-soda process is the most important. It was originally worked out and patented by Harrison G. Dyar and John Hemming in 1838 and depends on the decomposition of common salt by ammonia and carbon dioxide in accordance with the following equation :—

$$NH_3+CO_2+NaCl+H_2O=HNaCO_3+NH_4Cl$$

The process is carried out by passing carbon dioxide into a solution of salt and ammonia in water; the bicarbonate of soda being only slightly soluble crystallises out, and the mother liquor containing ammonium chloride is heated with lime forming calcium chloride and ammonia which is used again in the process. The calcium chloride is of value and can be purified and sold. Dyar and Hemming were not able to work the process economically, nor were Henry Deacon and William Pilkington who tried it in 1853 at Widnes, nor James Muspratt who tried it in his works at Newton about the same time, and it was not until 1855 that it was carried out on a large scale by Schlössing and Rolland near Paris. Not until Solway worked the process at Brussels in 1861 did it become profitable. Another alternative process formerly in use was the Hargreaves' process which consisted in treating salt in a kiln with sulphur dioxide, steam and air, so as to produce the following action :—

$$2NaCl+SO_2+H_2O+O=Na_2SO_4+2HCl$$



FLEETWOOD AMMONIA-SODA WORKS

The Leblanc process had disadvantages, of which the loss of hydrochloric acid escaping into the air and the loss of sulphur in the form of calcium sulphide were very important. The first of these defects was remedied by William Gossage, an alkali maker at Stoke Prior, in Worcestershire, who in 1836 patented a condensing tower containing lumps of coke down which water descended and up which the gases containing the hydrochloric acid rose. The water absorbed the hydrochloric acid, effecting a saving of money and reducing very much the destructive effect of the acid vapours on the vegetation of the vicinity. The Gossage tower was extremely successful and widely adopted. In the following year, 1837, Gossage took out a patent for a process for avoiding the waste of sulphur. He treated the calcium sulphide with carbonic acid, which formed calcium carbonate and sulphuretted hydrogen; the latter was burned to form sulphur dioxide, which was used, directly or indirectly, to decompose a further quantity of salt.

Another wasteful process studied by Gossage about the same time was the manufacture of chlorine by treating manganese dioxide by hydrochloric acid. In 1837 he patented a process for treating the resulting manganese chloride with hydrated lime, so producing calcium chloride and a hydrate of manganese which readily absorbs oxygen from the air and forms a hydrated dioxide available for succeeding operations. A number of works for the manufacture of sulphuric acid, alkali, bleaching powder, alum and other "heavy chemicals" grew up in Newcastle, Glasgow, St. Helens, Widnes and other Lancashire towns, and the names of Tennant, Muspratt, Brock, Gamble, Allhusen, Kurtz, Gossage, Deacon, Spence, Gaskell and Pilkington are well known as founders of the chemical industry in this country, and some of them left sons and grandsons to carry on the traditions they inherited, in a manner worthy of their distinguished forbears.

At this interval of time some little research is demanded of anyone who tries to find out why some of the early processes were not commercially successful. It was so long ago as 1831 that Peregrine Phillips proposed the manufacture of sulphuric acid by passing sulphurous acid and air over finely divided platinum, and a detailed account of his methods would doubtless be instructive. Exactly why Gossage's method of treating the manganese chloride residues was only partially successful is probably known to many, but the reason is not obvious to one who rapidly explores only the main features in this bit of history. It is, however, beyond question that, prior to the year 1867, the recovery of manganese from the liquors in the manufacture was expensive and unsatisfactory. In that year Mr. Walter Weldon patented a process, first carried out at Messrs. Gamble's works at St. Helens, which effected a revolution in the industry. This process enabled more than ninety per cent. of the previously wasted manganese to be recovered, and speedily brought the price of bleaching powder down by no less than £6 per ton. According to M. Dumas, "By Mr. Weldon's invention every sheet of paper and every yard of calico has been cheapened throughout the world." His process is to mix the solution of manganese chloride with milk of lime, forming manganese hydroxide, and then to heat the mixture to a temperature of 55° C. and blow air through it. The manganese dioxide, mixed with a little lime, settles at the bottom of the tank, and is known as "manganese mud"; this is washed with water, allowed to settle, pressed to a cake and used for the manufacture of chlorine. The difficulties in the industrial application of the ammonia-soda process of Dyar and Hemming, and how they were overcome by Solvay, belong to another chapter of the history of applied chemistry.

The disinfecting properties of the manganates and permanganates were noticed by Hofmann and the manufacture of them undertaken by Condy in 1856. Mr. Condy seems to have been somewhat of an optimist, for he solemnly recommended the use of his disinfecting fluid to wine-tasters for refreshing their palates. This fashion, if it ever prevailed, is not now frequently observed in this country. The history of the manufacture of chemicals recalls occasionally some old-fashioned practices. The manufacture of tungstate of soda and its use to make fabrics non-inflammable became unduly important in the middle of the nineteenth century, because, as Professor Hofmann observed, the ladies wore flimsy clothes which often caught fire, and "the fashion of expanding their attire with steel hoops increases the risks of these terrible casualties." The deaths from this cause were certainly remarkably frequent.

Naturally, the makers of alkali, who were large users of sulphuric acid, undertook the manufacture of it, and, indeed, the two industries were very closely identified. The substitution of iron pyrites for the Sicilian sulphur as basis for the sulphuric acid was an old practice, but it received a great impetus when, in 1838, the Neapolitan government interfered with the free exportation of sulphur from Sicily. Mr. Gossage showed how to recover copper from the pyrites, and this formed a connexion between the alkali industry and the copper industry.

It may well have been the great growth of the heavy chemical industry and its great prosperity which prevented the British chemical manufacturers from developing the organic side also. It would have been possible. Michael Faraday discovered benzene, or, as he called it, "bicarburet of hydrogen," in 1825, and Charles Mansfield was the first to prepare it from coal-tar in considerable quantities; this was in 1848.

(*To be continued*)

CHEMISTRY IN MEDIÆVAL ISLAM

By E. J. HOLMYARD

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It is a matter of common observation that adages usually exist in pairs, one member of the pair uncompromisingly contradicting the other —in appearance at least, if not in spirit. Thus Goethe's pregnant statement, "The history of a science is the science itself," can be countered with Kopp's opinion that "the history of alchemy is the history of an error." We should, perhaps, expect the poet to have a fuller grasp of philosophic truth, and there can indeed be no doubt that Kopp's judgment was shallow and lacking in insight; it connotes an ingenuous belief in the absolute value of scientific theories and hypotheses, partly accounted for by the vast development of science in the nineteenth century, but rather rudely shaken in the last few years by the elaboration of the theory of relativity. If we adopt the attitude succinctly expressed by Sir J. J. Thomson at Cambridge, in January—"theories are tools and not creeds"—we need make no apology for treating the history of science as a serious study, worthy of the same meticulous care and unsparing devotion as researches in the laboratory.

For five or six hundred years—from the seventh to the twelfth century A.D.—chemistry was almost a monopoly of the savants of Islam, who took it over from the Greek school at Alexandria at the beginning of the period and handed it on to mediæval Europe at the end. It is difficult to estimate accurately the extent and value of the contributions made to chemistry by Islam, but, in the words of one best qualified to judge, Prof. E. G. Browne (*Arabian Medicine*, p. 15), "it was in the domains of chemistry and *materia medica* that the Arabs added most to the body of scientific doctrine which they inherited from the Greeks." No serious attempt has hitherto been made, however, to study adequately the large number of Arabic chemical treatises which have come down to us, many of them of the greatest interest and importance.

The study of chemistry seems to have originated in Islam with the Ummayyad prince Khalid ibn Yazid ibn Mu'awiya (died 704 A.D.), who was taught the science by an Alexandrian monk named Marianus. Khalid, however, was more interested in the mystical side of chemistry than in its true scientific aspect, and from those fragments of his chemical verse which are extant, it is clear that he has no claims to serious consideration as a chemist. He had, nevertheless, the great merit of making chemistry fashionable, and among those whom he led to its study was a youth who afterwards became famous as Geber, or, to give him his full name, Abu Musa Jabir ibn Hayyan the Sufi. The question whether the Latin Geber is to be identified with the Arabic Jabir I have discussed elsewhere (*Nature*, Feb. 10, 1923). There seems to be no valid reason for denying this identity, as the content of the Latin works is very little different from that of certain Arabic works ascribed to Jabir, the authenticity of which has hitherto been undisputed. I hope to discuss the whole matter fully in a forthcoming work on the *Chemical Theory and Practice of the Arabs* (Gibb Memorial Trust Fund Publications).

The birthplace of Jabir is uncertain. He is known to have lived at Kufa, and is therefore sometimes called Al-Kufi, but it is possible that he was born at Harran in Mesopotamia, at that time a celebrated seat of learning and the centre of the Sabæan sect. He received a thorough training in philosophy and medicine, and attained to a position of eminence under the Caliph Harun al-Rashid (786–808 A.D.).

As Jabir's chemical views were largely coloured by the general trend of contemporary philosophic thought, it will be well for us to obtain some knowledge of the latter before proceeding to consider his chemistry in detail. Muslim philosophy was largely Aristotelian in character, but the critics had often failed to distinguish between theories of Aristotle himself and those of his commentators, among whom Alexander of Aphrodisias (second century A.D.) had most influence. Many works, again, which we now consider to be falsely attributed to Aristotle were in those days accepted as genuine, while the whole philosophic outlook of the Arabs was infused with the Neo-Platonism of Porphyry and Plotinus. Matters were still further confused by the tendency shown by the Alexandrians and the Sabæans to syncretism, which caused much legendary matter to be accepted as historically true. The leanings to mysticism which Geber and other chemists show is also probably to be attributed to Neo-Platonic influences.

However, the main features of what we may call the scientific philosophy of Islam are fairly clear. The first postulate is the unity of matter. All substances are composed of a *prima materia*, the Aristotelian ὕλη, but the *prima materia* has no actual existence unless it is united to Form, which is of two varieties, Corporeal Form and Specific Form. "Abstract Body" is the result of the combination of the *prima materia* with Corporeal Form, whilst the addition of Specific Form to Body in the Abstract gives rise to an Individual Body. The simplest kinds of Specific Form are those which, in combination with Body in the Abstract, give rise to the form Aristotelian "elements," Fire, Air, Water and Earth. All other substances are composed of these Elements in various proportions and combinations, but the *prima materia* is the same in all.

Abstract Body combined with the *metallic* Specific Form gives rise to the metals, which are therefore essentially all of one species. The existence of several different *varieties* of metals such as gold, silver, copper, lead and so on is explained by assuming that metals other than gold have become contaminated with certain accidental (*i.e.*, unessential) qualities; removal of these qualities from an "imperfect" metal will convert the latter into gold.

In common with all thinking men of the time, the Arabs believed in astrology, and considered that the planets exercised an influence upon the metals; but it is noteworthy that this belief, while acknowledged, is almost always relegated to the background by the chief chemists of Islam, who seem to have been men of an eminently practical habit of mind. They realised that no great advance can be made in science without the foundation of experimental fact, and one of the greatest of them, Maslima al-Majriti (died 1007 A.D.), tersely says:—"As to transmutation, there can be but one proof of that, namely, experimental"—and this although he himself firmly believed that transmutation was, *a priori*, possible.

Jabir ibn Hayyan is conspicuous at once for his tremendous energy, which embraced philosophy, natural history and medicine as well as chemistry, and was sufficient even to enable him to keep abreast of the latest developments in mystical theology—the system of Sufi-ism, founded a few years earlier by Abu Hashim of Kufa. Jabir wrote many books, at least fifty of which are extant. The most important of these, from a chemical point of view, are the *Great Book of Properties*, which exists in a unique manuscript in the British Museum, and the *One Hundred and Twelve Books*, unfortunately known to us only in fragmentary quotations. His contributions to chemistry (excluding those mentioned only in the Latin works) were very numerous, both in theory and in practice. His theory that metals are composed of mercury and sulphur, enunciated in the first book of the *One Hundred and Twelve Books* (quoted by Aidamir al-Jildaki in Vol. I. of his *Nihāyat at-Talab*, Cairo MS.) proved extremely fruitful and is a definite attempt to construct a more "chemical" theory than the philosophic Aristotelian one mentioned above. Jabir appears to have regarded mercury as the nearest approach among sublunary bodies to the *prima materia*, sulphur representing the combustible principle.

His views on the structure of mercuric sulphide, which I have already quoted in *Nature* (Feb. 10), are so remarkable, and bear such clear witness to the fine calibre of his mind, that I will give them again here. "When mercury and sulphur combine to form one single substance, it has been thought that they have essentially changed and that an entirely new substance is formed. The fact is otherwise, however. Both the mercury and the sulphur retain their own natures—all that has happened is that their parts have become attenuated and in close approximation to one another, so that to the eye the product appears uniform. But if one could find an apparatus to separate the particles of one sort from those of the other, it would be apparent that each of them has remained in its own permanent natural form and has not been transmuted or changed. We say, indeed, that such transmutation is not possible for natural philosophers." On the practical side Jabir's researches ranged far and wide, and it is worthy of note that they do not confine themselves, as do those of so many early chemists, to attempts at transmutation. He describes the preparation of various salts, such as white lead (by precipitating a solution of lead acetate with sodium carbonate) and cinnabar, the reduction of metallic calces, the use of alum as a mordant, methods of waterproofing cloth and of rendering it fire-proof, details of dyeing, pharmaceutical uses of compounds both organic and inorganic, and he discusses various operations such as calcination and distillation.

In his Book of the *Divine Science and Philosophical Wisdom* (Cairo MS.), he explains the nature and objects of chemistry and gives rules for the guidance of those who would study it. He says that chemistry is a branch of natural science, and that the chemist should strive to follow Nature's guidance; patience and continued practice are necessary, and it is advisable to acquire a thorough knowledge of the chemistry of mineral bodies before proceeding to the investigation of substances from plants and animals. According to one of his commentators, he deserved the name Jabir, for it was he who re-organised (*jabara*) the science of chemistry and put it on a firm basis.

He became involved in the fall of the Barmekide family, and had to fly to Kufa, where he spent many years in retirement, if not in definite concealment.

The chemical tradition was carried on by Abu Bekr Muhammad ibn-Zakariyya al-Rāzī (Rhazes), who died in 923 or 932, Maslima al-Majriti (died 1007), Ibn Arfa' Ra's (died 1197), Abu'l-Qasim Muhammad ibn Ahmad al-'Iraqi (about 1300), Al-Tughra'i (died 1121) and Aidamir al-Jildaki (died about 1360 A.D.) Works of all of these are extant, and additional information concerning chemistry in Islam is to be found in the *Kitab al-Fihrist* of Al-Nadim, in the *Prolegomena* of Ibn Khaldun's *History* in the biographical dictionaries of Hajji Khalifa, Ibn Abi Usaibi'a, and Al-Qifti, and in the encyclopædias of the Brethren of Purity and of Al-Qazwini, Al-Safadi, etc.

A system of chemistry, in which the main theory is that of the transmutation of the metals, naturally lent itself to charlatanry, and we find many amusing anecdotes on the frauds of alchemists in the popular literature. Thus Al-Janbari relates that a Persian impostor came to Damascus and, having filed into small pieces a thousand gold dinars, made the bits up into balls with fish-glue, flour and powdered charcoal. He then disguised himself as a dervish and sold the balls for a few pence to a druggist, under the name of *Tabarmaq of Khorassan*. He next clothed himself in a rich habit and made the acquaintance of the vizier, to whom he represented himself as an accomplished alchemist. The vizier presented him to the Sultan, who expressed a desire to see a transmutation. The charlatan wrote out a formula in which, among other drugs, Tabarmaq of Khorassan was indicated, to the weight of 100 mithgals. All the other chemicals were obtained easily, but a protracted search had to be made for the Tabarmaq. At last it was obtained from a druggist who said a dervish had sold it him. Needless to say, the experiment proved very successful; the Sultan was delighted, and wished to repeat the operation. However, no more Tabarmaq was to be found in Damascus, but the Persian said he knew a cave in Khorassan where it was to be found in abundance. So the Sultan equipped him with every requirement for the journey and gave him a large sum of money, after which he set out—and never returned.

Scepticism as to the possibility of transmutation arose at a very early date. Jabir himself, we are told by Al-Jildaki, was confronted with no little unbelief, and criticism of the transmutation theory assumed formidable proportions with the great Muslim philosopher Ibn Sina (Avicenna) in the tenth century A.D. Avicenna's attitude towards chemistry has not yet been thoroughly established, but as far as I can gather it seems to be that while he did not altogether rule out the possibility of transmutation, he considered that the theory of the unity of the metallic substance in the various metals was certainly inadequate and probably very wide of the truth. This is remarkable in view of the fact that his philosophy was essentially Aristotelian and Neo-Platonic.

The celebrated vizier Al-Tughra'i took up the cudgels on behalf of transmutation, but his arguments—mostly of a scholastic nature—are unconvincing, especially since he makes scarcely any reference to experimental work, for which he had little time, owing to the pressure of his ministerial duties. Al-Jildaki sums him up well when he says :—" Tughra'i was a man of exceptionally brilliant mind, but he carried out very little experimental work, and this renders his writings inaccurate."

Ibn Khaldun, Islam's greatest philosophic historian (died 1406), devotes several pages to alchemy in the Prolegomena to his History. He says :—" The object of the science of chemistry is to obtain a substance which may be employed, by suitable experimental methods, to cause the production in perfection of gold and silver. . . . The chemists make experiments on all sorts of things, after having discovered their temperaments and virtues, in the hope that chance may cause them to come across the substance possessing the property they seek. Not confining themselves to minerals, they even examine substances obtained from living organisms, and work on bones, feathers, hair, eggs and excrement.

" Chemistry also indicates the procedure, the object of which is to cause this substance (the transmuting agent) to pass from potentiality to actuality; as, for example, the resolution of bodies into their constituents by means of sublimation, distillation, solidification . . . . levigation . . . ., etc.

" Chemists maintain that they prepare by all these operations a natural body to which they give the name of *El-Iksir* and which, projected upon a mineral body such as lead, tin or copper, converts it into pure gold (under suitable conditions).

" In the obscure and enigmatical terminology of this art, the Elixir is called the *soul* and the substance upon which it is projected is called the body . . . . From ancient times up to our own day, men have not ceased to write on chemistry, and sometimes, even, books on chemistry have been published under the names of persons who never took any part in it."

Ibn Khaldun's last remark is very true, for instances of pseudepigraphy are numerous. Fortunately, the false works can usually be easily recognised by internal evidence. Thus, when one finds in an Epistle (MS. kindly lent me by Mr. A. G. Ellis) attributed to Mary the Copt, a conversation between the authoress and Jabir ibn Haiyan—who lived several hundred years later—one has no difficulty in deciding that the work is pseudepigraphical. However, the problem is not always as easy as this.

A further difficulty in the study of Arabic chemical manuscripts is that, as Ibn Khaldun says, the terminology is obscure, or, rather, technical. The lexicographers have little use for words which do not occur in the literary language, so that one has very largely to construct one's own dictionary. The few authors, such as Abu'l-Qasim al-'Iraqi, who give vocabularies are therefore invaluable; it is a matter for regret that there is no mediæval Muslim Beilstein, Thorpe, Richter or Watts !

A source of information on Arabic chemistry that up to the present has not been tapped is in the numerous collections of recipes that are scattered throughout the great libraries. These, the work very often of nameless authors, occasionally contain matter which more famous chemists would not deign to mention. Through the courtesy of the Librarian to the Pope, I have been able to have photographs made of one of these books which is preserved in the Vatican Library, and have found in it a good deal of interesting material. The whole subject, however, bristles with difficulties, and years of hard work will be necessary to elucidate properly the development of chemistry in Islam. The great need is the publication of texts—a need which, in these days when the setting up of Arabic type is almost prohibitive, is likely to remain unsatisfied. A study of the available material—original manuscripts, notices in Muslim history and encyclopædias, and the books and papers of Berthelot, Stapleton, Wiedemann and Carra de Vaux—has led me to the following conclusions, which, however, must be regarded as provisional only and liable to modification:—

1. Chemistry at the time when Muhammadan scientists first undertook its study presented three distinct aspects, the philosophical, the practical and the mystical. There was practically no correlation between the first two, and the latter formed a noxious jungle favoured by the unhealthy intellectual atmosphere of Alexandria. Khalid may be said to have lost himself in the jungle, but Jabir ibn Hayyan cut a way through it and made valiant and to some extent successful efforts to construct a coherent scientific method based on experimental facts interpreted in the light of contemporary philosophy. The Persian Al-Rāzī (Rhazes) was much more of an empiricist and acquired merit through his patient collection and orderly arrangement of facts and observations; he made no advance in chemical theory, and indeed as a physician his main interest in chemistry was from a pharmaceutical point of view. Except that the two men were as dissimilar as possible in character and disposition, Al-Rāzī might be called the Paracelsus of Islam.

2. It appears to me incontrovertible that in Islam chemistry was first elevated to the rank of a definite science and its theory and practice welded into a homogeneous whole.

3. The chemists of Islam, even if they did not invent that procedure which we now call scientific method, were certainly the first to apply it to chemistry.

4. Muhammadan chemistry is astonishingly matter-of-fact and free from magic and supernaturalism. It is quite definitely regarded as a branch of natural philosophy, distinct from and by no means a handmaiden to physics and medicine.

5. In passing to Europe *via* Spain, Muhammadan chemistry, whilst contributing to the general renaissance of science in the thirteenth century, lost a great deal. European chemistry of the fifteenth century—and possibly of the sixteenth—was not so far advanced as Arabic chemistry in the twelfth.

6. The phlogiston theory is a direct evolution of the sulphur-mercury theory of metals first formulated by Jabir ibn Hayyan.

These are no small achievements, and they were made in an age when science was not the powerful force in life which it is at present, and when chemists were regarded with a contemptuous pity at best, and often went in fear of their lives. The attitude of men of letters towards the chemist is, after all, not so very different now from what it was when Mas'udi (died *c.* 956) wrote :—" May Allah preserve me from applying myself to researches which enfeeble the brain, yellow the skin and ruin the sight, in the midst of the vapours of sublimation and the foul emanations from vitriol and other minerals ! "

THE PRINCIPLES OF TRANSFERENCE OF HEAT

By GEOFFREY J. GREENFIELD, S.M., A.I.C.

A great majority of processes in chemical industries involve the transference of heat from one body to another. Every boiler, still, heater, cooler, heat exchanger, and furnace presents a phase of this problem, which is therefore one of wide interest. Heat is carried from one point to another by one of three methods, viz. :—

Convection,
Conduction,
Radiation,

each of which we will consider separately.

Convection

The general effect of convection is that when heat is added to one portion of a fluid (whether liquid or gas), currents are set up in the fluid, so that in a very short time the whole mass is again at a uniform temperature. This time is all the shorter if the fluid is already in motion (*e.g.*, flowing through a pipe). Thus, in dealing with the practical transfer of heat, it is safe to assume that, once the heat is introduced into a fluid, it is rapidly distributed all through the mass.

Conduction

Transfer by conduction and by radiation, however, require a deeper consideration. We meet with conduction first in passing heat through a solid body—*e.g.*, a furnace wall (see Fig. 1). The quantity of heat which passes through the wall, from the hot side (tempera-

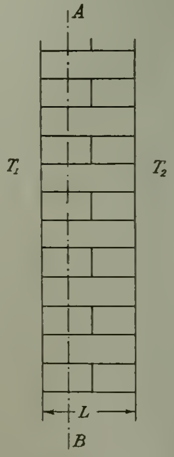

FIG. 1.

ture, T_1° F.) to the cold side (temperature, T_2° F.) in a given time, is the point of interest.

Let us compare the flow of heat through this wall with the flow of electricity along a wire. The rate of flow (B.T.U. per hour for the heat, amperes for the electricity) will be proportional to the driving force, or potential difference (degrees temperature difference for the heat, volts for the electricity) and inversely proportional to the resistance offered by the conductor. The electrical resistance of the wire is equal to

$$\frac{\text{length of wire}}{\text{cross-sectional area of wire} \times \text{specific electrical conductivity.}}$$

This is fairly obvious, since, the longer the wire, the more resistance will it offer; while the stouter it is, the more room is there for the electricity to flow. The "specific electrical conductivity" is a property of the substance of which the wire is made.

The same reasoning will be applied to the heat resistance of the wall. The length of the path which the heat has to travel is the thickness of the wall, L. The cross-sectional area is the area of a section AB, at right-angles to the plane of this paper in Fig. 1. The specific electrical conductivity of the above formula will be replaced by the specific heat conductivity, or coefficient of heat transfer. Thus, if

Q=amount of heat transferred (B.T.U.)
θ=time (hours)
A=area of the section AB, through which the heat flows (sq. feet)
L=thickness of wall (feet)
R=resistance of wall
k=coefficient of heat transfer
ΔT=temperature drop through the wall$=T_1-T_2$

then $R=\dfrac{L}{Ak}$

and $\dfrac{Q}{\theta}$ (rate of flow) $=\dfrac{\Delta T \text{ (driving force)}}{R \text{ (resistance)}}$

$$=\frac{kA\Delta T}{L} \quad . \quad . \quad . \quad (1)$$

This is the fundamental equation for the conduction of heat. The quantity k, the coefficient of heat transfer, is a property of the substance of which the wall is built.*

Film Concept

When a liquid or a gas is in contact with a solid surface, it behaves as though there were a stationary film, or skin, of the fluid adhering to the solid, notwithstanding that the body of the fluid may be in motion. To picture this the reader may conduct the following experiment, choosing a place with as little draught as possible. Light a cigarette, or a pipe; having taken a good "draw," quickly move the pipe to the surface of the table, holding the mouthpiece, inclined at 20° or 30° with the horizontal, in contact with that surface. In about ten seconds some smoke will have come out of it. and will rest in a little cloud on the table, Very gently remove the hand and the pipe, and the cloud will rest, almost stationary, for some time, being gradually moved by the convection currents above it. In a little while these currents will disperse it, and you will be surprised to find that it has been able to remain so still underneath such currents. If you blow upon the cloud you can see that, when the air is in motion relative to the table, the stationary film is soon reduced from several millimetres to a very thin layer. This is a very crude and simple experiment, and, to make it work properly, there should be a tablecloth on the table.

By carefully devised experiments, in which convection currents have been absolutely eliminated, it has been shown that liquids, and more especially gases, are very bad *conductors* of heat, much worse than most solids. This being so, it is evident that, in the general problem of the transference of heat *from* one fluid, *through* a solid wall, *to* another fluid, as in boilers, oil coolers, condensers, etc., *the fluid films will offer as much resistance as the solid walls, and often more.*

In Fig. 2, where, of course, the thickness of the air films has been vastly exaggerated, this idea is illustrated. The air on the hot side is maintained, by convection currents, at an even temperature T_1, and that on the cold side at an even temperature T_2. Heat flows from the hotter body of air to the colder, and its passage is opposed by three resistances in series, viz.:—

(1) The air film on the hot side.
(2) The solid wall.
(3) The air film on the cold side.

To each of these equation 1 applies. In the case of the film resistances, we do not know the value of the thickness, L. Indeed, there is not actually a definite line of demarcation between the stationary and the moving part of the gas. So, in dealing with this type of resistance, it is convenient to replace $\frac{k}{L}$ by a new symbol, h, which we may term the "film coefficient." This will be affected by everything which affects the thickness of the film, such as the velocity of the body of the fluid, the viscosity of the fluid (which, for any particular fluid, is a function of the temperature), and the shape of the solid.

Before going into the conditions affecting the value of the film coefficient, it will be well to consider how to deal with cases such as that of Figure 2, where the flow of heat is met by several resistances in series, and where the temperatures at the intermediate boundaries are not known.

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* Care should be taken to notice in what units the conductivity is expressed. In the following pages all values given have the dimensions, $\dfrac{\text{B.T.U.} \times \text{ft. thickness}}{\text{sq. ft.} \times {}^\circ\text{F. temp. diff.}}$ and film coefficients (see later) $\dfrac{\text{B.T.U.}}{\text{sq. ft.} \times {}^\circ\text{F. temp. diff.}}$ When values are available in continental units (gr.-cals., cms. and ° C.), they may be converted to English units by multiplying by 242 (for conductivity) and by 7370 (for film coefficients).

The analogy between flow of heat and flow of electricity being so close, we may follow it a little further. For a number of electrical resistances in series,

$$R = r_1 + r_2 + r_3 + \text{etc.}$$

Similarly for heat resistances,

$$\frac{L}{kA} = \frac{l_1}{k_1A_1} + \frac{l_2}{k_2A_2} + \frac{l_3}{k_3A_3} + \text{etc.} \quad . \quad . \quad (2)$$

Usually (see Fig. 2) we know the temperatures at the beginning and end of the path, T_1 and T_2, but not those at the junctions of the component resistances, T_3 and T_4, so that it is convenient to use an *overall* coefficient, H, in the equation $\frac{Q}{\theta} = HA_{av}\Delta T$

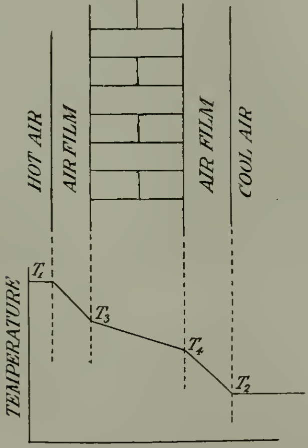

FIG. 2.

where A_{av} is the average area through which the heat flows, in cases where the area varies, as it will between the inner and outer surfaces of a circular, lagged pipe. This overall coefficient will be calculated from equation 2. The first and third resistances are films, so that l_1 and l_3 are unknown, and since $L = l_1 + l_2 + l_3$, therefore L is unknown. Substituting, therefore, H for $\frac{k}{L}$, h_1 for $\frac{k_1}{l_1}$, and h_3 for $\frac{k_3}{l_3}$, we have

$$\frac{1}{HA_{av}} = \frac{1}{h_1A_1} + \frac{l_2}{k_2A_2} + \frac{1}{h_3A_3} \quad . \quad . \quad . \quad (3)$$

from which, if we know the quantities on the right-hand side of the equation, we can find the value of HA_{av}, and substitute it directly in the heat flow equation.

Utility of the Film Concept

A great deal of work has been done on those problems of heat transfer which are of practical importance, but efforts have often been directed to establishing an *overall* coefficient. That the film concept is more likely to lead to useful results can easily be shown. Consider, say, the partial condenser of a still, in which feed liquor flows inside pipes, and takes heat from the vapours which condense outside the pipes. The three resistances here are :—

(1) Vapour film.
(2) Solid wall of pipe.
(3) Liquid film.

One's first impulse, if studying the overall coefficient, would be to seek some relation between it and the liquor velocity. If we double the liquor velocity, clearly the thickness of the liquid film will be reduced. Experiment shows that it is not quite halved, but it is at least reasonable to expect the film thickness to be proportional to some power of the velocity Thus, we have changed one of our three resistances, while the other two have remained unchanged ; so that any attempt to establish a relation between the overall coefficient and the liquor velocity will yield a result of very limited applicability. Such a relation, for instance, established for an ammonia still, where the vapour is a mixture of steam and ammonia, could not justly be applied to the design of an oil still ; nor, if determined for a condenser with copper tubes, could it be applied to one with aluminium tubes. But if we can find relations between the *film* coefficients and the variables affecting them, these will have a wider applicability.

Dominating Effect of Film Resistances

The predominance of film resistances over solid resistances is shown by the following example, chosen at random. The values of the coefficients used will be discussed later, and for the moment must be taken for granted by the reader.

In the liquor heater connected with the saturator of a certain plant for the direct recovery of ammonia from coal gas, the following conditions prevail :—

Temp. of entering liquor = 172° F.
Temp. of leaving liquor = 214° F.
Temp. of steam = 366° F.

Thickness of copper heating tubes = 0·165 in., 0.014 ft.

To protect the copper from the action of sulphuric acid, it is proposed to sheath the tubes in lead, $\frac{1}{8}$ in. thick (=·0104 ft.). What decrease in efficiency will occur ?

(*To be continued*)

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

Mr. E. Kilburn Scott's Cantor Lectures

at the Royal Society of Arts should remind us that, although the world is greatly overstocked with plant for producing nitrates from the air as a result of the war, the demand is increasing so rapidly that this condition of affairs cannot last. In ten years the demand for nitrates for non-military purposes has doubled. It would admittedly be difficult to work any of the arc processes in England at the present time, however desirable it might be from the point of view of national security; but, as Mr. Scott pointed out, the available water power in Canada and New Zealand is as large and as easily accessible as any in Europe. The great variety of processes shows clearly, I think, that the design of plant is very far from the goal to which it will ultimately tend. Perhaps the most interesting part of the first lecture dealt with the new Swiss plant, in which the amount of gases combined has been raised to 2½ or 3 per cent.; other improvements have resulted in the elimination of the alkali tower, whilst the yield is 75 grams of nitric acid per kilowatt hour. I shall look forward to hearing the remaining two lectures in the series.

Chemical Engineering

These lectures are of particular interest to those who feel that we cannot continue to do without the chemical engineer in this country. Where raw material costs nothing, the question of power is of supreme importance. If our industrial chemists are to make a success of nitrogen plant at home or in the Empire, they must be willing and able to meet the producers of electrical power halfway. They must be prepared to utilise off-peak power, to design their furnaces to give a high power factor and utilise three-phase current where necessary. A dialogue between an engineer (knowing no chemistry) and a chemist (knowing nothing of electrical machinery) engaged in designing an arc furnace would prove interesting reading; but would the result be satisfactory? I know that "fancy plant" is anathema in many works. The marine store dealer may meet the need where a small and uncertain demand for a chemical of restricted use has to be satisfied. But in such an industry as this special plant is indispensable, and Mr. Scott has shown us how great is the improvement brought about by improvements in design. It is remarkable, however, that the yield of the best modern plants does not exceed by 50 per cent. that obtained by Lord Rayleigh in his pioneer work on nitrogen fixation.

The Centenary of the Alkali Industry

is being celebrated as these lines go to press. What a wonderful record could be written of these 100 years, and what an interesting share the Muspratt family have had in the work. In 1650, in the ancient and at that time leading city of Winchester, there was a Thomas Muspratt who was the Mayor. From him there was directly descended the James Muspratt who went over and settled in Ireland and was the great-grandfather of the present Chairman of the United Alkali Company, Ltd. He had two sons; one of them, John Petty Muspratt, who was a director of the East India Company, and the other, James Muspratt, the founder of the Alkali Industry in this country. He was a pugnacious fellow even in his schoolboy days, and the Napoleonic wars drew him like a magnet, and he saw service not only in the Army in Spain, where he had the most thrilling adventures, but also in the Navy. Soon he was back again in Dublin engaged in the manufacture of prussiate in a small way, and in 1822 he came to Liverpool because of its more central position. The removal of the tax on salt in the next year gave him his opportunity, and he promptly installed a plant to work the Leblanc process.

It Sprang from the Napoleonic Wars

and the milestones along the road of progress are the wars of the century. This is an interesting fact. The war between the North and South of America was the first interruption to the steady progress which was being made in the industry. It fought its way through this handicap. Then came the Franco-German war, which was succeeded by a period of prosperity and of over-production, with the inevitable result. Prices fell to an unremunerative level and provided the stimulus for further research. Then came the ammonia soda process, introduced by Messrs. Brunner Mond & Company, and the struggle between the two processes compelled increased efficiency all round and the formation of the United Alkali Company as we know it to-day. Finally, there was the Great War, to which the industry contributed its full quota, and on the industry has been left the mark of that war also. Little wonder is there that such a goodly company of scientists and industrialists should be journeying down to Liverpool this week to mark the record of a century's work. Work which has placed that portion of British chemical industry on such a secure basis that no other country in the world has been able to assail it successfully.

FORTHCOMING EVENTS

Apr. 21. The Mining Institute of Scotland. The Forty-Sixth Annual Meeting, to be held in the Royal Technical College, George Street, Glasgow, at 3 p.m.

Apr. 23. The Institute of Brewing. Meeting at the Institute of Chemistry, 30, Russell Square, W.C. 1, at 8 p.m. Discussion on "Moisture in Malt."

Apr. 23. Royal Society of Arts, John Street, Adelphi, W.C. 2, at 8 p.m., Cantor Lecture. "Nitrates from Air" (Lecture 3), by E. Kilburn Scott, M.I.E.E.

Apr. 24. The Institution of Civil Engineers, Great George Street, Westminster, S.W. 1. Annual General Meeting.

Apr. 24. Royal Photographic Society of Great Britain. Meeting under the control of the Scientific and Technical Group, at 35, Russell Square, W.C. 1, at 7 p.m. "Photomicrography as Applied to the Iron-Carbon Alloys," by Capt. J. W. Bampfylde.

Apr. 25. Society of Chemical Industry, *Nottingham Section*, University College, Nottingham, at 8 p.m. (1) "The Action of Sodium Hyposulphite on Cupric Chloride in Aqueous Solution," by J. B. Firth, D.Sc., and J. Higson, B.Sc. (2) "The Sorption Activity of Carbon," by J. B. Firth. (3) "The Action of Potassium Carbonate on Lead Glass," by H. Droop Richmond, F.I.C. (4) "The Analysis of Lead Glasses," by J. M. Wilkie, B.Sc.

Apr. 25. Royal Society of Arts (Ordinary Meeting), at 4.30 p.m. Conference on "The Milk Question." (1) "The Arguments for Maintaining an Open Market for Fresh Milk," by Prof. R. S. Williams, B.Sc. (2) "Changes in the Digestibility and Nutritive Value of Milk induced by Heating," by Prof. J. C. Drummond, D.Sc. (3) "The Effect of Heat on some Physiological Principles in Milk," by S. S. Zilva, Ph.D. A Demonstration of some of the Chemical Changes in Milk on Heating to Various Temperatures will be given by Captain J. Golding, D.S.O., and Mrs. A. T. R. Mattick, M.Sc.

Apr. 25. The Royal Microscopical Society, *Industrial Applications Section*, at 7 p.m. (1) "The Manipulation of the Microscope in Industrial Laboratories," by J. E. Barnard, F.Inst.P. (2) "The Microscopical Examination of Coal in Relation to Fuel Economy and Efficiency," by Dr. M. C. Stopes.

Apr. 26. Society of Dyers and Colourists, *London Section*. At the Dyers' Hall, Dowgate Hill, E.C., at 7 p.m. "Fur Dyeing," by L. G. Lawrie.

Apr. 27. Society of Chemical Industry, *Liverpool Section*, Muspratt Lecture Theatre, the University, Liverpool, at 6 p.m. Annual General Meeting. "The Determination of Sulphur," by J. M. Taylor.

SOCIETY OF CHEMICAL INDUSTRY

ANNUAL GENERAL MEETING, 1923

In accordance with the provisions of By-law 68 notice is hereby given that the Annual General Meeting of the Society of Chemical Industry will be held in the Arts School, Benet Street, Cambridge, on Thursday, June 21, 1923, at 11 a.m.

The programme of the proceedings will be issued shortly.

In accordance with the provisions of By-law 23 intimation is hereby given that the following members of Council retire from their respective offices at the forthcoming Annual General Meeting:—Dr. E. F. Armstrong, F.R.S., *President*; Mr. John Gray, Mr. D. Lloyd Howard, Mr. Emile Mond, and Mr. Edwin Thompson, *Vice-Presidents*; Dr. T. Howard Butler, Mr. F. H. Carr, Mr. W. H. Coleman, and Dr. R. T. Colgate, *Ordinary Members.*

Dr. E. F. Armstrong, F.R.S., has been nominated for re-election to the office of President under By-law 19; Dr. T. Howard Butler, Mr. F. H. Carr, Prof. G. G. Henderson, F.R.S., and Mr. Emile Mond, have been nominated Vice-Presidents under By-law 20.

Mr. E. V. Evans has been re-elected Hon. Treasurer, and Sir Wm. J. Pope, K.B.E., has been elected Hon. Foreign Secretary.

Members are requested to nominate, on or before May 15 next, fit and proper persons to fill the four vacancies among the Ordinary Members of Council. Forms for this purpose can be obtained from the General Secretary of the Society.

By-law 22.—An Ordinary Member of Council shall be nominated by five or more members upon Form B in the Schedule, a copy of which form shall be furnished by the General Secretary upon the written or verbal request of any member, but a member shall not be eligible to sign more than one such nomination form, and the member nominated shall sign the declaration set forth on the form.

A nomination shall be declared invalid by the Council if:—

(*a*) The member thereon nominated is disqualified for election, or ineligible to be elected, as provided by the By-laws.

(*b*) The nomination is not made on the authorised printed form, or substantially not in the manner directed thereon.

(*c*) The nomination form is signed by less than five members not disqualified or not ineligible to nominate as provided by the By-laws.

(*d*) The nomination form is not received before or upon the day appointed therefor.

(*e*) The member nominated has not signed the declaration printed upon the form.

A member whose nomination aforesaid is declared to be invalid shall receive notice thereof from the General Secretary, and shall not be submitted for election.

J. P. Longstaff,
General Secretary

MEETING OF COUNCIL

The monthly meeting of Council was held on April 13, 1923, the President (Dr. E. F. Armstrong, F.R.S.) in the Chair.

The President read a letter from Monsieur Deschiens, expressing his thanks for his reception in London and his pleasure in promoting good feeling between English and French chemists. He has presented to the Society a reproduction in colours of the portrait of Pasteur in the Sorbonne, which was accepted with thanks.

A proposal was received from the Council of the British Electrical and Allied Manufacturers' Association, which is responsible for the organisation of the World Power Conference to be held in June, 1924, at the British Empire Exhibition, that the Society should undertake the organisation of the Chemical Section of the Conference. The proposal was agreed to, and it was decided to ask the Chemical Engineering Group to undertake the arrangements.

The Council was invited to send a delegate to attend :—

(1) The celebration of the 75th anniversary of the Société des Ingénieurs Civils, to be held in May, 1923 ; and
(2) The 122nd anniversary of the Société d'Encouragement pour l'Industrie Nationale of France, in June, 1923.

It was agreed to ask Monsieur Paul Kestner to act as representative of the Society.

A letter of condolence was sent to Lady Dewar on the death of her husband, Sir James Dewar, F.R.S., a former President and Medallist of the Society.

The reports of the Hon. Treasurer and of various Committees of the Council were discussed, and 18 new members (home, 8 ; overseas, 10) were elected.

Dr. E. F. Armstrong, F.R.S., was nominated for re-election as President of the Society for the year 1923–24, and Dr. T. H. Butler, Mr. F. H. Carr, Prof. G. G. Henderson, F.R.S., and Mr. Emile Mond were nominated as Vice-Presidents. Mr. John Gray and Mr. D. Lloyd Howard, retiring Vice-Presidents, were specially thanked for their services to the Society during the years they have been on the Council. Mr. E. V. Evans was re-appointed Hon. Treasurer, and Sir W. J. Pope, K.B.E., F.R.S., was elected Hon. Foreign Secretary for 1923–24.

On the proposal of Sir W. J. Pope it was decided that the Society shall, following the practice of other scientific societies, give its Honorary Membership to a limited number (not more than 30) of distinguished foreign and colonial chemists.

It was agreed to enter into an arrangement with the Faraday Society (similar to that already made with the Chemical Society) by which papers for the Faraday Society may be presented at meetings of Local Sections of the Society of Chemical Industry.

Mr. F. H. Rogers and Mr. F. M. Potter were appointed representatives to serve on the Committee of the Institution of Civil Engineers concerned with the Tabulation of Results of Steam Engine and Boiler Trials.

It was agreed to ask Dr. W. R. Ormandy to act as the Society's representative on the sectional Committee of the British Engineering Standards Association set up to prepare Standards for petroleum products for engineering purposes.

NEWS FROM THE SECTIONS

LONDON SECTION

The meeting held at the Engineers' Club, Coventry Street, on April 9, was presided over by Mr. E. V. Evans, and two papers were read and discussed.

The first paper, entitled " The Cod-liver Oil Industry of Newfoundland," by Messrs. S. S. Zilva and J. C. Drummond, related to part of a detailed inquiry into the cod-liver oil industry, in order to elaborate a method for estimating the vitamin content of cod-liver oil, as it had been found that cod-liver oil was about 250 times as potent as an average sample of butter. It was necessary to investigate both the method and conditions of manufacture in Norway and in Newfoundland, these being the two chief centres of production. In Norway, the oil was not always pure cod-liver oil but was obtained from mixed catches of fish, whereas in Newfoundland, all the fish was cod, and the oil pure cod-liver oil. There were three main methods of producing cod-liver oil. The first was the process—now seldom used—in which the livers were allowed to rot and the oil rose to the surface ; the second consisted in steaming the liver in jacketted apparatus until the oil rose to the surface ; and in the third method, the one now mainly employed in Newfoundland, steam was blown into the liver to break up the tissues, the oil rising to the surface. The regulations for preparing oil by this method provided that the oil must be steamed until a scum was formed ; then decanted, filtered and stored in a tank for 24 hours, and then filtered again and casked. Samples of oil made by the jacketted process and the direct-steam process showed no difference in vitamin potency, so that the direct method was as good as the older method practised mainly by the Norwegians. The first fraction was decanted and used for medicinal purposes, the remaining second fraction being known in Newfoundland as common cod-liver oil, which was not used for medicinal purposes. It was found that the vitamin potency of this second fraction was almost as good as that of the first fraction and it seemed a pity that this fraction should only be used industrially because it would be quite good for medicinal use and for agricultural purposes, such as feeding cattle, etc. In the refining process the oil was chilled and the stearin settled out, an oil being obtained which did not go turbid when stored in a cool place. Oils obtained in 1919, 1920 and 1921 were tested and found not to vary in their vitamin potency as between each other. It had been proved that the fish did vary anatomically according to the place where they were caught, but investigation showed that the oil produced from the livers of these various fish did not differ in vitamin potency. The minimum dose of Newfoundland cod-liver oil necessary to promote growth in rats was from 1·2 to 1·6 mg. and there was a great uniformity of potency in the Newfoundland fish. With the well-known Lofoden cod-liver oil from Norway, the minimum dose was found to be 5 mg., and fish caught on the northern coasts of Norway showed a great variation in potency owing to the fact that the catches were often very mixed. There was little doubt that the high potency of the Newfoundland oil was characteristic of the fish of that part of the world and this fact, coupled with the very hygienic conditions under which the oil was produced, should place it very high on the market.

Capt. Gordon, Deputy High Commissioner for Newfoundland, who opened the discussion, said, at the present time Norway exported five times more cod-liver oil to this country than Newfoundland did, which was strange. Prof. J. C. Drummond said the idea seemed to be strongly held, especially by the medical profession, that only the oil coming from Norway was of any value. The authors had been much impressed with the fact that in removing the stearin a large amount of vitamin was also removed. Although the stearin was not as potent as the original oil, it was far more potent in most cases than the equivalent weight of butter and it seemed surprising that such a valuable product should be turned to technical use only. Dr. Zilva, in reply, said the use of open vessels in the direct-steam process in Newfoundland did not make any difference to the final product; he did not think there was much fear of losing much potency in refining. The amount of stearin extracted was from 2 to 3 per cent.

The second paper, bearing the title, "A Study of the Separation of the Gases formed in the *n*-Butyl Alcohol-Acetone Fermentation Process," was by E. W. Blair, B.Sc., T. S. Wheeler, B.Sc., and J. Reilly, M.A., D.Sc. The production of *n*-butyl alcohol and acetone by the fermentation of carbohydrate material is a comparatively new industry and, as yet, little attention has been given to the recovery of the gaseous products of the process. These products represent over 60 per cent. by weight of the products of the fermentation—*e.g.*, 100 lbs. of maize containing 65 per cent. of starch yield approximately 7 lbs. of acetone, 16 lbs. of *n*-butyl alcohol, 39 lbs. of carbon dioxide, 1 lb. of hydrogen and 1 lb. of fatty acids. The gas contains 60 per cent. by volume of carbon dioxide, and 40 per cent. of hydrogen with only traces of other gases; per 100 lbs. of maize it occupies 550 cubic feet at N.T.P.

In the plant employed, the fermentation-gas, measured through a meter, passed through a compressor whence it was delivered at a pressure of 11 atmospheres to the bottom of the first of two towers. The gas entered through a spray nozzle immediately underneath the bottom plate in the first tower, passed up through the packing, meeting the downward stream of water, finally leaving at the top with a composition 85 per cent. hydrogen, 15 per cent. carbon dioxide to be treated similarly in the second washer. The water was delivered at a pressure of some 50 lbs. above that of the gas into the top of the washers. On leaving at the bottom the water from each tower which was about equal in quantity flowed into a separate pressure breakdown where the gas evolved was discharged through relief valves set at the desired pressure. The water from both towers was measured and, passing through a spray, fell over louvres, during which it gave up the remaining dissolved gas. It then flowed back to the sump to be re-utilised. The gas from the second tower pressure breakdown, which has the approximate composition of the fermentation-gas, was passed to the crude-gas main to be rewashed. The plant washed some 300 cb. ft. (at 15°C and 1 at.) of 40 per cent. hydrogen-gas per hour; the time of washing in each tower was about 30 minutes. Only 1 cb. ft. of hydrogen was lost per 100 cb. ft. of gas treated.

Assuming that the water leaving the bottom of the tower is in equilibrium with the gas entering it, an equation can be obtained and curves drawn giving immediately the quantities of water required theoretically in each tower to wash the gas so that it may have given compositions leaving the first and second towers of the plant. Curves then can be deduced showing the quantities of hydrogen carried away by the water flowing from each tower. These curves have been found to apply in practice very accurately to the first tower in the plant where the hydrogen-gas (40 per cent. by volume) was washed so that it contained 85 per cent. of hydrogen by volume. The agreement between theory and practice was not good in the second tower; it is difficult to obtain equilibrium when the gas entering a tower contains more than 80 per cent. of hydrogen; this also applies when it is sought to wash fermentation-gas so that it may contain more than 90 per cent. of hydrogen. For example, with 40 per cent. hydrogen-gas entering a tower and 87 per cent. hydrogen-gas leaving, 9·84 cb. ft. of water was used per 100 cb. ft. (measured at ordinary pressures) of entering gas as against 9·60 cb. ft. on theory; when the exit gas was 95 per cent. hydrogen, 18 cb. ft. of water was actually used as against the theoretical 10 cb. ft.

Mr. E. V. Evans, in congratulating the authors on their paper, pointed out the great importance of cheap industrial hydrogen. Dr. Reilly observed that the plant was only an experimental unit and many of the questions raised had not been considered. There was plenty of gas, but he did not think the recovery of hydrogen could become a large-scale operation. Practically 25 per cent. of the hydrogen in the starch came off as hydrogen-gas, and in the tropical countries, with cheap supplies of starchy materials, recovery might be economically possible. The gas used was pure, containing no methane, and liquefaction would not pay. Mr. Wheeler, who read the paper, pointed out the difficulties in the way of using sodium or potassium bicarbonate to wash the gas. There was no need to de-gasify the water in the sump, which contained practically no gas, and it was doubtful whether the results in the second tower could be improved upon.

BIRMINGHAM AND MIDLAND SECTION

The annual meeting took place at University of Birmingham on April 10, Dr. E. B. Maxted presiding over a representative attendance of members.

The several offices were filled as follows:—Chairman, Dr. E. B. Maxted; vice-chairmen, Prof. G. T. Morgan and Mr. F. R. O'Shaughnessy; hon. sec. and treasurer, Mr. G. King; hon. auditor, Mr. C. Watson. The following were elected to the committee: Messrs. D. F. Twiss, A. W. Knapp, W. A. S. Calder, W. T. Collis, and A. E. Johnson.

Mr. King reported that nine meetings were held during the session, including a dinner, and the average attendance being 54. A large proportion of the papers communicated to the Section had been published or passed for publication in the *Journal*. Subject to the approval of the Council the Committee recommended the creation of an associate group of the Section, to embrace those under 24 years of age who desired to receive all local section communications and to attend meetings and other functions. A fee of 2s. 6d. would be charged to cover expenses. Such associates would, however, be ineligible for election to the committee and would not receive the *Journal* of the Society. They would not be considered associate members of the Society, but rather as associate members of the Birmingham Section. It was proposed to extend the scheme of co-operation with the Chemical Society to the Faraday Society. During the year the Society's library in London had been dispersed, and the Section had received a number of journals and some patent literature, weighing about two tons, which were stored in the University Library, where they might be consulted by members of the Society of Chemical Industry. In conclusion Mr. King asked for the more active co-operation of the members of the Society. The average attendance at meetings was less than 20 per cent. of the number of members. The committee therefore looked for and expected considerably more support from the main body of members. Mr. King added that the funds of the Society were devoted entirely to the futherance of chemical science. The *Journal* was not a commercial venture and it was the duty of all members as chemists to further the interests of the Society.

The Chairman observed that the past successful season had been due to a very large extent to the devoted work of the hon. secretary, Mr. G. King. He was to be congratulated upon the excellent series of meetings. A meeting had been held fortnightly since the opening of the new year. Alluding to the programme for next session he mentioned that the idea of holding a symposium for the consideration of "Colloids" was favoured, but whether that would be arranged would depend upon the support likely to be forthcoming. Suggestions in relation to papers were invited.

Subsequently Mr. F. R. O'Shaughnessy, A.R.C.Sc., read a paper on "Physics and Sewage Disposal."

The paper discussed the physical properties of the principal components of normal sewage (*i.e.*, of the water on the one hand and the usual polluting bodies on the other) as affecting the operations of preparatory treatment preliminary to disposal.

The effect of various methods of treatment on sewage were discussed, and it was shown that whereas the visible suspended solids in sewage were for the most part readily separated, the bulk of the colloidal solids were held very tenaciously by the sewage water. Colloidal solids were but partially thrown down by simple sedimentation. Chemical precipitation effected only partial removal, even when large amount of chemicals added, but, when in moderate amount, improved the liquor for the bacteria bed. Anærobic action removed colloids, but made the liquor very offensive; it was, however, the only means of precipitating colloidal solids.

The work of Mr. F. W. Stoddart indicated, that given a limpid sewage liquid, which had been freed from colloidal solids by appropriate means, the quantity of liquid which could be put through a suitable percolation bacterial bed might be immensely increased, even to 10 or 20 millions gallons per acre. The technique provided by Messrs. Ardern and Lockett in the activated sludge process had furnished the key to the solution of this problem, and the author suggested that a modified use of this technique, which he proposed to call the "flocculated sludge process," was the appropriate means of dealing with colloidal matter in solution.

The merits of the activated sludge process were :—Completion of sewage purification in one tank in one operation ; elimination of nuisance ; reduction of area, and production of valuable fertiliser. The objections were :—Existing works made useless ; sludge problem more complex ; economical recovery of sludge problematical ; extravagant, *i.e.*, prolonged, aeration, high oxygen demand by sludge, alteration of physical character of sludge, etc. ; slow rate of solution of oxygen in water the central physical fact here ; and in many cases protection required for aeration. The procedure in this process was arbitrary, its objective largely commercial, *i.e.*, to conserve manurial elements, and must stand or fall on financial merits.

In the flocculated sludge process three operations were involved :—(*a*) agitation of sewage and flocculated sludge with air for a time to bring about clarification of the sewage and partial purification of the liquor ; (*b*) separation of sludge from treated sewage and (*c*) re-aeration of separated sludge. This mode of procedure might be applied to the whole sewage (less grit, etc.), as in the activated sludge process or after any desired degree of preliminary sedimentation. Its advantages were :—The wide choice of procedure available, for the process could be incorporated with existing plant ; a greatly increased volume of liquid could be put on bacteria beds ; nuisance (odour and flies) could be eliminated, and the expensive aeration period reduced.

The theory of the flocculated sludge process was then discussed, and evidence given that the purification of sewage is effected by physical agents, which brought about flocculation of colloidal solids, and by biological agents which brought about oxidation of the dissolved impurities. In the activated sludge technique the real flocculating agent was the sludge, the condition of the sludge being much more important than its quantity ; with the procedure advocated in the flocculated sludge process very remarkable and rapid purification could be obtained with greatly reduced volume of sludge.

With sludge this change was conveniently effected by the inoffensive, intensive, anærobic digestion of the sludge as by the Imhoff Tank, or by the method of separate digestion, as at Birmingham (England) and Baltimore, U.S.A., and elsewhere. In conclusion, the author claimed that the cost of the latter method was relatively low.

MEETINGS OF OTHER SOCIETIES

FARADAY SOCIETY

The Meeting held on April 13 was devoted to a discussion on "Alloys Resistant to Corrosion," held jointly at Sheffield with the local section of the Institute of Metals and the Manchester Metallurgical Society.

In a paper on "Monel Metal," J. Arnott, A.I.C. pointed out that as the metal was primarily an engineering material with excellent physical properties and good resistance to corrosion its sphere of use was different from that of acid-resisting metals, such as the iron-silicon alloys which had to be used in certain cases, despite their poor mechanical properties. The author discussed the composition and physical properties of monel metal, and stated that it had a high resistance to impact, a low heat conductivity (about 7 per cent. of that of copper) and retained strength and ductility at high temperatures, retaining 85 per cent. of its normal strength at 750° F. The metal was little affected by exposure to fairly pure air, and it resisted sea water and steam perfectly. It was unsuitable for use with strong acids, but was not affected by alkalis and only slightly by solutions of most neutral salts at ordinary temperatures ; it, however, would resist dilute acid solutions.

"The Resistance to Corrosion of Stainless Steel and Iron" was discussed by J. H. G. Monypenny, who pointed out that, contrary to the general opinion, there was a wide range of stainless steels, in which the main variable was carbon, followed by silicon, manganese and nickel. The resistance to corrosion could also be modified by varying the heat treatment, and the greatest resistance was obtained by quenching from a temperature of 900° to 950° C. Tempering had little effect on the resistance to corrosion, although this was lessened by tempering between 500° and 600° C. When annealed between 700° and 750° C. the material was softer than when hardened and fully tempered, and less resistant to corrosion. When distorted by cold work stainless steel rusted comparatively readily, and this was why a polished surface on stainless steel was more resistant than a roughly machined surface, the effect being due to the absence of distorted skin. The resistance to staining increased with a decrease in the carbon content. The presence of silicon in notable amounts raised the critical ranges and diminished the air-hardening capacity, but a content of 1 per cent. silicon had little effect on corrodibility. Nickel present in amounts up to 2 per cent. had no appreciable effect on the resistance. In conclusion, the author discussed the resistance to various corroding agents, and concluded that the following were without action on stainless steel :—Tap, sea, river and well waters ; ammonia, alkalis and alkaline carbonates ; aqueous solutions of salts, with the exception of ammonium chloride; vinegar, fruit juices, atmospheric agents, and superheated steam. Hydrochloric and sulphuric acids attacked the material rapidly, but whereas fairly strong nitric acid was without effect, dilute nitric acid attacked stainless steel slowly.

Mr. U. R. Evans contributed a paper on "The Mechanism of the So-called 'Dry Corrosion' of Metals," in which he defined the types of corrosion as (*a*) "wet corrosion"; *i.e.*, when metal was completely immersed in water; (*b*) "wet and dry corrosion"; *i.e.*, when the metal was periodically wetted and allowed to dry; and (*c*) "apparently dry corrosion"; *i.e.*, where a metal protected from rain was exposed to air. The paper was devoted to the discussion of the "apparently dry corrosion," and described experiments with electrolytic copper, zinc, lead and iron foil, and brass, etc. All the specimens used were cleaned and roughened by rubbing with coarse emery cloth, and special attention was paid to the question of "reproducibility" when different samples of the same material, exposed under apparently similar conditions, did not behave in the same way. It was concluded that no corrosion occurred when these apparently dry metals were kept over sulphuric acid, and only slow superficial corrosion when kept over water. The rate of attack was greatly increased by the presence of volatile electrolytes in the air, sulphur dioxide being most dangerous to iron and nickel, ammonia to copper and its alloys, and hydrogen chloride to zinc and aluminium. Hydrogen sulphide and carbon dioxide somewhat increased the rate of rusting of iron, but produced only superficial changes on other metals. Corrosion of iron was not induced by the presence of ammonia. Corrosion by volatile electrolytes appeared to require the presence of some moisture, but proceeded in air which was distinctly unsaturated. Special phenomena occurred at the contact of dissimilar metals, apparent electro-chemical protection being observed in some cases. The phenomena could be explained by assuming that electro-chemical action occurred in the adherent film of moisture. Volatile electrolytes increased the conductivity of this film and thus accelerated corrosion. When hygroscopic corrosion-products were produced further moisture was absorbed; the thickness of the film increased; the metal, originally dry, soon began to shed liquid and became seriously corroded.

ANNALI DI CHIMICA APPLICATA

As the publication of this Italian periodical, initiated in 1913, was suspended in 1919, it is of interest to note that the Italian Association of Pure and Applied Chemistry and the Italian Society of Industrial Chemistry have decided to resume publication of the *Annali*, which will now appear once a fortnight.

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held on April 12, Sir Max Muspratt presiding.

Arrangements were made to obtain, for the benefit of all members, as complete a record as possible of the imports of chemicals into this country. Arrangements were also made to obtain statistics of the consumption of fuel, for power and other purposes, by the industry.

Details of the arrangements in connexion with the British Empire Exhibition, 1924, were reported to the Council. Rather more than 37,000 sq. ft. of space has been reserved for the Chemical Section. A largely attended meeting of exhibitors recommended that there should be a comprehensive scheme of lay-out and decoration covering the whole of the chemical section. Plans are being prepared and will be considered later.

A deputation consisting of Sir Gregory Foster, Sir Robert Robertson, Dr. Seton and Mr. W. MacNab from University College, London, was received in support of the appeal for funds in connexion with the establishment of a Chair of Chemical Engineering at the University College. It transpired that the object of the Chair was for the study of the Physics of Applied Chemistry, and, having regard to the importance of this subject, the Council agreed to commend the scheme to the members for their support.

Sir William Alexander reported that difficulties were being experienced in the dye industry in connexion with the price to be paid for British goods and that negotiations are still in hand with the colour users on the subject. It is interesting to note that the British dye industry is now able to supply 80 per cent. of the colours previously made by Germany.

PETROLEUM DEPOSITS IN ITALY

The existing petroleum wells in Italy are situated principally in Emilia, and yield an average of 6000 tons of crude oil per annum, a maximum of 7000 tons having been reached in 1916. According to the *European Commercial*, fresh deposits have been discovered near Ripi (province of Rome) at a depth of 470 metres, which yield about two tons of oil daily. As a result the Italian Ministry of Agriculture has appointed a committee of geologists to direct the systematic examination of the whole country for further deposits. The committee reports that preliminary surveys in Emilia, Lazio, Campania, Apulia, Abruzzo, Basilicata, Calabria and Sicily have revealed sufficient indications of hydrocarbons to justify the expense of preliminary borings, and it is anticipated that important results will be obtained.

CORRESPONDENCE

THE TITLE "CHEMIST"

Sir,—The correspondence on this matter is indicative of a desire to do the right and proper thing for all concerned, but no practical suggestion has been put forward for discussion. On committee work it is often useful to have a suggestion, which is bad in principle, so that it may be "flogged to death" and from the carcase some useful bones are often picked.

If we look back in history we find the word "clerk" had a very restricted use, to-day it is the appellation of millions of workers and yet the correct designation of some thousands of clergymen to-day is "clerk in holy orders."

There must have been a time when the word clerk ceased to have its original meaning and to-day the title "chemist" has certainly been restricted for the use of certain trained people—men and women—by an "Act of Parliament," which could never have anticipated the advances to be made by chemical science. The Pharmaceutical Society has not been backward in the use of the title "Pharmacist" as describing the qualified persons who may keep open shop in such a way as complies with the Pharmacy, Poisons and other Acts of Parliament, but the official title of a shop-keeping pharmacist remains at "Chemist and Druggist." The word is in keeping with the French "pharmacien" and the German "pharmazent," and is descriptive to the rising generation. But supposing that the Pharmaceutical Society were willing to ask Parliamentary sanction for altering the title "Chemist and Druggist" to "Pharmacist" the difficulty remains; who is to be called a "Chemist"? We are left with a word similar to the above cited "clerk," which may belong rightfully to all kinds of chemists, and who is to control them all and protect the public from the unskilled, or the skilled scientist from unscrupulous advertisers?

We need a new word and it should not be beyond the ingenuity of man to coin a euphonious one. If the pharmacists wanted a new name the word Galenist might be acceptable to the disciples of Galen. To carry the analogy into the realm of modern chemistry and adopt a parent from one of our deceased great chemists gives rise to such words as Davyist, Crookesist, Ramsayist, Listerist; which would be meaningless for the next fifty years and we are almost forced back on the root "Chem," which is again in accord with the French and German. So also would be the word Alchemist and there seems no reason whatever why that name should not be rejuvenated and attached exclusively to such chemists as are properly trained and qualified to carry on skilled chemical work in all its branches. There are many good titles beginning with the initial letter "A" and, although it may sound too exclusive to most of us, yet not a few chemists would be pleased with anything less than *Alph-Ega* for their descriptive cognomen. How would dignity sit at the feet of an Alphegist or the Journal of the Society of Alphegists tower above the present effort in journalese?—I am, Sir, etc.,

C. Edward Sage

10, London Street, E.C.
April 13, 1923

ARTIFICIAL FATS AND FATTY ACIDS

Sir,—After reading your correspondent's excellent article on "Artificial Fats and Fatty Acids," a subject to which I have devoted some little attention, I am stimulated, with your permission, to make the following observations:

It may be contended that the attempts to compete with nature in the production of such a complex substance as even the simplest natural fat is at present little more than wasted effort, and that it were better and economically sounder to devote attention to the stimulation of nature to greater production. There are many arguments which may be advanced in support of this contention, the most cogent being that no-one yet knows enough concerning the total ingredients of the natural fats to render their reproduction from synthetic substances possible. The natural fat, with its complex organisation of mixed glycerides, phytosterols, chromogenetic substances, vitamins and other undiscovered or unidentified minor ingredients, is in no danger of being supplanted by rival artificial productions for many years to come.

This is, however, fully realised by the technical and industrial research chemists who are interested in the question. In fact, industrial research in this connexion is concentrated not so much on the artificial production of a fat identical with natural fat, but on the manufacture of products which shall prove suitable as a substitute for natural fat in some particular industry. The chemical constitution of the substance is not of first importance so long as the substitute can be produced more economically than the natural fat and is not detrimental to the quality of the article to be manufactured from it.

Viewed from this standpoint the developments which have been made in the technical production of fatty substances during the last few years in this and other countries are of practical significance and offer considerable promise of successful application.—I am, Sir, etc.,

A. N. Salway

Rock Ferry
April 13, 1923

BAYBERRY OIL

Sir,—With reference to the correspondence which has recently appeared in connexion with the above oil, Lewkowitch (Vol. II., sixth ed., p. 509) gives considerable information concerning bayberry or laurel oil (*Laurus nobilis* L.), whilst Jumelle (Les Huiles Végétales, 1921,

p. 166) states the following data:—S.g., at 15° C., 0·995, m.p., 40°—48° C.; solidifying point, 45°—39° C.; acid value, 3—4·4; saponification value, 205—217; iodine value, 2—3·9; Reichert-Meissel value, 0·5; solidifying point of fatty acid, 46° C. He says that the preponderating fatty acid is palmitic, with a little oleic acid and a small quantity of lauric acid. The iodine value is much lower than that given by Lewkowitch (*loc. cit.*), but is more in accordance with that published by Mr. C. J. Gundel in your last issue (p. 373).—I am, Sir, etc.,

London, S.E. 1. A. Harvey
April 13, 1923.

PERSONALIA

Sir J. J. Thompson has been awarded the John Scott Medal, and an accompanying purse of $1000, by the American Philosophical Society, and the Franklin Medal by the Franklin Institute. The John Scott Medal and a money prize have also been awarded to Dr. F. W. Aston for his work on Isotopes, and to Dr. Eijkman of the Utrecht University for research in medical science.

Prof. G. Louis will retire from the chair of mining and surveying and the William Cochrane lectureship in Metallurgy at Armstrong College on September 30, on reaching the age for retirement. Prof. G. Pool, of the University of Leeds, has been appointed professor of mining and Dr. J. A. Smythe, at present senior lecturer in chemistry, will take over the William Cochrane lectureship in metallurgy.

Mr. T. J. Pentecost, F.C.S., has been elected to the presidency of the Society of Dyers and Colourists.

The Bessemer Medal of the Iron and Steel Institute will be presented to Dr. W. H. Maw, at the annual meeting of May 10.

The Willard Gibbs medal of the Chicago Section of the American Chemical Society has been awarded to Prof. J. Stieglitz for his researches in organic chemistry.

Prof. Brogger, of Christiania, has been elected a foreign member of the Académie des Sciences.

It is announced in *Nature* that the tricentenary of the birth of Blaise Pascal occurs on June 19, and preparations have been made to hold official celebrations in France on July 8 and 9.

* * *

The death is announced from Germany of Prof. G. Köhler, aged 84, Director of the Clausthal Mining Academy and author of important treatises on mining.

From France the death is announced of Monsieur Edouard Dreux, managing director of the Longwy Steel Works, and well-known in the French metallurgical industry.

NEWS AND NOTES

CANADA

The Iron and Steel Industry in 1920

A report issued by the Dominion Bureau of Statistics (Mining, Metallurgical and Chemical Branch) states that the cost of materials used by the Canadian iron and steel industry in 1920 was $321,298,396, and the value of the products $640,233,785, $318,935,389 having been added to the value by manufacture in the 1475 establishments engaged in the industry. The earnings of the 102,661 wage-earners totalled $132,885,132, and the total capital invested in the industry amounted to $642,904,322. A large range of commodities was produced, the chief being 1,090,396 tons of pig iron and 1,166,691 tons of ingots, 191,283 tons of steel bars, 216,172 tons of wire rods, and 737,729 tons of blooms, billets, etc. By far the largest proportion of the industry is located in Ontario, 65·9 per cent. of the total capital of the industry being invested in that province, followed by Quebec with 20·5 per cent. of the entire capital and Nova Scotia with 5·3 per cent.

UNITED STATES

The Technology of Slate

The United States Bureau of Mines has published as Bulletin 218 (price 20 cents.) a useful monograph on the "Technology of Slate" by Oliver Bowles. Starting with an account of the properties of slate and features of the deposits, the author goes on to discuss faults, testing, uses, quarrying and manufacture. A most interesting section is contributed under the heading, "The Problem of Waste," a most important feature of the industry, as the waste averages in most regions 70 to 90 per cent. of the gross output, and even as much as 50 or 60 per cent. under favourable conditions. Waste is due to imperfections in the material itself, and to losses in quarrying, etc. After considering methods to reduce waste in manufacture, an interesting account is given of the progress made in utilising slate waste, of which veritable mountains are available. Claims have been made that waste slate can be used in manufacturing brick, pottery, roofing tiles, glass, paint, distempers, putty, metal polish, abrasive soap, insulators, rubber goods, asphalt, Portland cement, and even toilet powders. Experience shows that the material can be used advantageously as a filler in rubber goods, oilcloths, floor coverings, etc., as well as for plastic roofing and flooring products. For some products, a much finer grain slate "flour" is required, and when a uniform, reliable product, 95 per cent. of which will pass a 300-mesh screen, is available, a considerably wider use could be found in the manufacture of products requiring extremely finely grained fillers. The various uses outlined above are discussed in detail in the Bulletin, much information having been derived from work done in Wales.

GERMANY

Aluminium Industry

The aluminium industry is the only metallurgical industry developed in Germany during the war which has not since suffered severe setbacks, and the metal continues to find fresh applications. In electrical installations aluminium is being used instead of copper for cables ; this development is aided by the fact that the metal is not needed in such a high state of purity as copper, whilst its low specific gravity and the good price it commands as scrap-metal are also favourable factors. Aluminium is also taking the place of copper and brass in the manufacture of scientific apparatus. In this case it possesses the advantage that no tinning or nickel-plating is needed to prevent the corrosion which copper and brass may suffer. The brewing industry has adopted aluminium as a material for barrels and pans. Many machine parts are now made of the metal, such as pistons and connecting rods in internal-combustion engines. Aluminium has also a firmly established position as a material for household utensils, though the problem of cleaning such utensils is still a matter of difficulty. A great advantage of the metal is its cheapness since an aluminium article costs only half as much as a similar one made of brass.

In conjunction with other branches of industry the first German aluminium exhibition is to be held next summer at Cologne. It is intended as propaganda for the new aluminium industry, to open up new markets and make known the possibilities of the metal. A special film is being prepared, " Aluminium, the metal of the future," which will be shown nightly, accompanied by an explanatory lecture.

Yeast as a Food

We have received a pamphlet of 16 pages, entitled *Der Mensch und die Hefe*, by Prof. W. Küster, of Stuttgart. It is the first number of a new series of Biochemische Tagesfragen, or bio-chemical problems of to-day, and deals with comparative biochemistry and the bases of a rational method of nutrition, for the benefit of those " who do not understand the a, b, c of chemistry." The author does not equal Faraday in his powers of popular exposition, and the chemistry of the human body, and even of yeast, is much more complex than that of a candle ; hence we may doubt whether the pamphlet will convey to a general public all that it is intended to do. In part it is a plea for the more extensive use of yeast as a food, but its most interesting feature is probably that, even in the present troubled times, there should be in Germany a lay public sufficiently large and sufficiently interested in science to make the new series worth printing. Indeed, science still commands in Germany a greater respect than elsewhere ; interest in science is still more widely diffused there than in any other country.

GENERAL

Research on Portland Cement

The British Portland Cement Research Association has published a pamphlet (No. 1, pp. 35) on the setting of Portland Cement compiled by W. L. Gadd. It is stated that, in the opinion of the Council of the Association the investigation of methods for the regulation of setting time and the causes of changes in the setting time of portland cement has reached such a stage as to justify the presentation of a summary of the results. The Council hopes, at some further time, to return to the investigation with a view to discovering improvements in methods of regulating setting and means of preventing changes in the setting time. Work is now proceeding upon the action of colloids and fatty acids on the setting and other properties of cement. A summary of the chief points raised in this pamphlet will appear in the Abstract section of this *Journal* at an early date.

Research in Paper-Making

The Technical Section of the Paper Makers' Association of Great Britain and Ireland have associated themselves with a scheme of research to be carried on in the laboratories of the University College, Gower Street, London. The fields of research include investigation of the phenomena of the beater and beating process, both physico-chemical and physico-mechanical ; beating of selected standard celluloses, cotton, wood, esparto ; effect of the ordinary saline impurities incidental to paper mill treatment. Special investigation will be made into the " alum effect " and in general into the effects resulting from interaction of celluloses and sulphate of alumina. The research work will also bear on methods of diagnosing degree of hydration and the effect of special admixtures, electrolytes and colloids. A small committee consisting of Prof. F. G. Donnan, F.R.S., Mr. C. F. Cross, F.R.S., Mr. Arthur Baker and Captain W. E. Nuttall, will control the scheme of research, and the experimental work will be carried out by Mr. J. W. Rowe, B.A., Post Graduate Research Scholar, in the Laboratories of the University College, London, under the immediate direction of Prof. F. G. Donnan.

The World's Output of Olive Oil in 1922

Figures published by the International Institute of Agriculture, Rome, indicate a total world's production of olive oil of 15,053 thousand centals in 1922, no less than 14,197·2 thousand centals having been produced in Europe and the remainder in Africa. This total represents over 90 per cent. of the world's production of olive oil and compares with a production of 11,382·7 thousand centals in 1921 and an average output during the period 1909-1913 estimated at 11,565·7 centals.

REVIEWS

THE VAT-DYE INDUSTRY IN GREAT BRITAIN

Synthetic Colouring Matters: Vat Colours. *By* Prof. J. F. Thorpe, F.R.S., *and* C. K. Ingold, D.Sc. *Monographs on Industrial Chemistry, edited by* Sir E. Thorpe. *Pp.* *xv*+491. *London: Longmans, Green and Co.,* 1922. *Price* 16*s*.

This treatise, one of the well-known series of monographs edited by Sir Edward Thorpe, will appeal to two classes of readers, those engaged in the production or use of vat colours and those who wish to gain a general knowledge of this interesting but very intricate group of synthetic colouring matters.

The latter class will certainly appreciate the completeness with which the authors have dealt with the historical introduction to the subject. Included in the category of vat colours are two of the dyes of antiquity, Tyrian purple and indigo, and on these topics the authors have made the most of their opportunities. The chapters on "the purple of the ancients" and "natural indigo" contain in a concise but very readable form an epitome of the ancient and modern literatures of these pigments. The ceremonial use of purple in ancient civilisations, the lapse of its manufacture during the dark ages, and the rediscovery and identification of the colour in modern times constitute one of the most enthralling romances in the history of science. The oft told tale of indigo possesses a similar fascination.

Modern vat dyes are products of the twentieth century, for their discovery synchronises with the beginning of this epoch. It was not until 1901 that indanthrene and flavanthrene were placed on the market by the Badische Anilin and Soda Fabrik. The same year saw the introduction of tetrachloroindigo, and thioindigo came later in 1906. Since these recent dates the scientific and industrial developments in this field of organic synthesis have been enormous, so that in place of one blue vat dye, indigo—the purple having long since become obsolete—dyers now have the choice of scores of these colouring matters giving every imaginable hue, and often excelling the prototype in brilliancy and durability.

The chemical constitutions of these new colouring matters are extremely complicated, and the authors are to be congratulated on the way in which they have evolved order out of chaos in the matter of classification and terminology. Following on a chapter devoted to synthetic indigo are sections dealing successively with its substitution products and homologues, and with its analogues derived from similar and dissimilar component nuclei. Over 200 pages are taken up with vat dyes from anthraquinone, special attention being paid to the chemistry of the first two industrialised products, indanthrene and flavanthrene.

The value of the work to chemical students is enhanced by two chapters giving experimental details for preparing certain representative vat colours and their intermediates. In spite of the highly technical and complicated character of the text, there are remarkably few errors and these are generally of a trivial character.

This monograph on vat colours appears at a psychological moment in the history of the manufacture of these dyes in Great Britain.

Until 1914, synthetic indigo and other modern vat dyes were a German monopoly restrained only to a limited extent by Swiss competition. No attempt had up to that time been made to produce vat colours in this country and on the outbreak of war there was an acute shortage of these indispensable dyes in England, and among the Allies generally. In 1915 the Sundour Fabrics Company, under the inspiration of Mr. James Morton, attempted the desperate expedient of manufacturing these complicated products without any previous knowledge of the art, and although everything essential had to be improvised, the enterprise succeeded. Other firms followed, and at present there are at least two actual British makers of vat colours, and two or three others who are potential producers. In most cases the quality leaves nothing to be desired; it is up to German standard, but the inexorable question of cost arises. Partly owing to the extreme youth and inexperience of the British vat-dye industry, which has been in existence for not more than seven years, and partly and to a larger extent because of the disparity of the exchanges, German products can be sold at prices with which at present British makers cannot compete. In this country the raw materials alone represent approximately three times the pre-war price of the German vat dyes. Obviously the finished product must, in existing circumstances, be relatively expensive. The other horn of the dilemma is represented by the position of the British dye users, who are faced with the competition in neutral and colonial markets of dyed and printed fabrics produced by foreign dyers and printers having access to cheap German dyes. Some solution of this knotty problem must be found without delay, otherwise our newly won independence of German dyewares will disappear, and with it will go one of our most highly skilled chemical industries and our hopes for a renaissance of applied organic chemistry within the British Empire.

That our anxieties in this direction should not, however, blind us to similar crises existing in other skilled industries is a lesson to be drawn from the significant circumstance that this monograph now under review, the first English treatise of its kind, is printed in Saxony.

G. T. Morgan

Oxidations and Reductions in the Animal Body. *By* H. D. Dakin, D.Sc., F.R.S. Monographs on Biochemistry, *edited by* Dr. R. H. A. Plimmer *and* Prof. F. G. Hopkins. *Second edition. Pp. ix*+176. *London: Longmans Green and Co.*, 1922. *Price* 6*s.*

The series of *Monographs on Biochemistry*, edited by Dr. R. H. A. Plimmer and Prof. F. G. Hopkins, has proved an undoubted success, and has been imitated in this country, as well as in Germany and the United States. The book under review is the second edition of a monograph on some aspects of intermediary metabolism.

Since Lavoisier, we know that the food we eat is burnt, as if in a fire, to carbon dioxide and water. But what are the intermediate steps? It is only during the last few decades that we have obtained something like an answer to this question, and Dr. Dakin has taken a large share in the unravelling of the sequence of reactions which go on in the body. His work affords one of the best examples of the successful application of organic chemistry to the elucidation of vital processes; it is one of the most interesting chapters in "dynamic" biochemistry; it is real chemistry, yet intimately associated with the living cell.

Let us take a concrete example. How is our breakfast bacon ultimately transformed into carbon dioxide and water? Before absorption into the blood stream, the fat is hydrolysed, but by what stages are the long carbon chains of the fatty acids slowly burnt? Readers of Dr. Dakin's book will learn that, according to Knoop's theory of β-oxidation, proved experimentally by Embden and others, stearic acid is successively transformed to myristic, lauric, decoic, octoic acid, etc. Each time two carbon atoms are removed. It is not a mere accident that milk contains only fatty acids with an even number of carbon atoms. Knoop's theory was at first attacked, because it was contrary to the experience of the organic chemist. Dr. Dakin himself, however, discovered in hydrogen peroxide a reagent which attacks the β-carbon atom *in vitro*. He even quotes an analogy from technical chemistry; Fischer and Schneider and others in Germany have recently shown that paraffin wax may be oxidised by air at 140-170° C. to a series of fatty acids in which the successive members differ from each other by two carbon atoms.

In another chapter of the monograph we learn how the various amino-acids of protein are oxidised. The chapter on the oxidation of carbohydrates has, most opportunely, required re-writing, and is of special interest owing to the recent discovery of insulin as a remedial agent in diabetes and because of the suggestion that the sugar of normal blood may be γ-glucose. Pathological conditions, as in diabetes, in which sugar cannot be burnt, and the oxidation of the long carbon chain stops short at aceto-acetic acid, or as in alkaptonuria, in which the benzene nucleus of tyrosine and phenylalanine resists oxidation, give valuable information as to the nature of the oxidative processes in the body.

There is also much important new matter in the introduction and in the section on the nature of oxidising and reducing agents, since these deal (rather succinctly) with Wieland's theory of dehydrogenation, Hopkins's work on glutathione, and the researches of Meyerhof and of Thunberg.

The second edition has been well printed in Germany, and except for the paper, the get-up is quite as good as that of the pre-war edition. In particular there are but few misprints. The most likely place to find these is in the extensive bibliography, which forms a valuable feature of this, as of other monographs of the series. Here a few names have been misspelt: Mummery, Röhmann and Traube (p. 146); Balcar (p. 163); Knoop (p. 164); Bezzola (p. 167); Thannhauser (p. 169).

George Barger

Vanille, Vanilline, Vanille-Extracten. *By* Dr. W. L. Utermark. *Koloniaal Instituut te Amsterdam, Mededeeling No. XVII. Afdeeling Handelsmuseum No.* 3. *Pp.* 116. *Amsterdam: Koloniaal Instituut*, 1922. *Price* 2·50 *florins.*

This little brochure, published by the Amsterdam Colonial Institute, forms a useful and comprehensive compilation on the natural and artificial vanilla flavours.

A short chapter on the botany of the vanilla plant and on its cultivation includes some excellent photographs; there are also some interesting illustrations of the process of artificial fertilisation, first introduced by Charles Morren in 1836, and developed by Albius in 1841, and now practically universally used.

The chapter on the chemistry of vanillin and its artificial production is fairly comprehensive, without too much detail, but not nearly so wide in its scope as a fairly recent series of articles on the subject which appeared in *La Parfumerie Moderne.*

The few pages on vanilla extracts are good so far as they go, but they are necessarily ambiguous and doubtful on account of the different methods of dealing with them in various countries. For example, attempts to standardise, with much emphasis on the so-called "lead number," have been made by foremost officials and unofficial chemists in the United States, whereas nothing of the kind has been done, for example, in this country.

The summary of methods of determination of vanillin in vanilla is very good and very accurate. This little work is to be commended as a useful summary on the subject, and one which all interested in the vanilla flavour would do well to consult.

Ernest J. Parry

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Salt Duty in India

In reply to Mr. Trevelyan, Earl Winterton said that the Indian Finance Bill containing a clause raising the rate of salt duty from Rs. 1·4 to 2·8 per maund which was rejected by the Legislative Assembly was certified by the Governor-General to be essential and accordingly became an Act of the Indian legislature. The Act was now operative.—(Apr. 9.)

British Industries Fair

Lieut.-Col. Buckley, answering Mr. Gilbert, said that the cost of the British Industries Fair recently organised by the Department of Overseas Trade at the White City was roughly £36,000, which was fully covered by revenue. The Birmingham section of the Fair was not organised by the Department, and did not involve expenditure out of public funds. The amount of orders received could not be estimated, but it was understood that satisfactory business was done this year.—(Apr. 9.)

Importation of Dyestuffs

Viscount Wolmer informed Mr. H. Simpson that the Central Importing Agency was set up by Messrs. Fairclough, Dodd and Jones to act as agents of the Board of Trade for the distribution of German reparation dyes.

Answering Mr. Pringle, Sir P. Lloyd Graeme said that the original arrangement made with the Agency did not provide adequate remuneration for the services performed by the Agency and the subsequent increase of the rate of remuneration had no connexion with the fact that the Agency had incurred bad debts. It was estimated that the amount to be credited to the German Reparation Account to date in respect of dyes and dyestuffs was, approximately, £950,000 and the amount realised from sales, approximately, £1,043,000. The realisable value of stocks on hand was estimated at £110,000 and the amount of profit realised to March 31, 1922, was £137,000.—(Apr. 9, 10.)

Dangerous Drugs and Poisons (Amendment) Bill

This Bill passed the third reading on April 9. The object of the Bill is to amend the Dangerous Drugs Act, 1920, and Section 17 of the Pharmacy Act, 1868, with a view to establishing closer control over the sale, distribution, and utilisation of dangerous drugs. Medical practitioners are relieved of the necessity of signing when purchasing poison for the purposes of their profession, and clauses are inserted in conformity with the provisions of the International Opium Convention, 1912.

Chemical Treatment of Imported Meat

In answer to Mr. H. Simpson, Mr. Chamberlain said that so far as he was aware, no meat treated with formaldehyde or sulphur dioxide had recently been imported into this country.—(Apr. 11.)

Imports and Consumption of Potash

Viscount Wolmer, in a written answer to Dr. Chapple, gave the quantities of potassium salts largely, but not wholly, used for manurial purposes and imported into the United Kingdom from Germany during 1920, 1921 and 1922 as follows :—

	1920	1921	1922
		Cwts.	
Potassium chloride ..	119,447	83,612	348,201
Kainite and other potash fertiliser salts	230,077	607,648	1,989,618
Potassium sulphate ..	103,450	47,870	156,473

Kainite, with 12½ per cent. potash, was sold at an average price of 103s. per ton in 1921 and 55s. per ton in 1922 for 2-ton lots, free on rail. In 1912 it was estimated that 80,000 tons of potash was used in agriculture and in 1922 the imports into Great Britain and Ireland of potassium compounds (excluding potassium nitrate) were 200,357 tons of an average value of 93s. per ton, but how much of this was used for manurial purposes was not known.—(Apr. 12.)

LEGAL INTELLIGENCE

Absortion of Arsenic by Potassium Carbonate from Glass Bottle. Birmingham Corporation *v* Boots' Cash Chemists (Western), Ltd.

On April 13 a case was heard by the Birmingham magistrates in which Boots Cash Chemists (Western), Ltd., of Nottingham, were summoned for selling at 275, Coventry Road, Small Heath, potassium carbonate which was not of the quality demanded, as it contained 80 parts of lead per million and about 10 parts of arsenic per million.

Mr. Liverseege, the city analyst, said that the article was impure commercial salt of tartar instead of pure potassium carbonate, and contained 16 times the lead and 5 times the arsenic allowed in the British Pharmacopœia. The price of the pure drug was charged for the impure article, so that the sale prejudiced the purchaser. He did not think it probable that the arsenic and lead were absorbed from the bottle, because the substance was dried.

Mr. H. Droop Richmond, F.I.C., Chief Analyst to Boots Pure Drug Co., said that as he found the product really contained lead and arsenic, he analysed the glass of the bottle containing it and found that potassium carbonate, which was hygroscopic, had extracted lead and arsenic from the glass. On putting potassium carbonate in a similar bottle, less than 5 parts per million of arsenic had increased to 15 parts per million in a fortnight.

The magistrates dismissed the case, and the chairman said that they believed Mr. Droop Richmond's discovery would be historical.

COMPANY NEWS

SALT UNION, LTD.

Mr. G. H. Cox, who presided over the annual meeting held in Liverpool on March 27, reviewed the state of trade during the past year, and said there was considerable improvement, due to the absence of any interruption to production and delivery, and to reduced cost of production. During the past year economies of production and administration had been effected by concentration of work at the most favourable centres, and the results had proved very beneficial. The export trade was satisfactory, exports to India having increased despite competition from German and solar salt. Shipments to Rangoon were maintained, and those to Japan, which had been entirely arrested, had now been resumed, and West African trade was also growing. The research department had solved several important problems, and had made it possible to establish a chemical industry to utilise a waste product, a plant having now been erected to produce magnesium carbonate on a commercial scale. A new purifier and preservative which was a by-product had also been placed on the market. The immediate outlook for the salt trade was fairly satisfactory, but further improvement was hindered by heavy taxation and costs. The home trade had had to meet heavy foreign competition, and prices in some cases declined to the level of costs. The net surplus of £182,228 was allocated as follows: Preference dividend, £70,000; ordinary dividend, £80,000; staff superannuation fund, £10,000; carry forward, £20,228. During the past year the B debenture issue had been cancelled in exchange for first debenture stock.

BRITISH PORTLAND CEMENT MANUFACTURERS, LTD.

The annual meeting was held on March 28, under the presidency of the Hon. F. C. Stanley, who stated that the associated company had purchased the works and other assets of the Kent Portland Cement Co., Ltd., and had guaranteed the issue by that company of £6,600,000 of Kent 6½ per cent. debenture stock. The dividend was maintained at 10 per cent., but trading conditions were very difficult; the demand was very small, and the turnover was less than in the previous year. It was to be regretted that certain public authorities had placed contracts for cement, etc. with continental manufacturers assisted by depreciated currencies. The immediate outlook was not as promising as could be wished, for but little reduction in the cost of manufacture could be expected. The reductions already made in the selling prices would exceed any possible saving in manufacturing costs. Nothing was being neglected to increase the use of cement, and the use of concrete in road construction was being vigorously advocated.

REPORT

Report on the Financial and Economic Conditions of the Argentine Republic, September, 1922. *By* H. O. Chalkley, *H.M. Commercial Secretary, Buenos Aires. Pp.* 52. *Department of Overseas Trade. H.M. Stationery Office,* 1922. *Price* 1s. 6d.

Trade in Argentina was stagnant during 1922, and, though the outlook is generally considered to be hopeful, the individual trader is not yet able to feel any optimism. Europe is too poor to buy Argentine products and in some cases values have fallen till they hardly cover the cost of production. The sugar market is somewhat depressed since unnecessarily large imports were made in 1921 to augment the home production of 194,000 tons; an output of 200,000 tons is estimated for 1922. Trade in hides exceeded expectations in 1922, the exports for the first seven months being almost equal to the total for 1921. Cotton was produced in 1921 to the extent of 18,000 t., part of which was exported. The dairy industry continues to flourish, though early in 1922 it passed through a critical period; 6568 t. of casein was exported in the first half of 1922. Petroleum continues to be the chief mineral product. During the first half of 1922 the State fields, far and away the most important, produced 1,013,000 barrels, compared with 1,730,000 during the whole of 1921. A still higher output will probably be attempted under the new Government. Other mining enterprises remain unimportant; the non-metalliferous minerals, such as borates, salt, gypsum, limestone, and mica are the most worked. The position of manufacturing industries has changed very little since 1921 (*cf.* J., 1922, 106 R).

Exports in 1921 were estimated at £132,900,000 (£1=5·04 gold pesos); details are not given of the countries of destination, but the items include:—Quebracho, logs, 30,857 t., extract, 120,100 t.; hides, 4,368,073; skins, 45,467 bales; tallow, 19,375 t. Imports were valued at about £155,000,000. The latest analysis of imports is for 1920 when iron and steel was imported to the value of £27,418,000; coal, cement, sand, bricks, etc., £15,838,000; glass, porcelain, china, £2,602,000; chemicals and drugs, £9,313,000; oils, fats, petroleum, petroleum products, £10,229,000; paints, varnish, dyes, ink, £1,521,000; tinplate, copper, lead, zinc, £1,095,000.

The volume of British exports to Argentina decreased from £42,921,254 in 1920 to £27,622,024 in 1921 and in the first six months of 1922 to £10,993,379. The principal articles imported from the United Kingdom are coal, iron and steel goods, and textiles. Competition in Argentine markets is not now restricted to the United States and the United Kingdom; Germany, Belgium, Spain, France, and Italy have also entered the lists, although the United Kingdom appears to have the best chances of increasing its trade.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for April* 5 *and* 12)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Albania	Chinaware	423
,,	Iron, steel, cement	425
,,	Sugar	10313,F.E./CC/2
,,	Paint and varnish	459
Algeria	Sugar	489
Argentina	Tin, tinplate, linseed oil, soap, perfumery	492
,,	Shellac, gold leaf, bronze and aluminium powders	493
Australia	Aluminium ware	*
British India	Portland cement (tender for)	†
Canada	Salt	418
Czechoslovakia	Dyes	427
Denmark	Edible animal oils and fats	428
Egypt	Leather (tender for)	**
,,	Linseed oil	488
Italy (Fiume)	Hides, kips, etc.	430
Netherlands	Pottery, china, glass	432
,,	Non-ferrous metals, chemicals	434
Netherland E. Indies	Photographic plates, films, printing paper and chemicals	442
Norway	Asbestos goods, tar products, paper and pulp supplies	477
Panama	Leather goods, paints	494
,,	Perfumery	495
Poland	Tin, antimony regulus, aluminium, chemicals, drugs	478
Peru	Earthenware	496
Siam	Paint (tender for)	10059/F.E.
South Africa	Varnish and enamel (tender for)	10872/E.D./C.C./2
Spain	Edible oil	481
Switzerland	Chemicals, pharmaceuticals, resins, oils	485
United States	Iron and steel	18677/10/F.W./E.C./2
,,	Calcium arsenate	5411/C./T.C./C.C./2
,,	Steel	18677/F.W./E.C./2
Yugoslavia	Metals	437, 480

* Ref. No. Com. 412/7/1/1/97, Commercial Bureau, Australia House, Strand, W.C. 2.

† Director-General, India Store Dept., Belvedere Road, Lambeth, S.E. 1.

** Muh. 1923/37/1, Inspecting Engineer, Egyptian Government, Queen Anne's Chambers, S.W. 1.

TARIFF CUSTOMS EXCISE

Australia.—Dumping duties have been applied to German glassware and Norwegian calcium carbide.

Canada.—" Dumping " duty is not to be applied to goods from countries with depreciated currencies, provided that the selling price in Canada is not less than the fair market value in the country of origin. Previously such goods were appraised according to their value when produced and sold in the United Kingdom or other European country whose currency has not substantially depreciated. Artificial silk for manufacturing purposes may be imported duty-free.

Far Eastern Republic.—Importation of all goods is subject to licence ; articles, the importation of which is prohibited, include various metallurgical, leather, mineral, chemical, pharmaceutical and agricultural products.

Fiji.—The export duty on copra has been reduced to 5s. per ton or part of a ton.

France and Algeria.—Hides and skins, crude wax, groundnuts, edible oils, etc., may be imported duty-free.

Germany (*Occupied*).—Goods in transit are exempted from export duty, including shellac exported to destinations other than unoccupied Germany.

Honduras.—Coconuts, copra and coconut oil may be exported free of duty.

Madagascar.—The statistical tax on packages of merchandise has been increased from 25 to 30 centimes per 1000 kg. or per cb. metre.

Newfoundland.—The export tax on seal oil has been suspended.

New Zealand.—The embargo on German and Austrian goods will be withdrawn on September 1.

Portugal.—A translation of the new customs tariff, which includes many raw materials and chemicals, is given in the issue for April 12.

South Africa.—The import duty on calcium carbide has been doubled, and the duties on paint, glass bottles, asbestos sheets, slates, sheet metal, matches, rubber tyres and inner tubes, have been revised. A " dumping " duty has been imposed on cement imported from Great Britain.

Spain.—Export prohibitions have been removed from petrol, petroleum, tanned hides and skins, untanned hides, and cement. The export duties on groundnuts, vegetable charcoal, soap, and tanned hides and skins have been withdrawn. The issue for April 5, gives a list of goods in respect of which certificates of origin must be supplied to secure reduced rates of duty. Among the goods included in the list are :—asbestos wares, hides, skins, iron and steel goods, purpurin of copper, copper alloys, scientific instruments, coal-tar derivatives, etc.

Tunis.—A " coefficient of increase " has been applied to glucose, mineral kermes and other antimony salts, and coal-tar derivatives. The export of sugar has been prohibited.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acid Acetic, 40% tech.	£23-£25 per ton. Very firm with little available. Complete absence of German supplies.
Acid Hydrochloric	4s. per carboy.
Acid Nitric	£24 10s. per ton. No signs of improvement.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw. is 70s., f.o.r. makers' works, with slight variations up and down, due to local considerations.
Acid Sulphuric, 94% arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Steady demand. Continental inquiries more frequent.
Arsenic (white)	£70-£75 per ton. Market steady.
Bisulphite of Lime	£7 per ton. Packages extra.
Bleaching Powder	£10 10s. per ton d/d. No change. Spot demand poor.
Calcium Chloride	£6 per ton d/d.
Copper Sulphate	£27 per ton. Somewhat firmer
Potash Caustic, 88/90%	£35 per ton. Considerably advanced in value. No German supplies.
Potassium Bichromate	5¾d.-6d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£5 per ton. Normal.
Soda Caustic, 76%	£20-£21 per ton. Demand good, especially for the Continent.
Sod. Bicarbonate	£10 10s. per ton.
Sod. Acetate, 97/98%	£25 per ton.
Sod. Bisulphite Powder, 60/62%	ton lots £19 10 £19 10s. 5 £20 2 £20 10s. 1 £20 10s. 1 f.o.b. or f.o.r. London, 1-cwt. iron drums included.
Sod. Chlorate	3d. per lb. Demand not quite so brisk, with better supplies.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide	£15-£16 conc. solid carr. paid. Better demand.
Sod. Sulphite, Pea Cryst.	ton lots £17 2 £17 10s. 1 1-cwt. wooden kegs included.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	8d.-1s. 3d. per lb.
Crimson	1s. 7d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6½d. per lb.
Sulphur, finest	£11 10s. per ton.
Arsenic Sulphide	2s. per lb.
Chromium Oxide	1s. 5d. per lb.
Lead Hyposulphite	8d. per lb.
Zinc Sulphides	7½d. per lb.
Carbon Bisulphide	£28 per ton.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Thiocarbanilide	2s. 6d. per lb.

WOOD DISTILLATION PRODUCTS

At the present time there is a fairly good demand for all Wood Distillation Products.

Acetate of Lime Brown	£10 per ton d/d.
Grey	£20 per ton d/d.
Liquor	9d. per gall, 32° Tw.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
Red Liquor	1s. 2d. „ „ 24° Tw.
	1s. 3d. „ „ 14/15° Tw.
Wood Creosote	2s. 6d. „ „ Unrefined.
Wood Naphtha, Miscible	6s. 6d. „ „ 60% O.P.
Solvent	5s. „ „ 40% O.P.
Wood Tar	£5 per ton d/d.

TAR PRODUCTS

Acid Carbolic Crystals	1s. 7d.-1s. 8d. per lb. Temporary lull in the demand, but makers are fully sold. Prices unchanged.
Crude 60's	4s. per gall. Little business passing.
Acid Cresylic, 97/99	2s. 1d.-2s. 3d. gall. More inquiry. Higher prices expected.
Pale 95%	1s. 11d.-2s. 2d. per gall. More inquiry. Higher prices expected.
Dark	1s. 9d.-1s. 11d. per gall. Little demand.
Anthracene Paste, 40%	4d. per unit per cwt. Price nominal.
Anthracene Oil—	
Strained	9⅝d.-11d. per gallon. Numerous inquiries but supply still limited.
Unstrained	9d. per gallon.
Benzole, Crude 65's	1s. 1d. per gall.
Standard motor	1s. 6½d.-1s. 8d. per gall.
Pure	2s.-2s. 4d. per gall.
Toluole, 90%	1s. 9d.-1s. 11d. per gall. Market steady.
Pure	2s.-2s. 6d. per gall. Fair inquiry.
Xylol	2s. 9d.-3s. 3d. per gall.
Creosote—	
Cresylic, 20/24%	11d.-1s. 1d. per gall.
Middle Oil Heavy Standard Specification	8½d. to 10d. per gall. Business active.
Naphtha—	
Crude	9d. -9¼d. per gall.
Solvent, 90/160	1s. 6d.-1s. 9d. per gall Better demand.
Solvent, 90/190	1s. 6½d.-1s. 7½d. per gall. Price steady.
Naphthalene Crude—	
Drained Creosote Salts	£7-£10 10s. per ton. Demand good. Supply short.
Whizzed or hot pressed	£11-£14 ton. Market active.
Naphthalene Crystals	£17 10s. per ton.
Flaked	£16 10s. per ton.
Pitch, Medium soft	190s.-200s. per ton, nominal. No business doing for this Season.
Pyridine—90/140	11s.-12s. 6d. per gall. Few inquiries. Price steady.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Business in Aniline Dyestuffs has not been quite so good during the past week, principally owing to the depressed state of the Textile Industry. This has been somewhat compensated for by orders from abroad which have come in a little more freely. Prices are very firm, and no reductions are expected in the near future.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride anhydrous	1s. per lb. delivered.
Aniline Oil and Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlor Phenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol, 29/31° C.	Fair demand with advanced prices in sympathy with Carbolic prices.
m-Cresol, 98/100%	2s. 3d. per lb. Fair demand.
p-Cresol, 32/34° C.	2s. 3d. per lb. Fair demand.
p-Dichlorbenzol	£70 per ton.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlor benzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene—48/50	8d.-9d. naked at works.
66/68	1s. 2d.-1s. 3d. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d, packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
a-Naphthol	2s. 8d. per lb.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d.-8d. per lb.
Nitronaphthalene	1s. per lb. d/d.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. d/d.
m-Phenylene Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. per lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sod. Naphthionate	2s. 8½d. per lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Although prices are much firmer, it is thought that quotations will inevitably go still higher as demand arises, as there is very little doing in the market at the present time. The export trade in these chemicals is, however, much better and promises to improve in the near future.

Acid, Acetic, 80%	£50-£53 per ton.
Acid, Acetyl Salicylic	3s. 4d. per lb. is the value to-day. It is firmly held at this figure.
Acid, Benzoic	2s. 3d. per lb. Unchanged with little inquiry.
Acid, Citric	1s. 8½d. per lb. for ton lots. Market very firm with tendency to advance.
Acid, Gallic	3s. per lb. for 2-cwt. lots, 3s. 3d. per lb. for 56lb. lots.
Acid, Pyrogallic, cryst.	5s. 9d. per lb. Price advanced.
Acid, Salicylic	2s. 3d.-2s. 6d. per lb. Buyers holding back but market firm.
Acid, Tannic	3s. 3d. per lb. still quoted.
Acid, Tartaric	1s. 3½d.-1s. 3¾d. per lb. As anticipated there has been a further rise in price and the demand is much greater. Raw materials continue to advance in price.
Amidol	9s. per lb.
Acetanilide	1s. 6d. per lb., with few orders about. This price is very low and must advance when stocks have to be renewed.
Amidopyrin	13s. 6d. per lb.—weaker.
Ammon. Benzoate	3s. 6d.-3s. 9d. per lb. advanced rate as anticipated.
Ammon. Carbonate B.P.	£37 10s. per ton.
Barbitone	17s. 6d.-20s. per lb. as to holder.
Benzaldehyde	3s. per lb.
Bismuth Salts	Unchanged. Steady market and good demand.
Bromides	All quite 1d. per lb. higher, with inquiry especially from abroad.
Calcium Lactate	2s. 9d. per lb. for English made.
Chloral Hydrate	4s. per lb., with little doing.
Guaiacol Carbonate	10s. per lb. is the value, though some holders are willing to clear their stocks at slightly lower rates.
Hexamine	4s. 6d. per lb. This price is well maintained.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. in 1-cwt. lots.
Magnesium Carbonate—Light Commercial	£38 per ton. Market fairly active recently.
Magnesium Oxide—Light Commercial	£85 per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Menthol	31s. per lb. original cases. Smaller quantities 32s. per lb. nett.
Methyl Salicylate	2s. 6d. per lb. in glass, tins being 2d. per lb. less.
Methyl Sulphonal	14s. 6d. per lb. is present value.
Paraformaldehyde	4s. per lb.
Paraldehyde	1s. 7d-1s. 9d. per lb. More enquiry.
Phenacetin	6s. 6d. per lb. Unchanged.
Phenazone	7s. 6d. per lb is now asked in some quarters. The price is certainly much firmer.
Phenolphthalein	5s. 6d. per lb—still better.
Potass. Bitartrate—99/100% (Cream of Tartar)	95s.-97s. 6d. per cwt., less 2½% for ton lots. Higher prices expected. Raw materials advancing.

Potass. Iodide	15s. 8d. per lb., cwt. lots packages free.
Potass. Permanganate	10d.-11d. per lb. Considerably firmer.
Potass. Sulphoguaiacolate	5s. per lb. is the value.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. Steady demand.
Resorcin	5s. 6d. per lb.
Salol	2s. 9d. per lb. Stocks are getting into small compass and the price now quoted is expected to advance before long.
Sod. Benzoate	2s. 3d. per lb. Spot supplies are firmly held at this figure.
Sod. Citrate	U.S.P. quality 2s. 2d. per lb.
Sod. Hyposulphite—Photographic	£15-£17 per ton according to quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d. per cwt. Poor demand.
Sod. Salicylate	2s. 8d. for Powder, 2s. 9d. for Crystal, are the new advanced rates, being 3d. per lb. higher.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. f.o.r. London, 1-cwt. wooden kegs included.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 4d. per lb.
Thymol	18s. per lb. for good White Crystal.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d.
Anise Oil, Red Ship Brand	2s. 1d.
Bergamot Oil	12s 6d. spot, 13s. 6d. forward.
Cananga Oil, Java	9s.
Cassia Oil, 80/85%	8s. 3d.
Cinnamon Oil, Leaf	4¼d. per oz.
Citronella Oil—	
Java 85/90%	4s. 3d.
Ceylon	3s. 3d.
Clove Oil	8s.-8s. 6d.
Eucalyptus Oil 70/75%	1s. 9d.
Lavender Oil, Mont Blanc 38/40%	13s.
Lemon Oil, Spot	3s. 1d. Higher prices are asked for forward delivery.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet, Spot	10s. 6d. Higher forward.
Otto of Rose Oil—	
Anatolian	24s.
Bulgarian	30s.
Palma Rosa Oil	17s.
Peppermint Oil—	
English, Mitcham	80s.
Wayne County	13s.
Japanese	6s. 3d.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	13s. ,, ,,
Amyl Acetate	2s. 6d. ,, ,,
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (melting point 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. per lb.
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate	3s. ,, ,,
Cinnamic Aldehyde—	
98/100% Natural	14s. 9d. ,, ,,
Coumarin	15s. 6d. ,, ,,
Citronellol	22s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	18s. 6d. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	7s. 6d. per lb.
Iso Eugenol	16s. 6d. ,, ,,
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	22s. 6d. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Ketone	35s. ,, ,,
Musk Xylol	9s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Terpineol	3s. 1d. ,, ,,

TRADE NOTE

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications for licences under the above Act made during March, 1923, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 539, of which 459 were from merchants and dealers. In addition, 30 applications were outstanding on March 1, making a total for the month of 569. These were dealt with as follows:—

Granted, 405 (of which 376 were dealt with within 7 days of receipt).

Referred to British makers of similar products, 105 (of which 96 were dealt with within 7 days of receipt).

Referred to Reparation supplies available, 37 (all of which were dealt with within 2 days of receipt).

Outstanding on March 31, 22 (mostly received immediately prior to Easter).

Of the total number, 569, of applications received, 467, or 82 per cent., were dealt with within 4 days of receipt.

PUBLICATIONS RECEIVED

THE SETTING OF PORTLAND CEMENT. *Compiled by* W. L. GADD, F.I.C., *Pamphlet No. 1. The British Portland Cement Association. Pp. 35. London: 6, Lloyds Avenue,* 1922.

ALUMINIUM AND ITS ALLOYS: PROPERTIES, THERMAL TREATMENT AND INDUSTRIAL APPLICATION. *By* LIEUT.-COL. C. GRARD. *Translated by* C. M. PHILLIPS *and* H. W. L. PHILLIPS, B.A. *Pp. xxiii+184. London: Constable and Co., Ltd.,* 1921. *Price* 17*s*. 6*d*.

JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

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EDITORIAL

IT is an agreeable task to skim some old accounts of applied chemistry and see how the various processes have changed with the growth of the science and the manifold requirements of modern civilisation. A complete summary of the progress of chemical industry should be both interesting and valuable, but it is too great a task for this periodical unless a number of our readers will assist by pointing out omissions or mistakes, and by giving particulars which only those engaged in the different branches of manufacture can readily furnish. How many ingenious processes have been suggested and either never tried on a large scale or tried and found to be impracticable at the time of their trial! There was a process for obtaining nitrogen from the air by means of titanium oxide, put forward at a time when titanium oxide was not so easily procured as now, and when the fixation of atmospheric nitrogen or its conversion into ammonia were of no very obvious interest to commercial men. Do the same conditions apply to-day? The older text-books are full of such problems. And in browsing about one comes upon such a variety of topics; Tyrian purple directed our attention to Réaumur, and we found his life full of interest. Some of these older writers had a cheerful wisdom and instructive mirth which we confess appeal to us; armchair reading is, on the whole, preferable to study at a desk. A perusal of Faraday's account of the alloys of iron with chromium, platinum and other metals makes one wonder whether some new varieties of stainless steel will yet come on the market. It will be a long while before captive science yields her last retreat. The number of questions which would form suitable subjects for research was enormous a hundred years ago, and for every one which has been worked out a dozen new ones are waiting attention; and they have their bearing on arts and manufactures. The most abstruse points in electronic philosophy, in thermodynamics or the theory of allotropy, all create some new phase of thought, some fresh device or some unsuspected explanation which involves a supply or a demand previously lying hid. "The discoveries of each of the faithful, when weighed in a true balance, make a tiny portion of science, but by the anxious investigations of a multitude of scholars, each as it were contributing his share, the mighty bodies of the sciences have grown by successive augmentations to the immense bulk that we now behold."

* * *

A glance through our columns shows in how many branches of industry chemistry plays an important part, and it also shows how many different types of chemist use our columns as a means of making their views known or of learning items appertaining to the special feature which interests them or binds them together. If professional etiquette only permitted it, how this would be made apparent by a disclosure of the letters of criticism we receive! We wish we received more. The Society of Chemical Industry, of course, represents the most important part of our public and the membership of the Society, which slightly exceeds 5000, shows how many are interested in some way or other in applied chemistry, but this is not their only chemical interest. A considerable number of them follow the new discoveries of pure chemistry with serious attention and expect to find in our pages comparatively learned expositions of theoretical importance. Another large body of the Society is the Chemical Engineering Group which has now moved into more convenient quarters in Abbey House, Westminster. Its activities are occasionally relaxed—*nec semper tendit arcum Apollo*—as by the dinner to be held on May 4 at the Engineers' Club, Coventry Street, to be followed by a social evening with musical interludes—it was no doubt this which reminded us of Apollo. In another sphere of activity we remember the National Union of Scientific Workers who have absorbed or been absorbed by the British

Association of Chemists. Both these hitherto distinct organisations have made it their business to watch over the material rather than the intellectual rewards of workers and the meeting to be held on May 8, under the presidency of Mr. C. S. Garland, one of our few chemical Members of Parliament, will probably be largely attended. Elsewhere is a reference to the meeting of the Federal Council and the names of fully a score of other societies, institutes and associations are of frequent occurrence. Almost all the criticisms we have received, including those letters praising with faint—we forget the exact quotation—comment on the fact that we have devoted too much space to that type of article or news which the reader is not specially devoted to and too little to that variety which appears to him to be required. None the less we value such letters and have from time to time adopted suggestions made to us and as we grope about trying to feel our way into that position which such a journal as this demands, we do so with increased cheerfulness, knowing that the co-operation of our readers will in time enable us to continue an improvement which our vanity leads us to think is already beginning.

* * *

One who contributes every week to a chemical journal is never short of a subject; these exist in profusion. What is sometimes lacking is the inclination to write on the topics which are most urgently needed. Instead of settling down and doing the ordained work one finds " 'tis sweet to sit entranced, and muse thereon, in melancholy and godlike indolence." There is a feeling that the divine inspiration is somehow lacking and the drudge whose business is merely to condense some article of five columns into four inches likes, naturally enough, to consider himself one of those inspired by a muse. He repeats to himself :—

> Believe me there are tuneless days,
> When neither marble, brass nor vellum
> Would profit much by any lays
> That haunt the poet's cerebellum.

But bring the poet face to face with the alternative of poetry or starvation; how speedily the muse appears; some Discourager of Hesitancy would have no difficulty in making any contributor do his best and this pretence of inspiration is too often a mere cloak to conceal the laziness of the writer. The amateur can afford such a luxury and it matters to very few if he finds it more diverting to watch his aubretia and saxifrages than to write a breezy little sketch of tautomerism; but turn him into a professional, how his nature is changed :—

> The unhappy man, who once has trailed a pen
> Lives not to please himself but other men.

Come, forget the cuckoo and the feats of Chance, and get on with your Dyestuffs Act and statistics of the production of molybdenum in Armenia!

OTHER FACTORS INFLUENCING CO-ORDINATION

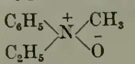
By Prof. T. MARTIN LOWRY, F.R.S.

1. Transfer of Electric Charges

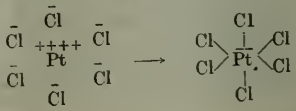
The two preceding articles of this series were already in the press before I had the opportunity of becoming acquainted with the conceptions that Mr. Sidgwick put forward at the meeting of the Chemical Society on March 1. It is, therefore, interesting to find that he lays special stress on an aspect of the problem which was not referred to in my previous article, although I have discussed it fully elsewhere, namely, the transfer of electric charges which accompanies the sharing of electrons.

It is a general rule that if one atom shares two electrons with another, but contributes *both* electrons to the common stock instead of only one, it acquires a positive charge, whilst its neighbour (which has acquired a half-share in two electrons not originally belonging to it) becomes negatively charged. I have illustrated this phenomenon, in a paper read before the Faraday Society on November 20, 1922, in the case of Meisenheimer's methylethylaniline oxide. In the oxidation of the amine from which this oxide is derived, a nitrogen atom carrying a complete octet unites with an oxygen atom carrying only as extet, to form a double-octet thus

$$:\underset{..}{\ddot{N}}:+\underset{..}{\ddot{O}}:=:\underset{..}{\ddot{N}}:\underset{..}{\ddot{O}}:$$

In this process the oxygen gains, and the nitrogen parts with, a half share in the two electrons which are held in common. The nitrogen therefore becomes positively charged and the oxygen negatively charged, as in the formula  . At the same time the valency of the nitrogen is increased by two units, from 3 to 5, by the addition of one covalency and one electrovalency. The transfer of electricity, which Sidgwick postulates in the case of co-ordinated compounds, is of a precisely similar character, and some of the effects of this transfer are set out below.

(*a*) *In the platinichlorides*, the outer shell of 32 electrons is completed by drawing in six duplets belonging to six chlorine ions. These six duplets are held in common by platinum and chlorine, and each element can claim an equal share in them. The platinum therefore gains six electrons, whilst each chlorine atom loses one. The result of this transfer is shown in the equation



The bivalent anion, $PtCl_6$, in the second formula is seen to contain six neutral chlorine atoms, held by covalencies, whilst the double negative charge of the anion is carried by the platinum.

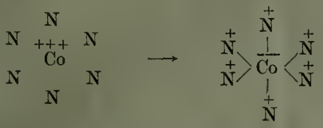
(*b*) *In the cobaltammines*, the transfer of electric charges between ammonia and the metallic ion on co-ordination is similar to that which occurs when an amine is converted into an amine oxide, *e.g.*,

$$NH_3+Me \rightarrow \overset{+}{N}H_3—Me$$

(where Me is a metallic atom) compare

$$NR_3+O \rightarrow \overset{+}{N}R_3—\overset{-}{O}$$

Each molecule of ammonia that is co-ordinated, therefore, acquires a positive charge, like that of an ammonium ion, whilst the cobalt gains an electron. The effect of this is first to neutralise and then to reverse the charge on the metal. Thus in the hexammines the charge on the cobalt is changed from $\overset{+++}{Co}$ to $\overset{---}{Co}$, as in the equation



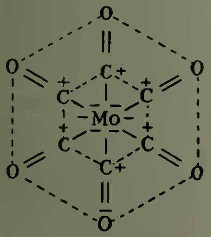
where for convenience of printing all the hydrogen atoms have been omitted.

(*c*) *In the metallic carbonyls* the sharing of electrons in the outer shell of the molecule converts a neutral into a polar system, since the addition of carbon monoxide to a metal must be represented by the scheme

$$:\ddot{O}::C:+Me \longrightarrow :\ddot{O}::C:Me$$

$$\text{or}\quad O=C<+Me \longrightarrow O=\overset{+}{C}—\overset{-}{Me}.$$

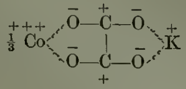
In the case of molybdenum hexacarbonyl, the formula would show a negatively charged metal attached through a inner octahedral shell of six positively-charged carbon atoms to an outer octahedral shell of six doubly-bound but neutral oxygen atoms.



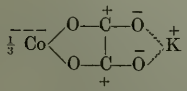
2—Ring Formation

Tschugaeff has pointed out (*J. pr. Chem.*, 1907, [ii], **75**, 153) that the formation of ring-systems is an important factor in co-ordination. In his experiments on optically-active co-ordination-compounds, Werner usually employed the oxalates. When these are represented in such a way as to show one oxygen of each carboxylic group attached to the metal, the ring system contains five atoms as in the formulæ III. and IV., and may, therefore, be compared with furfurane, pyrrol or succinimide.

III



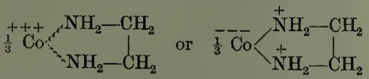
IV



In formula III. the cobaltic ion, $\overset{+++}{Co}$, is represented as attracting three bivalent oxalate radicals, of which (for convenience of printing) only one is shown. Formula IV. on the other hand shows the effect of the transfer of electric charges which results from the sharing of electrons, as discussed under (1) above. The malonates prepared by Jaeger may be formulated as containing a six-atom ring; the succinates prepared by Duff (*T.*, 1921, **119**, 385) contain a seven-atom ring; and Price and Brazier (*T.*, 1915, **107**, 1373), by introducing sulphur into the carbon-chain, have prepared compounds in which the ring contains eight atoms.

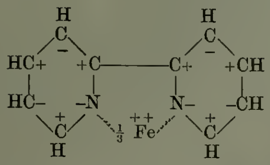
In the ethylenediamine compounds prepared by Werner the ring contains the same number of atoms as in the oxalates, as in the tervalent kation

V



A similar statement may be made in reference to tri-dipyridyl ferrous chloride, the bivalent kation of which may be represented as in VI.

VI

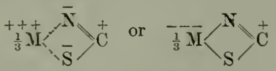


where again, for convenience of printing, only one of the three complexes attached to the iron is shown.

The stability of the oxalates may be associated with the well-known stability of five-atom rings. It should, however, be noticed that the two carbon atoms of each oxalate group are similarly charged; there is, therefore, a crossing of the polarities, which may be supposed to act as a factor antagonistic to co-ordination. In this respect a six-atom ring has a real advantage over a five-atom ring, since a chain of six atoms allows room for the concordant conjugation of three plus and three minus atoms ; at the same time the presence of six atoms introduces no serious strain in the ring. The advantage of being able to secure in this way a complete conjugation of all the atoms in the ring is clearly shown by the well-known stability of benzene, and, indeed, of *six-atom rings* generally, in conjugated compounds of the *aromatic* series, as contrasted with the greater stability of the *five-atom* rings in the saturated compounds of the *aliphatic* series, where conjugation does not " come into the picture."

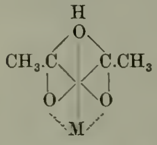
The factor of ring-formation in the side-chains is only of minor importance in the very stable co-ordinated compounds of tervalent cobalt, quadrivalent platinum, etc., since here the electrostatic attraction of the multivalent metallic ion, and the tendency for the metallic atom to complete its outer shell of electrons, exert such powerful forces that bipolar ions can be drawn into the system even when they give rise only to a four-atom ring, as in the thiocyanates

VII

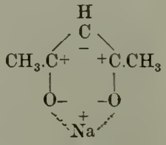


But in the case of metals of lower valency and smaller co-ordination-number, where the factors favourable to co-ordination are at a minimum, the question of ring-formation in the side chains becomes of predominant importance. Indeed, in the case of the alkali metals, the whole possibility of forming co-ordination compounds depends on bringing the metal into a stable ring-system, rather than on attaching to the metal a stable grouping of radicals, such as the octahedron which forms so conspicuous a feature in co-ordination-compounds of the type of the cobaltinitrites or platinichlorides. It is for this reason that in so many cases *tripolar* ions, rather than *bipolar* ions, are used to prepare co-ordination complexes.

This feature has been specially conspicuous in the work of Morgan, who has also, by assigning a centric formula VIII to derivatives of acetylacetone, directed attention to the analogy between these compounds and the aromatic ring-systems. The significance of the analogy is, however, seen much more clearly when polar formulæ are used as in IX.



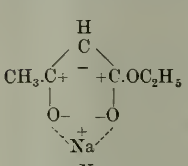
VIII



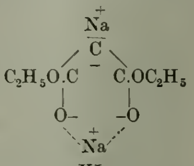
IX

The formula IX provides an excellent illustration of the significance of tripolar ions in co-ordination, the third negative pole being required merely in order to maintain the alternating polarities and so to continue the conjugation of the atoms right round the ring.

The sodium derivative of ethyl acetoacetate may be formulated in a similar way as X



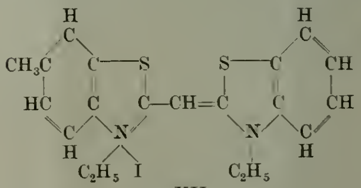
X



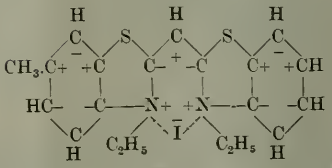
XI

The mono-sodium derivatives of ethyl malonate would be represented by a similar formula ; but in this case the second hydrogen atom of the ester (corresponding with the one that is shown as occupying a *para*-position to the sodium in IX and X) can also be replaced by sodium. This hydrogen atom is therefore mobile ; but when it escapes as an ion, or is replaced by a sodium ion, it leaves an electron behind on the carbon atom, which, therefore, acquires a double negative charge as in XI. It will be seen that in this case the third pole of the tripolar ion assumes an active instead of a passive part, but only in virtue of the double negative charge which it carries.

An example of a co-ordinated ring containing six atoms, in which a tripolar *kation* is co-ordinated with a negative radical, is provided by the thiocyanines, the " virtual tautomerism " of which was investigated by Mills and Braunholtz (*T*., 1922, **121**, 1489). The compound formulated as XII is shown as a co-ordinated complex in XIII, where it will be seen that the iodine is co-ordinated with the two ammonium radicals, but at the same time



XII



XIII

becomes a part of an aromatic ring similar to that postulated by Morgan in the acetylacetones. Ring-systems containing six conjugated atoms can also be detected in the formulæ of the sodium derivatives of nitrocamphor and of benzoyl-camphor, when formulated as co-ordinated compounds.

3—Summary

(*a*) The sharing of electrons which accompanies co-ordination has the effect of transferring electrons from the radicals to the metal, which also become united by covalencies.

(*b*) Co-ordination can be brought about, often under very adverse conditions, by making the co-ordinated groups part of a conjugated system. A conjugated ring-system containing three positively-charged and three negatively-charged atoms, as in benzene, is particularly favourable to co-ordination.

UNITED ALKALI COMPANY DINNER

The dinner given by the directors of the United Alkali Company at the Adelphi Hotel, Liverpool, on April 18, to celebrate the hundredth anniversary of the founding of the alkali industry in this country, was very largely attended. Sir Max Muspratt, Bart., presided, and amongst those who were present were Lord Doverdale, the Lord Mayor of Liverpool, Sir Benjamin Johnson, Sir A. Salvidge, Sir William Pope, Dr. E. F. Armstrong, Sir William Alexander, Sir Edward Brotherton, Bart., Major-General Thuillier, Sir J. Reynolds, Bart., Sir Ernest Oldham, Sir John Cowan, Sir R. Threlfall, Sir A. Bicket, Messrs. R. G. Perry, J. Tennant, A. T. Smith, H. Wade Deacon, Percy Ashley, J. E. Davidson, W. A. Tennant, Sir F. E. R. Becker, Sir Frederick Norman, Messrs. Roscoe Brunner, Robert Mond, H. S. Smith, Professors E. C. Baly, W. Ramsden, Green, Francis, J. F. Thorpe, I. Heilbron, Col. W. H. Stott, Dr. G. C. Clayton, the Prime Warden of the Dyers' Company, Messrs. G. H. Cox, A. Ree and W. Windus, the Mayor of Widnes, Dr. A. Holt, Messrs. W. J. U. Woolcock, Garrod Thomas, R. M. Bewick, Gaskell Holbrook, Stuart Deacon, Sir C. Mandleberg, Messrs. R. H. Davidson, C. A. Hill, H. Levinstein, Edwin Thompson, A. E. Rayner, Cecil Pilkington, W. A. Short, C. H. Nelson, Horace Muspratt, Sir James Ritchie, Bart., Sir L. Weaver, Messrs. E. P. Chance, L. B. Holliday, T. W. Stuart, John Kendrick, C. F. Ratcliffe, and T. L. Bailey.

After the loyal toasts, Sir Max Muspratt read a number of congratulatory telegrams, including the following: "Society of Chemical Industry sends congratulations on Anniversary of establishment of Alkali Industry, and recalls with pride that its senior Past President is your revered Dr. E. K. Muspratt. Armstrong, President." Sir Benjamin Johnson, High Sheriff of Lancashire, proposed the toast of His Majesty's Forces. The reply to this was made by Major-General Thuillier, C.B., C.M.G., who was Director of Chemical Warfare Services in France during the war. He spoke of the manner in which the chemical industry of Great Britain had contributed to the winning of the war, and mentioned that after the Germans had introduced poison gas, Great Britain successfully undertook the manufacture of this and poured on to the German troops twenty times the volume of gas our troops had to endure. He felt confident the chemical industry of the country would, whenever the occasion arose, respond to any call which was made to it. Mr. R. G. Perry, C.B.E., president of the Association of British Chemical Manufacturers, proposed the Alkali Industry, and briefly traced the history of this from the time of the French Revolution to the present day. He paid a tribute to the energy and acumen of the founder, Mr. James Muspratt, grandfather of Sir Max, and sketched the changes in the industry brought about by the Solvay process, applied in this country by that outstanding genius, Dr. Ludwig Mond, who, in co-operation with Sir John Brunner, had fifty years ago founded the firm of Brunner, Mond and Co. The Leblanc process and the Solvay process had made Britain supreme in alkali manufacture. The United Alkali Company were not only makers of alkali, but also the largest makers in Great Britain of sulphuric acid and heavy chemicals. Sir Ernest Oldham, deputy chairman of the Federation of British Industries, supported the toast.

Sir Max Muspratt, who was enthusiastically received, said that he felt proud of the industry which they were assembled to honour, and proud of his ancestry. The centenary celebration they were taking part in was a landmark of national defence as well as of peaceful development. Without a scientific basis their industry would vanish into ruin; and so they were trained to habits of clear thought, to an accurate sense of proportion, and to a complete readiness to adopt new methods which had survived the test of criticism. Mr. Roscoe Brunner, who also responded, mentioned how the descendants of the founders of the industry remained connected with it and claimed that the continuous association of great family names in the industry had been an asset of enormous value, and it had largely accounted for the splendid relationship which existed between employer and employed. Mr. A. T. Smith proposed the Merseyside Municipalities, to which the Lord Mayor of Liverpool and the Mayor of Widnes responded. Mr. W. A. Tennant proposed the health of the chairman, which was briefly acknowledged. A telegram of congratulation was sent by the Lord Mayor of Liverpool, in the name of the assembled guests, to Dr. E. K. Muspratt, the president of the United Alkali Company.

SIR MAX MUSPRATT, BART.

THE PRINCIPLES OF TRANSFERENCE OF HEAT

By GEOFFREY J. GREENFIELD, S.M., A.I.C.

(*Continued*)

Taking the following values:—steam to solid, $h_s=2000$, solid to liquid (not boiling), $h_l=50$. copper, $k_{Cu}=238$, lead, $k_{Pb}=20$, and assuming that the inside and outside areas of the copper tubing are the same, we may cancel all the A's in equation 3 ($A_{av}=A_1=A_2=A_3$). We have, before putting on the lead sheath,

$$\frac{1}{H}=\frac{1}{h_s}+\frac{l_{Cu}}{k_{Cu}}+\frac{1}{h_l}$$
$$=\frac{1}{2000}+\frac{\cdot014}{238}+\frac{1}{50}$$
$$=\cdot02056 \quad \text{Therefore } H=48\cdot7$$

Temp. diff. (entrance) $=366—172=194°$ F.
Temp. diff. (exit) $=366—214=152°$ F.
Average temp. diff. $=173°$ F.

Hence $\frac{Q}{A\theta}=H\,\Delta\,T=(48\cdot7)\,(173)=\underline{8420}$ B.T.U. per sq. ft. per hour.

After putting on the lead sheath, we have four resistances:—

$$\frac{1}{H}=\frac{1}{h_s}+\frac{l_{Cu}}{k_{Cu}}+\frac{l_{Pb}}{k_{Pb}}+\frac{1}{h_l}$$
$$=\frac{1}{2000}+\frac{\cdot014}{238}+\frac{\cdot0104}{20}+\frac{1}{50}$$
$$=\cdot02108 \quad \text{Therefore } H=47\cdot5.$$

Assuming the same temperatures as before,

$\frac{Q}{A\theta}=H\,\Delta\,T=(47\cdot5)\,(173)=\underline{8210}$ B.T.U. per sq. ft. per hour. That is, although lead is only *one-twelfth* as good a conductor as copper, yet the efficiency with the lead sheath is 97·5% $\left(\frac{8210}{8420}\,100\right)$ of that with bare copper tubes.

For most solids of industrial importance for the transmission of heat, physicists have determined the specific conductivity (k). For any substance this will vary to a certain extent with temperature, allotropic modifications, etc., but for practical purposes may be taken as constant. Film coefficients are more difficult to determine, and are affected by many external circumstances. Four cases must be considered —viz., the flow of heat from :—

(1) Gas to solid, or *vice versa*.
(2) Liquid (not boiling) to solid, or *vice versa*.
(3) Condensing vapour to solid.
(4) Solid to boiling liquid.

I. Gas to solid, and vice versa

(*a*) The gas is not in forced motion relative to the solid: *e.g.*, heat loss from the outside of a still, or a steam pipe, to the air of the room. In this case we shall expect the film to be a relatively thick one, since nothing but convection currents tends to tear it away; therefore, the film coefficient will be small, but it will increase with temperature, since viscosity decreases with temperature. Usually it lies between 1·0—2·0.

(*b*) The gas is flowing past the outside of a pipe. The commonest cases of forced flow outside pipes are those of air heaters, such as the Buffalo and the Sturtevant types, where the gas flows at right-angles to a bank of pipes, there being steam inside them. A higher coefficient will be expected here, because the velocity of the gas will tend to reduce the film. The following formula has been determined by Carrier for the Buffalo type:—

$$h=\frac{22\cdot3\ v}{1\cdot42+v}$$

where v=lbs. air passing per square foot of free area (measured at the point where the free cross-sectional area between the pipes is the least) per second.

(*c*) The gas is flowing inside a pipe. This will be dealt with later, under IIb.

II. Liquid (not boiling) to solid, or vice versa

(*a*) Liquid outside pipes. This is not often met with, except in preheaters for stills, in which fairly viscous oils are distilled. The film coefficient may vary between 10 and 100, depending upon the velocity, viscosity, etc.

(*b*) Liquid inside pipes (also gases, see Ic). Here the film will sometimes be very thin, for the body of the fluid is travelling parallel to the solid surface, and so exerts a *direct shearing stress* on the film. When a fluid flows very slowly in a pipe, each particle travels essentially in a straight line. This is called "viscous flow." In such a case, heat from the wall of the pipe must travel by *conduction only* through the liquid; that is to say, the "film" becomes the whole of the liquid. As the velocity is increased, a critical velocity is reached, above which the fluid breaks into eddies. This is called "turbulent flow." It is at velocities above the critical that fluids usually flow in practice. (The critical velocity depends upon the density and viscosity of the fluid and the diameter of the pipe.) Without going into this involved case fully, we may indicate the results of the latest work* as follows:—

The factors influencing the film thickness, and therefore the coefficient are:—

K = thermal conductivity of the fluid
D = diameter of pipe (inches)
u = velocity of fluid (f.p.s.)
ρ = density of fluid (lbs. per cu. ft.)
z = viscosity of fluid film relative to water at 68° F.

For liquids:—

$$h=\frac{22\cdot6K}{D}\left(\frac{Du\rho}{z}\right)^{0\cdot796}$$

The mathematical development of this equation is fully discussed in the article cited. Since the factor, $\frac{Du\rho}{z}$, is used equally for the calculation of flow of liquids and of gases in pipes, it is fairly safe to prophesy that McAdams and Frost will eventually devise an equation for gases, on similar lines to the above.

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* McAdams and Frost, J. Ind. and Eng. Chem., 1922, **14**, 1101.

III. Condensing vapour to solid

When a hot, non-condensable gas is giving up heat to a solid surface, every molecule has, in effect, to come up to that surface, give up part of its energy, and then return to the body of the gas, thus opposing the passage of other molecules bent on the same errand. In the case of a condensable vapour, the molecules, having given up the necessary energy (*i.e.*, latent heat), do not have to leave the solid surface again, but remain there as liquid and trickle away. Thus the rate of flow of heat from a condensing vapour to a solid is very high. For pure steam the coefficient is as high as 2400. There will be a liquid film, thickness depending on the viscosity of the liquid. In most cases, and especially in some still-condensers, there will be some non-condensable gases mixed with the vapour, and this will have an adverse effect. For commercial steam a value of 2000 may be used. For other vapours than steam, the coefficient may be *roughly* determined from the equation[*]

$$h=h_s\left(\frac{u_w}{u}\right)\ \left(\frac{K}{K_w}\right)$$

where h_s and h=coefficients for steam and the vapour respectively, u_w and u=viscosities of water and the condensed vapour respectively (any units), K_w and K=thermal conductivities of water and the condensed vapour respectively.

IV. Solid to boiling liquid

This case is met with in stills heated by closed steam, in steam-jacketed pans, and in tanks in which reactions are conducted in a boiling solution kept hot by steam coils. This is a difficult case to investigate, and not much is known of it, since the coefficient will depend upon the disposition of the heating surface in the vessel, the density, heat capacity and viscosity of the boiling liquid, and also upon whether movement of the liquid depends upon natural convection or is assisted by a stirrer or circulating pump. The *overall* coefficient (steam to boiling liquid) has been known to have all values between 200 and 500. In enamelled apparatus it will be much less, owing to the high resistance of the enamel.

Radiation

Transmission of heat by radiation will, in general, be of interest to those engaged in high-temperature work, since it is at high temperatures that its effect becomes marked. Although the loss of heat from the surfaces of boilers, stills, and similar hot bodies situated in the open air, or in a room at atmospheric temperature, is loosely spoken of as "radiation loss," the above discussion makes it clear that it is partly due to conduction and convection. Radiation strictly means the transmission of heat from a body by means of heat waves in the ether (similar to light waves, but longer). These waves can travel through a gas or vacuum almost unimpeded, but are arrested on meeting a solid or a liquid. Like light waves, they can only, under ordinary circumstances, travel in straight lines. Of the energy in the wave the solid or liquid will reflect part, transmit part, and absorb part, just as it would with a light wave. Polished metallic surfaces reflect most of the radiant heat reaching them; glass and similar materials transmit most of it (in the wave form, and not by "conduction"); and all ordinary opaque, unpolished materials absorb most of it. A body which absorbs all radiant energy reaching it is said to be "perfectly black," and a body which absorbs, say 90%, is said to be "90% black," or to have a "coefficient of blackness of 0·9." White paper is about 80% black.

Not many substances other than the metals have been studied for "blackness," but for inorganic salts, and for most amorphous and rough-surfaced substances, including rusty and painted pipes, a coefficient of blackness of 0·9 may be taken. The following values for some metals were determined by Langmuir (Trans. Amer. Electrochem. Soc. 1913, 23):—Bright cast iron, 0·22; Iron (oxidised surface), 0·62; Monel metal, 0·43; Silver, 0·03.

The law of radiation, discovered by Stefan and Boltzmann, states that every body radiates heat in proportion to the fourth power of its absolute temperature, and also in proportion to its area. This means that, if we double the *absolute* temperature of a body, it will radiate sixteen times as much heat. Since all bodies are always radiating heat, the heat transferred from one body to another by radiation will be the excess of the heat received by the cooler body from the warmer, over the heat radiated by the cooler body. The simplest case is that of a small cool body surrounded completely by a larger hot body. In this case the heat received by radiation by the cooler body will be

$pAC'\ (T_1^4-T_2^4)$ B.T.U. per hour, where
p = coefficient of blackness of small body
A = area of small body
C' = universal radiation constant = $1{\cdot}62\times10^{-9}$
T_1 = temp. of large (hot) body in ° F. abs.
T_2 = temp. of small (cool) body in ° F. abs.

For practical use the equation may be written

$$\frac{Q}{\theta}=pAC\left[\left(\frac{T_1}{100}\right)^4-\left(\frac{T_2}{100}\right)^4\right]$$

where $C = C'\times10^8 = 0{\cdot}162$

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[*] McAdams and Frost, *loc. cit.*, 1922, **14**, 17.

This may be applied to find the heat radiated from a furnace fire-bed to the boiler tubes above it, since none of the heat so radiated can get to any place save these tubes. In this case, A will be the surface of tube which one could see from the firebed—*i.e.*, the projection of the tubes on a plane parallel to the bed. In general, this will merely amount to the horizontal cross-sectional area of the combustion space. This is small compared with the total heating surface of the boiler, but plays an important part in comparison to its size. In a particular case, the area of the fuel bed was 37·4 square feet, and the total heating surface was 2010 square feet (37·4 is 1·9% of 2010). Yet, of the total heat imparted to the boiler, the amount calculated to be transferred by radiation was 2·9%.

The equation may also be applied to a steam pipe, or to a hot vessel, situated in a room. When a hot body is situated in the open air, the temperature of its surroundings (including clouds, if any) may be taken as that of the atmosphere, and it should be noticed that, when the sky is clear, that part of a body which is directly exposed to the sky is *radiating to the absolute zero*—*i.e.*, the T_2 term drops out. It must also be remembered that bodies such as are indicated in this paragraph are also giving up heat to their surroundings by conduction and convection through the air (see case Ia above). The following example may be given:—

The lagging has dropped off from 1 ft. length of a standard 6-in. pipe, which carries steam at 150 lbs. pressure. Assuming that the room is at 70° F., to find the heat loss per hour.

Area exposed = 1·73 sq. ft.
Steam temp. = 366° F. = 826° F. abs.
70° F. = 530° F. abs.
h (conduction) = 1·5

(*a*) Loss by conduction :—

$$\frac{Q}{O} = hA\Delta T = (1{\cdot}5)\ (1{\cdot}73)\ (366-70)$$
$$= 768 \text{ B.T.U. per hour}$$

(*b*) Loss by radiation :—

$$\frac{Q}{\theta} = pAC\left[\left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4\right]$$
$$= (1{\cdot}73)\ ({\cdot}9)\ ({\cdot}162)\ [(8{\cdot}26)^4 - (5{\cdot}30)^4]$$
$$= 976 \text{ B.T.U. per hour}$$

Total loss = 1744 B.T.U. per hour, or 2 lbs. steam condensed

In this article an attempt has been made to state in fairly simple language the main facts of a subject to which much attention is being paid at the present time. Mention may be made of "Heat Transmission, Technical Records Explosives Supply, No. 9," published by the Department of Scientific and Industrial Research, which is specially notable for the clarity with which examples are worked out. The subject has been very exhaustively investigated at the Massachusetts Institute of Technology, U.S.A., where, it is understood, a book is now in preparation.

FORTHCOMING EVENTS

Apr. 30. The Ceramic Society, Annual Meeting to be held in the Central School of Science and Technology, Stoke-on-Trent, at 7.30 p.m.

Apr. 30. Royal Society of Arts (Howard Lecture), at 8 p.m. "The Development of the Steam Turbine," by S. S. Cook. (Lecture 1.)

May 2. Society of Public Analysts, at Burlington House, Piccadilly, W. 1, at 8 p.m. (1) "The Quantitative Determination of Hemp and Wood in Papers containing these two Fibres," by W. Dickson, F.I.C. (2) "The Estimation of Fat, Lactose and Moisture in Dried Milks," by H. Jephcott, M.Sc. (3) "The Estimation of Lactose by the Polarimetric and Gravimetric Methods," by A. L. Bacharach, B.A. (4) "The Melting Point and Iodine Value of Refined Natural D. Camphor," by M. S. Salamon, B.Sc. (5) "The Presence of Barium and Strontium in Natural Brines," by A. G. Francis, B.Sc.

May 2. Institute of Metals, at Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. 1, at 8 p.m. "The Inner Structure of Alloys," by Dr. W. Rosenhain, F.R.S.

May 3. The Institution of Sanitary Engineers, Caxton Hall, Westminster, S.W. 1, at 6.30 p.m. "The Relationship between Insanitation and Disease," by W. R. Hadwen, M.D.

May 3. The Ceramic Society, *Refractory Materials Section*, Town Hall, Bournemouth. Spring Meeting, 1923. Also on May 4.

May 3. The Chemical Society, Burlington House, W. 1, at 8 p.m. (1) "Change of Properties of Substances on Drying." Part II. H. B. Baker. (2) "The Sodium Salts of Phenolphthalein." H. Bassett and P. Halton. (3) "The Action of Thiosulphates on Cupric Salts." H. Bassett and R. G. Durrant. (4) "The Conditions of Reaction of Hydrogen with Sulphur." Part II. "The Catalytic Effect of Oxygen." Part III. "On the Mechanism of the Reaction of Hydrogen with Sulphur and Its Catalysts by Oxygen." R. G. W. Norrish and E. K. Rideal. (5) "Studies on Electrovalency." Part II. "Co-ordinated Hydrogen." T. M. Lowry. (6) "Investigations on the Dependence of Rotatory Power on Chemical Constitution." Part XX. "The Rational Study of Optical Properties: Refraction a Constitutive Property." H. Hunter.

May 4. Society of Chemical Industry, Chemical Engineering Group, Engineers' Club, Coventry Street, W. 1, at 6.30 p.m. Annual General Meeting, followed by an Informal Dinner at 7.30 p.m., and later by a Social Evening. Members of the Group may introduce non-members to the Dinner and subsequent proceedings.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

June holds out the promise of a busy and interesting month. On the first the International Mining Exhibition at the Royal Agricultural Hall will be opened by Sir Philip Lloyd-Graeme, President of the Board of Trade. The exhibition has been organised by an influential committee of which Sir John Cadman is president, and is supported by the Institution of Mining Engineers, the Institution of Mining and Metallurgy, the Institution of Petroleum Technologists and similar well-known societies. The Governments of France, Belgium, Roumania, Mexico and other countries are sending exhibits and so are the Duchy of Lancaster, the Geological Survey and the Imperial Mineral Sources Bureau. Monsieur Paul Kestner and some of our other French friends are on the committee and we hope they will be able to pay visits to the exhibition. In any case a number of French chemists will come to London on the 14th to hear Professor C. Moureu, C.B.E., deliver his lecture to the Chemical Society on *Les gazes rares des sources thermales des grisons et autres gazes naturels.* Then on Sunday the 17th I suppose there will be an assembling at Cambridge. In addition to the social functions I hear there is to be a conference on Tautomerism opened by Prof. J. F. Thorpe, one on Catalysis opened by Dr. Eric Rideal, a paper on Oxidation in Animal Tissues by Professor Gowland Hopkins, and an account of Soap-solutions by Professor MacBain. These important topics and the transaction of the business of the various commissions will fill up the 18th, 19th, and 20th June pretty completely and then we shall have three strenuous days of the Annual Meeting of the Society of Chemical Industry. I feel sure that our President will begin his second year of office by delivering an address which will bring home to the general public as well as to the Fellows of the Royal Society the importance of chemistry to our national well-being.

The Alkali Centenary Celebrations

were the feature of last week. I find it difficult in a limited space to deal adequately with even the main features of the celebration, but the organisation of the dinner was excellent. The mechanical perfection of the arrangements was, however, overshadowed by something less tangible and more difficult to explain. The "atmosphere" pervading the whole of the visit was remarkable. How easily might the very gigantic character of the entertainment have proved top-heavy and wearisome. Nothing of the sort happened. We began the after-dinner speaking which followed the loyal toast, with Sir Benjamin Johnson and General Thuillier, who respectively proposed and replied to the toast of "His Majesty's Forces." Two good speeches delivered in an atmosphere of expectancy. Everybody had the air of waiting for something, and then Mr. R. G. Perry (President of the Association of British Chemical Manufacturers) rose to propose the toast of "The Alkali Industry." He began very quietly to fulfil his allotted task; in a few minutes he sketched the progress of the industry through the century. He then asked us to think of England without the alkali industry—Widnes without smoke, Northwich without salt and Port Sunlight without soap. Then came the disclosure of one of the secrets of the success of the industry, the good relationship between the employer and the employed. Here Mr. Perry struck the high idealistic note which was, indeed, maintained throughout. Sir Ernest Oldham followed, and then came the speech of the evening.

Sir Max Muspratt

was the first to reply to the toast; he admitted frankly that a dinner alone could never have drawn such a company together. It was the celebration of a century of progress, of development in the arts of peace and of national defence. Then he visualised the problems of the future, social, moral and labour. Material results were not enough: all their efforts would have to be concentrated on new problems. There was plenty of goodwill in the alkali industry in spite of superficial differences. If the goodwill continued they would overcome all their difficulties in the future as they had done in the past, and realise in the century before them an even more magnificent record than that they had already achieved. I very much doubt whether Sir Max Muspratt has ever achieved a better speech. In good delivery, restraint, sincerity and modesty, as well as in its matter it was excellent.

Mr. Roscoe Brunner

had to follow—not an easy task. He determined to compete with Sir Max in sincerity and and modesty. In a five-minute speech he paid a very generous tribute to Sir Max and the United Alkali Company. He humorously referred to two of the difficulties with which that company had to contend; their names, he said, were "Brunner" and "Mond." He followed up a thought of Mr. Perry's as to the value of the family interests in chemical firms, which has undoubtedly had a great deal to do with the freedom from labour troubles in chemical industry. And so we celebrated the centenary of the British alkali industry in typically British fashion. Mentioning our achievements with modesty and restraint: understating, rather than boasting of, our achievements; but with a clear eye and good courage for the future.

SOCIETY OF CHEMICAL INDUSTRY

NEWS FROM THE SECTIONS

YORKSHIRE SECTION

The fourth meeting of the session was held on April 16, Dr. L. L. Lloyd in the chair. Reference was made to the loss that the Society had sustained by the death of Mr. George Ward, one of the oldest members, and the Hon. Secretary was instructed to send the relatives of the deceased a letter of sympathy on their bereavement.

Mr. J. A. Reddie presented a paper, entitled "Some Notes on the Production of Alkali by Bacteria as registered by Different Indicators." At the Bradford sewage-disposal works the alkali content of the sewage invariably increased in passing through the filters. This was not due to the nature of the filtering medium, as it occurred even with quartz; the Bradford sewage was high in protein and albuminoid matter, and this unusual feature was undoubtedly due to bacterial action on the nitrogenous bodies. Accordingly, experiments were undertaken to elucidate the phenomenon. In the first series a standard broth of lemco and peptone was used and mixed cultures obtained by incubating the broth after inoculating it with filter washings. Tests were made daily over twenty days, the alkalinity as expressed by parts of sulphuric acid per 100,000 towards methyl orange and litmus, and the hydrogen-ion concentration being ascertained until the broth was used up. There was a very striking rise in the alkalinity, as expressed by (*a*) methyl orange from 53·9 to 521; (*b*) litmus from neutral to 225; (*c*) p_H figure from 6 to 9·67. Towards the end the alkalinity began to decrease. A portion was taken when the alkalinity reached 342 (towards methyl orange), reduced to 9·8 by adding dilute acid, and re-tested. Again the alkalinity increased, although with fluctuations. For example, the p_H figure was acid to begin with, from 5·9 to 2·6, and then began to rise.

The effect of adding various carbohydrates to the protein broth was next studied. During the first few days there was a sharp acid production, for the next fifteen days the figures were very erratic, and afterwards more normal figures for protein fermentation were obtained; a very vigorous carbohydrate fermentation set in before the protein fermentation. In another experiment, using two similar broths, only differing in their p_H figures, 7·168 and 2·9 (the first alkaline, the second acid), there was a preliminary instability, but the increase of alkali was more marked in the acid broth.

Another experiment in which alkalinity, hydrogen-ion concentration and free ammonia were ascertained was cited as showing the general course of the change, and the marked and wide discrepancies between the numbers.

A series of experiments was next carried out with one standard broth and pure cultures of 12 organisms, the majority of which occurred commonly in sewage, and one, *B. lacticus*, which did not. Phenolphthalein was added to the indicators studied. There was not the slightest difference with these cultures, except in degree; all produced alkali, the amount always rising steadily. The p_H figure was regarded as the best, the colour indicators showing wide differences.

In the discussion the chairman observed that with the complex fermentation and hydrolytic changes occurring with proteins any type of indicator was unlikely to give proper figures. Mr. F. W. Richardson said that the weak point was the use of a mixed protein medium, and suggested that further experiments should be made with pure proteins and bases like tryptophane with one organism, *B. coli communis*. Mr. W. J. Read emphasised his disbelief in indicators as giving figures of real alkali production, and quoted figures comparing methyl red and phenolphthalein. His results led him to conclude that the destruction of "buffering" substances led to the alteration in the hydrogen-ion concentration. Dr. N. M. Comber thought that results obtained with soil solutions were pertinent to the discussion. All indicators showed considerable differences and the electrometric method was the best at the moment. Mr. J. H. Garner spoke of the importance of the C : N ratio, as if the nitrogen was in excess to carbon alkali was produced. He asked if there was any evidence of nitrification and of the effect of carbon dioxide and carbonates on hydrogen-ion concentration.

Replying to the discussion, Mr. Reddie stated that the broth was used because it was standard, and might be used for comparison, but he recognised it was open to objection. He had found no sign of nitrification in the broth cultures; on filters it did occur, but not in Bradford as a rule; the alkali production might have something to do with this. Of the effect of carbon dioxide he had no knowledge. All organisms tended to give acid, but with certain foods they gave alkalinity.

MEETINGS OF OTHER SOCIETIES

INSTITUTE OF PHYSICS

The next lecture of the series on "Physics in Industry" will be delivered by Dr. J. W. Mellor, and the title will be "The Application of Physics to the Ceramic Industry." The meeting will be held at the Institution of Electrical Engineers, Victoria Embankment, W.C. 2, on May 9, at 5.30 p.m. Sir J. J. Thomson, president, will preside. The Board has kindly invited the members of the London Section of the Society of Chemical Industry to attend this lecture.

ACADÉMIE DES SCIENCES

The meetings held on March 19 and 28 were devoted to many interesting chemical problems. One paper was devoted to the petroleums of Auvergne. A boring sunk at Crouelle revealed the presence at a depth of 856 metres of clay, calcareous and other layers impregnated with petroleum. Geological evidence revealed by this boring suggested that the conditions of sedimentation in this district were favourable to the formation of petroleum. At a depth of 850 metres the bore reached a sandy layer, 40 cm. thick, containing 22 per cent. of oil, or about 1100 metric tons per hectare. It appears that 300 metres have still to be bored before the bottom of the Limagne basin is attained, a basin where it is expected petroleum will be found.

Monsieur l'Abbé Senderens communicated the results of work on the catalysis of alcohols by means of dilute sulphuric acid, and described a general method for preparing oxides and ethers.

Messieurs Bordas and Touplin described a new denaturant for ethyl alcohol. The new denaturant, intended to replace wood spirits, is extracted from the oils produced by distilling resins and tars of the Landes.

SOCIETY OF GLASS TECHNOLOGY

The sixth Annual General Meeting was held in Sheffield on April 18, the President, Prof. W. E. S. Turner, D.Sc., in the chair. The formal business included the election of the following officers :—*President :* Prof. W. E. S. Turner, D.Sc. (re-elected). *Vice-Presidents :* E. A. Coad-Pryor, B.A., W. J. Gardner. *Members of Council :* F. F. S. Bryson, M.A., B.Sc. ; Violet Dimbleby, B.Sc. ; Major G. V. Evers ; Col. S. C. Halse ; T. Teisen, B.Sc., C.E. *Treasurer :* J. Connolly (General) ; Wm. M. Clark, Ph.B. (American). *Hon. Sec. :* S. English, M.Sc. *Auditors :* E. Meigh, M.Sc. ; D. Wood, F.S.A.A.

The President's address on "The Year in Review in the World of Glassmaking" was taken as read, the main business of the meeting being a general discussion on "Works Organisation." Mr. W. W. Warren opened the discussion with a paper entitled "Organising for Production from Pot Furnaces." After a discussion on this paper, which had already been presented at the meeting in February (*cf. Chem. & Ind., p.* 235), the case for "Tank-furnace works organisation" was presented by Mr. T. C. Moorshead, who defined the organisation of manufacturing industry as a combination of men distributed in parts or groups with proper officials, managers, and foremen, and so co-ordinated that they were able with the aid of suitable machines and tools to produce a finished article efficiently. Such an organisation was necessary in order to define responsibility, but the man really responsible for the losses in plant efficiency was the active head of the institution. He agreed with the expert opinion that the average manufacturing plant had only 50 per cent. efficiency, and that 80 per cent. of this tremendous loss of efficiency was due to a lack of proper or efficient management. The causes of this loss of efficiency could be grouped under five headings :—

(1) *Faulty Raw Material.* The buyer, or preferably a works chemist, should investigate the sources of supply to make provision for constant and regular supplies, keep a sufficient quantity in store at all times in order to ensure against stoppage in case of failure of deliveries, and analyse the materials frequently for purity and conformity with specifications.

(2) *Poor Labour.* This was a difficult problem and should be dealt with at the source. Provision should be made for carefully investigating every application for work in the plant, and the applicant should be interviewed by a man who is a good judge of human nature.

(3) *Poor Attendance.* It was a fundamental principle that a man's work should be interesting. This might be done by ensuring that the employees understood what they were doing and why. Weekly managers' and foremen's meetings should be held, complete records or minutes of which were kept and copies circulated to those who were present.

(4) *Large Labour Turnover.* To prevent the wastage due to this cause the work should be made agreeable. It was also necessary to regularise it or make it steady, and every man should be given identity, and made to feel that his progress was being watched and interest taken in him.

Many manufacturing plants actually made a careful analysis of each job, the main idea being to find what the requirements of each job were, both with respect to physical strength and mental capacity. When this was done, the results were tabulated and printed on a card in the form of job specifications. Then, when new men were employed, they were selected in conformity with these specifications and adjusted to their positions in such a way as to make them contented and turn out the largest possible output.

(5) *Machine or Mechanical Breakdowns.* This was the least wearisome cause of loss of efficiency. In 9 cases out of 10, machine breakdowns were due to lack of foresight : failure of the man responsible for the particular machine to anticipate troubles, failure to see that spares for vital parts of the various machines were kept in store ; and failure to keep all moving parts properly oiled and the machines clean.

Mr. Moorshead concluded his paper by emphasising the great responsibility resting on the foreman and gave some suggestions as to what questions a manager might ask himself in selecting his foreman or determining his capabilities.

CHEMICAL SOCIETY

An ordinary scientific meeting was held on April 19, the newly-elected president, Prof. Wynne, being in the chair. A vote of condolence on the death of Sir James Dewar was passed, and the names of the following Fellows were read as having died since the last meeting: G. Embrey, H. H. Froysell, J. S. Wilkes, R. D. Pettigrew, Henry Walker, T. Howard. Five papers were read.

(1) "The influence of nitro-groups on the reactivity of substituents in the benzene nucleus. Part VII. Reactions of 2 : 5- and 4 : 5-dinitro-m-xylenes," by E. Ibbotson and J. Kenner. Dr. Kenner summarised this paper from the standpoint of the Lapworth theory of induced polarity and discussed the importance of the key atom, the possibility of forecasting the position in which substitution would take place, and the chemical reactivity of the products.

(2) "The chemistry of the three-carbon system. Part I. The influence of the cyclohexane ring on the $\alpha\beta$–$\beta\gamma$ change," by S. F. Birch, G. A. R. Kon and W. S. G. P. Norris. Dr. Kon explained many of the reactions in a three-carbon system on the assumption that tautomerism occurred in the same way as with ethyl aceto-acetate. It was suggested that various kinds of tautomerism might account for different reactions.

(3) "On the promotion of catalytic reactions. Part I.," by S. Medsforth, who pointed out that nickel might act both as a catalyst and promoter, or the metal might act as the catalyst and the oxide or sub-oxide as promotor. An added promotor caused a reaction to take place more rapidly as the catalyst was then left to do its work unimpeded. The consideration assumed the formation of an intermediate compound and the dehydration hypothesis to explain the function of the promotion. Experimental results were given and a method outlined for testing reactions according to various groups present in the substance catalysed. The high efficiency of the incandescent mantle was given as an illustration of catalysis, the 99 per cent. of thoria acting as the catalyst and the 1 per cent. of ceria as the promotor. Dr. Rideal pointed out the importance of surface tension and surface action in catalyst reactions. As an instance of the latter he mentioned that the decomposition of calcium carbonate crystals occurred at the interfaces whereas in the readsorption of carbon dioxide the whole surface was concerned.

The last two papers were: "The action of halogens on phenylhydrazones. Part I. The action of bromine," by J. E. Humphries, E. Bloom and R. Evans, and "The mobility of symmetrical triad systems. Part II. The conditions relating to systems terminated by the *o*-phenylene group. Derivatives of indene," by Dr. C. K. Ingold and H. A. Piggott.

FARADAY SOCIETY

A meeting was held on April 23 in the Chemical Society's Rooms, Burlington House, and three papers were read.

Dr. E. K. Rideal presented a paper on the "Rate of Hydrogenation of Cinnamic and Phenyl-Propiolic Acids." The investigation bore on the mechanism of hydrogenation in a solution of two salts, sodium cinnamate and sodium phenyl-propiolate, differing from one another only in the possession of a treble bond in the latter in place of a double bond in the cinnamate, the object being to determine whether the reaction velocity really conformed to a reaction of zero order, and whether the reaction velocity was really the velocity of diffusion of the hydrogen to the colloidal palladium. Colloidal palladium sol was used and electrolytic hydrogen free from oxygen was utilised in all cases. It was concluded that the two salts in solution underwent hydrogenation at equal rates of hydrogen uptake in the presence of palladium sol when present in large quantities. The rate of hydrogenation depended on the rate of supply of hydrogen to the palladium and was proportional to the square of the shaking speed, the reaction velocity being of zero order. For small quantities of palladium the reaction velocity was proportional to the palladium concentration and the phenyl-propiolate absorbed hydrogen at roughly twice the rate of the cinnamate. Above certain limits the rate was independent of the shaking speed. The reaction velocity was, within limits, independent of the salt concentration. All sols began reaction with a velocity curve of zero order, but terminated in a reaction velocity curve of the first order. It was found that both salts undergoing hydrogenation as well as the hydrogen were adsorbed and it was assumed that the quantity of active sols adsorbed was independent of the bulk concentration down to extreme dilutions, but the limiting concentration with old sols rose, due to a decrease in adsorptive power. The adsorbed salt remained on the surface until completely hydrogenated, so that the rate of hydrogenation of phenyl-propiolate was the same as that of cinnamate, the former taking up two molecules of hydrogen in the same time as the latter took up one.

A note on the "Coagulation of Milk by Acid" was presented by L. Anderson, B.Sc., who described work designed to obtain information on the behaviour of casein and the protection of the fat globules, particularly regarding their resistance to coalescence when treated with acid and alkali respectively. On adding hydrochloric acid to milk of various dilutions casein was precipitated, the amount of precipitation increasing with increasing amounts of acids until a maximum rate of settling of the casein occurred. The amount of acid required to give this maximum rate of settling was inversely proportional to the dilution of the milk. That the fat globules were carried down mechanically by the casein was shown by the fact that on dissolving the curd the uncoalesced globules of fat rose to the surface. At higher concentrations of acid, casein was again precipitated; this precipitation was the salting out of the casein chloride by hydrochloric acid. Decinormal caustic soda would not cause coalescence of the fat globules, and it was concluded that casein was the protective agent preventing the fat globules from coalescing. Emulsions of benzene and olive oil in casein solution behaved similarly to milk with respect to acid and alkali.

Mr. A. Taffel read a paper on the "Temperature of Maximum Density of Aqueous Solutions." The author observed that the density of pure water passes through a maximum at 4° C., and that aqueous solutions of salts have a temperature of maximum density of less than 4°. Despretz was the first to show that the lowering of the temperature of maximum density below 4° was directly proportional to the concentration of the salt in solution. The present paper was devoted to an attempt to account for the effects produced on the temperature of maximum density of water by various solutes. The decrease in the total volume occurring when 1 gram of a substance was dissolved in water at a definite temperature to give a solution of a definite concentration was termed the "solution-contraction" for that substance at that temperature and concentration. If the solution-contraction increased with a decrease in the temperature at which solution occurred (this seemed to be a general rule), then the temperature of maximum density of the solution was below 4° C. If the solution-contraction, however, decreased as the temperature of the solution was lowered, as occurred with methyl, ethyl and propyl alcohols, then the temperature of maximum density of the solution would be above, at or below 4°, according as the rate of decrease of the solution-contraction was greater, equal to, or less than the rate of thermal contraction of the solute. The specific effect of ions and molecules on the depression of the temperature of maximum density of water resulted from their specific solution-contraction.

Messrs. J. H. Shaxby and J. C. Evans presented a paper on the "Variation of Pressure with Depth in Columns of Powders," in which they showed that the general form of the pressure-depth curves agreed well with the equation $p_a = p_m(1 - Ce^{-Kx})$ in which p_m was the maximum pressure and C and k constants.

Two papers on (*a*) "The Compressibility of Powders" and (*b*) "The Distribution of Densities in Columns of Compressed Powder," were contributed by Dr. E. E. Walker. In the first paper, the author described methods for measuring the resistance of powders to compression by static loads and blows from a falling weight, and the investigation of the resistance offered by powders made from various organic and inorganic substances to both these forms of compression. A theory was put forward to explain the different forms of load-volume curves. The second paper described measurements of local densities in columns of compressed powder, and gave a curve deduced to show the distribution of pressure in a column of compressed powder.

ROYAL SOCIETY OF ARTS

Sir R. Redmayne, K.C.B., read a paper entitled "A Review of the Base Metal Industry, with Special Reference to the Resources of the British Empire," at the meeting held on April 20.

After reviewing the position of base-metals during and after the war, Sir R. Redmayne gave a detailed account of the chief non-ferrous metals, of which an abstract is appended.

Copper is the metal of which the British Empire has the smallest domestic supplies. In 1919, the British Empire contributed only 6% to the world's output of copper; in 1920 7·5%, and in 1921 8·5%. The country chiefly affected by the decline in production since 1917 is the United States, which produces normally over 50% of the total world's output, and controls a still larger production by ownership of mines in other countries, notably Chile and Peru. The pre-war consumption (1913) of the three greatest copper consumers in the world, was as follows:—U.S.A., 340,000 t.; Germany, 255,000 t.; Great Britain, 138,000 t., or, in the case of Great Britain, one and a half times the Empire's output. From the point of view of potential resources the British Empire contains extensive areas of copper-bearing ground that are worth investigation. Canada presents a most likely source of increased supply, particularly British Columbia. The production from the Otavi mines in South-West Africa is also increasing, and production may soon be expected on a larger scale from Papua, where are extensive deposits of high-grade ore. Production by the Union Minière du Haut Katanga, in the Belgian Congo, largely controlled by British capital, has increased from 30,000 tons in 1922 to over 40,000 tons in 1922. In Northern Rhodesia the Bwana M'Kubwa Copper Co. has proved the existence of over 7,000,000 t. of ore carrying an average of 4% of copper, and proposes to apply a special ammonia process in treating the ore.

The chief hope for a gradual reduction in the price of metal would appear to be in the wider application of flotation methods for concentrating the ore and new leaching processes for extracting the metal from the ore, as they would permit the vast deposits of low-grade ore in Chile, etc., to be worked. The treatment of low-grade oxidised copper-ores by leaching processes has developed greatly in recent years.

Several processes of leaching with sulphuric acid are now in operation; in some, the copper is precipitated by scrap or sponge iron, in others by electrolysis. A fact worthy of note is that the Anaconda Copper Mining Co. has gradually acquired the control of a considerable portion of the world's copper resources, including the Chuquicamata mine, which has reserves of ore estimated (1916) at 700 million tons, equivalent to 14 million tons of metallic copper.

Lead.—The British Empire is in a somewhat better posision in respect of lead than as regards copper. In 1919, 1920 and 1921 the Empire produced, respectively, 17½, 12½ and 24 per cent. of the world's production. But the amount produced within the Empire falls short of the amount imported into the United Kingdom, viz., over 200,000 t. of lead in one form or another, but a certain proportion is exported, either as pig lead or manufactures of lead, to the extent of between 70,000 and 80,000 t. Although there was a marked increase in the production of lead during the war, the increased output was attained by the sacrifice of high-grade ore-reserves rather than by extension of smelting works. It appears that the lead-mining industry is one of the few branches of the base-metal mining industry which is not over developed. No great discoveries of lead ore have been made in recent years, and it looks as if the developed resources were being exploited near to, if not up to, their full capacity. The United States is the largest producer and the greatest consumer of lead in the world, but Spain and Australia both exporting more lead than America. In 1913 82% of the world's production was derived as follows:—United States, 37%; Australia, 20%; Spain, 15%; Germany, 6%, and Mexico, 5%. Britain is the largest importer of lead in the world; before the war Spain supplied 38% of our requirements; Australia, 28%; U.S.A., 15%; and Mexico, 10%.

The perfecting of the flotation process of concentration has made it possible to re-treat considerable accumulations of zinc-and-lead-bearing tailings and residues at the Broken Hill Mines of New South Wales. Our resources of lead within the Empire are considerable. Burma alone should contribute greatly, and home supplies will probably be found to be worth further exploitation as foreign costs increase.

Zinc ores are closely associated with those of lead, and the two metals are in many cases obtained from the same mine. Just as in the case of lead, the United States of America far exceeds any other country as a producer of zinc. In 1919, 1920 and 1921 the contribution of the British Empire to the zinc production of the world was 11%, 6% and 30% respectively, of the world's production, the low figure for 1920 being due primarily to the strike at the Broken Hill Mines in Australia. In 1913 the United States consumed 308,000 t., Germany 228,000 t., and the United Kingdom 191,000 t. Those three countries are the chief consumers of the metal. The British Empire meets only one-third of the requirements of the Mother Country.

The two most noticeable features in respect of zinc at the present time are:—(1) The rising production of electrolytic zinc, notably in Tasmania, Canada and the United States of America; and (2) the fact that, as a result of the war, the world's smelting capacity of zinc is largely in excess of the ore-production. The capacity in this respect of the United States alone is now 800,000 t. per annum. The electrolytic process is now an acknowledged commercial success, although still the greater part of the production is due to distillation.

Tin.—The Empire position in respect of tin is different from that of the three previously named metals, inasmuch as the Empire is the chief contributor to the world's production, accounting for more than half of the annual output. The Malay States is the chief producer, contributing over 36% of the world's output; then follow Bolivia and the Dutch East Indies, with about 20 and 15% respectively. At present the production and consumption of tin appear to balance. Normally the United Kingdom imports about 35,000 t. of tin ore, about 8,000 t. being from British Possessions, and 40,000 t. of metal, which, with the exception of 2000-3000 t., is derived from British Possessions. The re-exports in a normal year are about 3000 t. of ore, and 40,000 t. of unwrought tin. The balance, about 32,000 t. of tin ore, together with the domestic production, which in 1913 was 8,355 t., was apparently sufficient to meet the domestic requirements of the United Kingdom. Few new sources of tin have been discovered in recent years, although it appears probable that the Belgian Congo is likely to become an important producer in the not far distant future. It would seem that unless really extensive deposits are discovered, tin will be one of the first base metals to be exhausted. The smelting of tin ore is concentrated in few hands, although the tin-smelting capacity of the world is well in excess of the annual supplies of ore. In this respect the Straits Settlements heads the list with a capacity of about 58,000 t. of metal, Great Britain following with a capacity of about 34,000 t., and the United States with a capacity of 30,000 t., the total world smelting capacity being about 175,000 t, per annum.

Aluminium in the form of silicate is perhaps the most plentiful metalliferous mineral in the world, but owing to difficulty in extraction it is only of late years that it has been used on a large scale commercially. Bauxite, which contains from 30 to 60% of alumina and from 0·5 to 20% of silica, is the chief source of the metal, but only comparatively pure mineral can as yet be used profitably. In 1913 the British Empire accounted for little over 1% of the world's production of bauxite and in

1921 about 9%. The increase in the contribution from the British Empire is due to the development of the deposits in British Guiana. The United States is the chief producer, contributing 43% (1921) of the world's output. France comes next with 25% (1921). Besides the deposits of British Guiana there exist rich deposits of bauzite in India and the Gold Coast. In the former case development will depend on local demand, small at present, for the metal, and in the latter case difficulties stand in the way of transporting the ore to a place convenient for its reduction.

In conclusion Sir R. Redmayne said it would appear that stocks of the base metals were being absorbed, the demand was increasing, and a gradual improvement might be foretold with reasonable certainty. The feeling that we were on the eve of better times might be translated into certainty were the United States to cease from erecting tariff walls, and France and Germany to settle their difficulties. One effect of the tariff situation must be to force us to seek new sources of raw materials and to develop new markets.

INSULIN

The Medical Research Council announces that the remedy for diabetes, insulin, is now prepared in sufficient quantities to be placed on the market. A committee has been appointed by the Minister of Health to arrange for distribution to the medical profession and provisional authority has been given to the British Drug Houses, Ltd., in conjunction with Messrs. Allen and Hanburys, and to Messrs. Burroughs, Wellcome and Co. to distribute the remedy. A supply is also to be obtained from Eli, Lilly and Co., of Indianapolis, U.S.A. On the advice of the above-mentioned committee, supplies, while production is limited, will be restricted to hospitals and registered medical practitioners who have proper facilities for making accurate blood-sugar determinations in order to use the remedy in minimum quantity. Messrs. Burroughs and Wellcome, whose reputation in the field of biological productions is well known, has issued "Wellcome Brand Insulin" as a sterile watery solution in rubber-capped phials containing 100 units in 5 c.c. of solution. The dose is indicated in units, the average dose being 10 units injected subcutaneously twice a day. It is calculated that a unit will enable the patient to take at the ensuing meal 1·4 grams of additional carbohydrate, or its equivalent, without excreting sugar. An account of the production of insulin by the British Drug Houses, Ltd., in conjunction with Messrs. Allen and Hanburys was given in the last issue of *Chemistry and Industry*.

CORRESPONDENCE

THE TITLE "CHEMIST"

Sir,—Anent observation by "Eye-witness" in *Chemistry and Industry* of March 29, it may be of interest to you to learn that at the time the Institute of Chemistry was founded there *was* a good deal of discussion in point of fact concerning the possible clashing of interests between the Institute and the Pharmaceutical Society. I, myself, had several discussions with Mr. Carteighe concerning the matter, and at the time I regarded the position shown by him in respect of the Institute as rather protective of the interests of the Pharmaceutical Society than anything else.—I am, Sir, etc.,

C. T. Kingzett

Newlands, Weybridge
April 6, 1923

Sir,—Is it not time that the unseemly squabble about the use of the terms "chemist," "pharmacist," and "doctor" was brought to a close? It is not only unprofitable; it is worse, it is unprofessional and undignified.

After all, "the rank is but the guinea's stamp, the man's the gowd for a' that" and it may happen that a censorious world will think that those who are so keen in their insistence on the guinea's stamp are—shall we say?—a little doubtful of the fineness of their gold. It is the opinion of many who are well qualified to judge, that there is no title so becoming a gentleman as "mister."

It might be pointed out, too, to "Doctor of Science," since he is so interested in splitting etymological hairs, that unless he is a member of the teaching profession, he is not strictly entitled to the designation "doctor" (L. *docere*=to teach).—I am, Sir, etc.,

Harold Hunter

London, E. 12
April 10, 1923

Sir,—Why sigh for the moon when you know you can't get it?

Why ask Parliament to prevent drug-sellers being called chemists as they have been for ages past? Supposing Parliament did so, would that make the public drop the title? Can you impose a fine on every one who says he is going to a *chemist* to buy some opodeldoc after such a law is passed? Not you, but the public decides. It is quite hopeless to expect all this.

We have either to adopt, and restrict for ourselves, some new appellation, or to look backwards for some old one not already adopted by the drug-seller.

The names druggist, chemist, pharmacist, dispenser, etc., are already applied by the public to those who sell drugs and they will continue to do so whatever law is passed. Our first title was alchemist, the only one left to us is "analyst." Why not use it? Legalise it at once before that title too is snapped up by the drug-compounder. It may be urged that professors, teachers, works' advisers, consultants are not strictly "analysts." Well, if they have never used a test-tube they certainly have no claims to be either chemists or analysts.—I am, Sir, etc.,

A. W. Stokes
(Public Analyst)

Paddington Green
April 16, 1923

Sir,—Would it not be more practical, instead of claiming the title of chemist and endeavouring to persuade the chemist, who dispenses drugs, to forego his claim, to adopt another designation?

I would suggest reviving the term "alchemist." This term is now obsolete but as a profession we are the direct inheritors. The word alchemy, which is still sometimes used, conveys to the layman the suggestion of inquiry and discovery, so would not confuse him.

There are subsidiary arguments for the word alchemist. The professional chemist was originally usually called an analytical chemist, and if the broadest sense of the word analytical is taken, analytical chemist still describes members of the profession, particularly consultants, very well. As analytical chemist is too long, why not regard alchemist as a euphonic contraction for it? Or one could argue that an alchemist takes all chemistry for his province and is not restricted to the narrow field, which in the public mind is that of the chemist.

A united effort to establish and define the word alchemist would arouse far more useful public interest in the profession than anything in the nature of a squabble with the chemists and druggists. As a Scotsman I also think it would probably cost less.—I am, Sir, etc.,

W. H. Gibson

Belfast
April 16, 1923

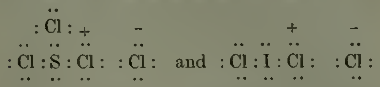
"CAUTION TO INVENTORS"

Sir,—In case the matter may not have been brought to your notice already, it has been suggested to me that I should draw your attention to "Caution to Inventors," which has been inserted by the Comptroller-General of Patents in the Illustrated Official Journal at the request of the Chartered Institute of Patent Agents:—"Inventors are advised to beware of suggestions such as are now being issued from a German source to the effect that, for reasons obscurely stated by the German writer, the British inventor should co-operate with him and in particular should send him by registered letter a sum of money. The communication is fraudulent, and on no account should money be sent."—I am, Sir, etc.,

Richard B. Pilcher
Registrar and Secretary
Institute of Chemistry, London
April 18, 1923

THE FORMULÆ OF SULPHUR TETRACHLORIDE AND IODINE TRICHLORIDE

Sir,—The method of formulation used by Mr. G. W. F. Holroyd in his letter of April 6, when applied to sulphur tetrachloride and iodine trichloride leads to the formulae



$$:\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:\underset{\cdot\cdot}{\overset{\substack{\overset{\cdot\cdot}{:Cl:}\\\cdot\cdot}}{S}}:\underset{\cdot\cdot}{\overset{\substack{+\\\cdot\cdot}}{Cl}}:\quad:\underset{\cdot\cdot}{\overset{\substack{-\\\cdot\cdot}}{Cl}}:\quad\text{and}\quad:\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:\underset{\cdot\cdot}{\overset{\cdot\cdot}{I}}:\underset{\cdot\cdot}{\overset{\substack{+\\\cdot\cdot}}{Cl}}:\quad:\underset{\cdot\cdot}{\overset{\substack{-\\\cdot\cdot}}{Cl}}:$$

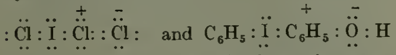
which indicate that these substances would be electrolytes.

The cryoscopic behaviour of solutions of iodine trichloride in phosphorus oxychloride has been investigated by Oddo (*Gaz. chim. ital.*, **31**, II., 151, 1901); and Abel and Halla (Abegg's *Handbuch der anorg. Chem.*, IV., 2, p. 484) quote the equation:—

$$ICl_3 \rightleftarrows ICl_2 + Cl'$$

as probably representing the dissociation found to occur. Further support for this view is derived from the work of Walden (Abegg's *Handbuch*, *loc. cit.*), who finds that in non-aqueous solution iodine trichloride behaves as an electrolyte, the ionisation increasing with dilution.

On this method of formulation there would be considerable analogy between the formulae for iodine trichloride and di-phenyliodonium hydroxide:—



$$:\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:\underset{\cdot\cdot}{\overset{\cdot\cdot}{I}}:\underset{\cdot\cdot}{\overset{\substack{+\\\cdot\cdot}}{Cl}}::\underset{\cdot\cdot}{\overset{\substack{-\\\cdot\cdot}}{Cl}}:\quad\text{and}\quad C_6H_5:\underset{\cdot\cdot}{\overset{\cdot\cdot}{I}}:\overset{+}{C_6H_5}:\underset{\cdot\cdot}{\overset{\substack{-\\\cdot\cdot}}{O}}:H$$

and, as is well known, the latter is a strong electrolyte.—I am, Sir, etc.,

T. S. Moore

Royal Holloway College,
London
April 9, 1923

"ORGANIC" CHEMISTRY

Sir,—The communications of Sir Wm. J. Pope and the letter from Sir A. Colefax in your January 5 issue, although apparently antagonistic, really serve to impress one with the same conviction, viz.:—the futility of the continued use of the word "organic" as a general term of classification in chemistry.

Sir Wm. Pope's series of quotations only emphasise the fact that all chemists who have considered this matter have realised the difficulty of formulating a logical definition. The majority of them have decided to abandon logic in favour of simplicity and have put forward definitions, which are certainly simple and comprehensible (so far as they go), but which ignore totally the meaning of the word "organic" and are a constant source of trouble when subjected to legal and technical scrutiny.

The fact is that the word "organic" (as used in the term organic chemistry) should have been abandoned when Berzelius' views were overthrown. Perhaps it is not too late to do this even now, drastic as such a departure will appear to the orthodox.

Difficulties, such as those revealed at the Board of Trade enquiries, will increase in the future and if precision is to be attained—and what is more important, absolute agreement amongst chemists—it can only be by the discontinuance in service of a word which is not only unscientific and misleading, but inaccurate.—I am, Sir, etc., T. W. Barber

Barrackpore, Bengal
March 27, 1923

ABSORPTION OF LEAD AND ARSENIC BY GLASS

Sir,—Referring to your report of the case against Boots Cash Chemists (Western), Ltd., at Birmingham, for selling potassium carbonate containing 10 parts of arsenic and 80 parts of lead per million, which was dismissed on April 6, I am reported as having said that in a sample of potassium carbonate placed in a similar bottle "less than 5 parts per million of *arsenic* had increased to 15 parts per million in a fortnight." Will you kindly note that what I actually said was that there was an increase from less than 5 parts to 15 parts of *lead* in this time. I find that I am correctly reported in the official shorthand notes, but other reports have apparently made an error.—I am, Sir, etc.,

H. Droop Richmond

Boots Pure Drug Co., Ltd.,
Nottingham
April 21, 1923

THE TAXATION OF MOTOR-CAR FUELS

Sir, — The taxation of motor-car fuels seems to have again become a point of practical consideration, but the adjustment of such a tax, at so much per gallon, if it is to be fair to all the substitutes for petrol now available, has become vastly more difficult since the time when different brands of gasoline were the only fuels in use.

Other things being equal, such as the absence of injurious substances, and a sufficient volatility for the ordinary carburetter, the value of a motor-fuel is dependent entirely on its calorific value. The calorific testing of a liquid fuel is quite simple, and the gas companies are rapidly accustoming the public to understand the meaning of the Therm. If, therefore, the taxation of any fuel were based on its calorific value per gallon, no one would have any ground of complaint. If necessary the boiling point or flashpoint could also be taken into account, and the tax limited to those below a certain point, so as to exclude ordinary burning oils and heavy fuel-oils. The use of the latter for motor-cars with engines on the Diesel principle need hardly yet be taken into account, and if the absence of tax encouraged experiment in this direction, it would be very much to the public advantage. If any adjustments are desirable between commercial and private vehicles they could easily be adjusted as at present, by taxes on the vehicles themselves. I am of opinion that a fuel tax is the fairest form of motor-taxation, but it must be based on principles suited to our modern knowledge and requirements.—I am, Sir, etc.,

Henry R. Procter

Newlyn, Penzance
April 18, 1923

Sir,—Having been allowed to see the letter from Prof. Procter on the above subject, I venture to write you in reference to a matter which is of very considerable importance to your readers.

The first paragraph of Prof. Procter's letter would lead one to imagine that a proposal had been officially made that motor fuels should be subject to some form of taxation which varied according to the nature of the fuel. For some ten years motor fuel, which then consisted chiefly of petrol, was taxed at so much per gallon, a rebate being allowed to certain classes of users. As alternative fuels were then not employed to any considerable extent, and as it was thought desirable to encourage the use of home-produced fuels, alcohol and benzol were not taxed. During the last few years taxation has been levied on the vehicle. The injustice of this is obvious, and all great motoring organisations in the country and the motor industry as a whole desire a return to fuel taxation, arguing that though the amount of fuel used is not an exact measure of the damage done to the roads, nevertheless it is very closely related thereto. The main opposition to the change comes from the heavy motor-vehicle side and from certain Government Departments. That the heavy motor-vehicle users do damage out of all proportion to the tax paid is common knowledge, and their opposition is readily comprehensible. It is proposed that there should be a flat rate tax on all motor fuels, and the practicable difficulties in the carrying out of the taxation actually intended are sufficient without introducing questions as to calorific value. Neither is it correct to state that the calorific value is a real measure of the value of a motor fuel. A No. 3 spirit consisting essentially of paraffin compounds is not as good a fuel as one of lower heat value containing aromatics or naphthenes, or, indeed, containing a limited amount of alcohol, merely owing to the fact that the latter group of fuels can be used with safety at a higher compression and that the gain of thermal efficiency due to the use of higher compression far outbalances any small differences there may be in calorific value. I do not see how the flashpoint can be brought in as a qualifying factor, although it might be used merely to differentiate between a motor spirit and a kerosene. As a matter of fact, most motor spirits flash from minus 20 to minus 40° C., and in any case the flash-point can be altered to an enormous extent by the addition of almost unweighable quantities of certain bodies which dissolve in most motor fuels. I agree entirely with Prof. Procter in his opinion that a tax on motor fuel is the fairest form of taxation, but believe that any attempt to vary taxation in amount dependent upon heat value or other physical property of the fuel would be attended with unsurmountable difficulties in practice and would be against the best interest of the motoring community. The fuel of the future will probably be one of low calorific value, which will be used much more efficiently than are the present fuels of high calorific value. The fuel of the lowest heat value at present available as a motor fuel is alcohol, and this is already severely taxed owing to the fact that it has to be denatured with considerable quantities of expensive products the nature and quantity of which is determined by the Government. As alcohol is the one fuel which can be produced without calling upon stored-up natural reserves, and as it can be produced within the British Empire, every encouragement should be given to those who are endeavouring to prepare for the time when petrol is not available in quantity to meet the ever-growing demand. In any scheme of motor fuel taxation, alcohol, which is already penalised by the denaturing laws, should be left tax free, and it is very debatable whether home-produced motor benzol should not receive preferential treatment. The taxation of benzol is attended with many difficulties and will be costly out of proportion to the returns. Moreover, every encouragement should be given to the development of low-temperature distillation and to the stripping of towns' gas. The whole problem of fuel taxation is one of considerable complexity, but it should be regarded not from the narrow standpoint of the Ministry of Transport but broadly from the point of view of Nation and Empire.—I am, Sir, etc.,

W. R. Ormandy

Belsize Park, London
April 23, 1923

PERSONALIA

Lieut.-Col. G. R. Lane-Fox has appointed Prof. W. S. Boulton, D.Sc., Prof. S. M. Dixon, M.A., M.Sc., Dr. J. S. Haldane, F.R.S., Prof. C. H. Lees, D.Sc., F.R.S., and Prof. J. F. Thorpe, C.B.E., D.Sc., F.R.S., to be additional members of the Safety in Mines Research Board.

The degree of D.Sc. in biochemistry has been awarded by the University of London to Miss K. H. Coward for a thesis entitled "The Formation of Vitamin A in Plant Tissues.

Mr. H. Barringer has been elected president of the Institution of Petroleum Technologists for the ensuing session.

Dr. R. W. Whytlaw-Gray, science master at Eton, has been appointed to the Chair of Chemistry in the University of Leeds, as from October 1, in succession to Prof. A. Smithells, F.R.S.

Mr. H. S. Taylor has been appointed professor of physical chemistry in Princeton University; G. Blumrick, formerly research chemist to the Welsbach Co., has been appointed chief research chemist for the Mantle Lamp Co.; and Dr. W. C. Gangloff, formerly research chemist to the National Aniline & Chemical Co., has accepted the position of chief chemist to the Dextro Products, Inc., Buffalo, United States.

Dr. G. Morselli has succeeded Prof. G. Bruni as president of the Italian Society of Chemical Industry for 1923 and 1924, and Prof. Senator E. Patern has been elected to the seat in the Académie des Sciences left vacant by the death of the Prince of Monaco.

Prof. Lenze has been appointed Director of the *Chemisch-Technische Reichsanstalt*, Berlin; Prof. A. Holste, of the Pharmacological Institute of the University of Jena, has been appointed professor of pharmacology and director of the Pharmacological Institute of the University of Belgrade; Dr. A. Kipple has succeeded Prof. A. Koch in the Chair of Agriculture and Bacteriology in the University of Gottingen; and Prof. P. Trendelenburg has been nominated Professor of Pharmacology in the University of Freiburg.

Prof. G. Tammann, of Gottingen, has been awarded the Bakhuis-Roozeboom Medal of the Royal Academy of Sciences of Amsterdam for his researches in connexion with the Phase Rule.

* * *

With regret we announce the death, at the age of ninety, of Mr. G. Ward, a member of the firm of Hirst, Brooke and Hirst, manufacturing chemists, and chairman of the Yorkshire Section of this Society from 1900 to 1902 and also from 1912 to 1914. As teacher of chemistry at the Leeds Institute, Mr. Ward's pupils included Sir E. Brotherton, Mr. J. E. Bedford and many other well-known men.

J. D. Van der Waals, a physicist who had devoted much time to investigations on the theory of surface tension, on Boyle's Law and other topics, died recently at the age of 87 in Amsterdam.

Prof. G. Siringo, incumbent of the Chair of Chemistry at the Royal Technical Institute, Chieti, has died at the age of fifty-five.

NATIONAL UNION OF SCIENTIFIC WORKERS

A public meeting will be held by the London Branch of this Association in the Birkbeck College on May 8, at 6 p.m., and Sir R. Gregory will speak on "The Worth of Science," Mr. C. S. Garland, M.P., presiding. A cordial invitation to attend is extended to all those interested in the work of the Union.

NEWS AND NOTES

AUSTRALIA

Sugar Industry

It is reported that previous estimates of the current year's production of sugar will not be realised. The Queensland sugar crop was estimated at 300,000 tons, but it is doubtful whether production will exceed 265,000 t., and as the New South Wales output will reach 18,000 t., the returns from the sugar producing areas will total 280,000 t. The sugar content of the cane, however, has exceeded expectations, the yield averaging 1 ton of sugar to 7 tons of cane as compared with 1 t. of sugar to 8 t. of cane in the previous season. It is reported that even if the estimated production is attained, there will be a carry-over of about 10,000 t. of sugar in Australia at the end of Government control in June, 1923.—(*U.S. Comm. Rep., Mar.* 12, 1923.)

UNITED STATES

Platinum and Allied Metals in 1921

The U.S. Geological Survey announces that the domestic production of platinum in 1921 was 977 oz. Platinum refiners, however, purchased 1021 oz. of domestic platinum from which 813 oz. of refined metal was recovered as follows :—Platinum 580 oz., palladium 3 oz., iridium 99 oz., osmiridium 119 oz., and osmium 12 ounces. Purchases of foreign platinum totalled 56,645 oz., nearly all of which came from Colombia. In addition to the above sources, certain amounts of these precious metals are recovered from scrap metal, nearly 26 per cent. of the consumption being obtained in this way. In 1921, the total recovery of platinum and allied metals was :—Platinum 39,131 oz., palladium 4887 oz., and iridium 1776 oz., making a total of 45,794 oz.

Sugar Industry in 1922

According to the annual report for 1922 of the American Sugar Refining Co., the world's estimated output of cane and beet sugar during 1922-23 will amount to 17,988,925 tons as compared with 17,637,728 t. in 1921. Of this amount 12,659,635 t. represents cane sugar and 5,329,290 t. beet sugar, the totals in the previous year being 12,657,786 t. of cane and 4,979,942 t. of beet sugar. The United States production of cane and beet sugar in the current year is estimated at 1,674,875 t. (cane 1,049,875 t., beet 625,000 t), as compared with 2,061,221 t. (cane 1,150,031 t., beet 911,190 t.) last year. Imports of full-duty sugars in 1922 totalled only 47,301 t. against 198,638 t. and 885,868 t. respectively, in 1921 and 1920. The chief sources of supply in 1922 were :—Mexico, 19,623 t. ; Nicaragua, 8501 t. ; Guatemala, 4809 t. ; Honduras, 4144 t. ; Peru, 2804 t. ; and Venezuela, 2481 t. Exports of refined sugar during the same period amounted to 819,964 t. (416,881 t. in 1921, 412,494 t. in 1920), and the chief destinations included the United Kingdom, 268,275 t. ; France, 150,810 t. ; Germany, 47,528 t. ; Norway, 32,864 t. ; Greece, 32,354 t. ; Turkey, 27,212 t. ; the Netherlands, 26,044 t. ; Spain, 25,361 t. ; Belgium, 23,190 t. ; Italy, 22,316 t. ; Argentina, 21,964 t. ; Uruguay, 15,837 t. ; British India, 12,455 t. ; and Egypt, 12,218 t. Exports in 1922 went to 83 foreign countries, the amount being practically equal to the 885,868 tons imported into the United States from nearly 50 foreign countries in 1920. It is considered that the export trade could be increased to a million tons per annum without curtailing domestic requirements.—(*Bd. of Trade J., April* 5, 1923.)

Proposed Cultivation of Rubber, Camphor and Quinine in the Philippines

A measure is before the Philippine Legislature to permit the use of about 50,000 acres for the cultivation, under the Forestry Bureau, of rubber, camphor and quinine for 20 years. It is stated that after the initial investment is recovered, a forestry tax of 10 per cent. will be levied.—(*U.S. Comm. Rep., Feb.* 26, 1923.)

German Observations on the Coal Industry

A report recently published by the German National Coal Commission deals with observations made by a German engineer on the coal industry of the United States. He remarks on the extensive use of mechanical diggers and the resulting continuous increase in the daily output per worker. Formerly sorting and washing the coal were unnecessary, but with the development of less clean seams these operations are being extended. Mention is made of the importance attached to coal analyses by coke manufacturers, who improve their products by using suitable mixtures of the raw materials. In general firing practice, the desirability of using large fire-boxes is becoming recognised. Recent development in coal-dust firing are dealt with ; it is pointed out that in this method it is not so much the quantity of ash that is important as its melting point, a consideration which may lead to the development of brown coals for dust firing.

JAPAN

A New Mercury Deposit

A new vein of quicksilver said to be seven miles long and to vary in width from 2 to 6 feet has been discovered near Kita Uonome in the Goto Archipelago. The ore contains 18 per cent. of mercury and preliminary trials indicate that the vein increases in thickness with depth. This discovery is important, as none of the veins so far discovered in Japan are suitable for working, and it should make the country independent of foreign supplies.—(*U.S. Comm. Rep., Feb.* 12, 1923.)

GERMANY

Chemical Industry and the Ruhr Occupation

Dr. A. Neuburger, discussing in the *Chemiker-Zeitung* (April 5, 1923), the effect of the French occupation on chemical industry in Germany deals with the consequent necessity of obtaining foreign coal at high prices. He draws particular attention to the large quantities of fuel locally available in the form of coke contained in the slag daily turned out of the furnaces and in the vast slag heaps that have accumulated in many places. The older these slag heaps are the more fuel will be obtainable from them, since modern firing is far more efficient than in former days. Several processes are available for the separation of the coke, and an efficiency of 98–100 per cent. is attainable. The calorific value of the fuel averages about 5500 cals. Apart from the fuel question, much depends on whether the German chemical industry is able to obtain coal-tar and its countless products from new sources to take the place of that previously supplied by the Ruhr coking concerns. The indications are, however, that the chemical industry, though having to make many sacrifices, will survive the French occupation.

The Peat Industry

Not only in neighbouring States but also outside Europe the peat industry is attracting increasing attention. Not only is peat used as a fuel, but it is also distilled, coke and other products, such as tar and alcohol, being obtained. In a forthcoming special international number the German weekly, *Deutsche Torfindustrie-Zeitung* will give a review of the present condition of the world's peat industry, and it is hoped that this will initiate the interchange of ideas between experts of other countries.

Shale Bricks

The development of the extensive oil shale deposits of Germany presents many difficulties owing to the small oil content. A method has recently been proposed for utilising these shales to make a cheap building material. The shale is ground and mixed with sand or clay, the proportion depending on the richness of the shale. Bricks of the material are shaped and placed in a kiln where they are baked by the combustion of their own oil. The bricks so obtained contain only small quantities of calcium sulphate and sulphite, and are as hard as ordinary bricks, from which they differ very little in appearance.

Clinker Bricks

An interesting plant is being worked at the municipal gas-works at Würzburg. Clinker is ground, mixed with one-ninth of its weight of cement, and the mixture formed into bricks. By this means 8 cubic yards of a good building material are produced from half a cubic yard of cement, with the consumption of energy equivalent to about 13 lb. of coal. The bricks are 10 in. by 4·8 in. by 4 in., their size making them economical of mortar. Volume for volume these bricks are produced at only half the cost of ordinary bricks; they have a low heat conductivity and fireproof properties which render them suitable for building dwelling houses.

Glass Textiles

Recently a novel process has been patented by a German inventor, E. Klapp, who has developed the manufacture of fancy articles from glass wool. Glass fibres or bundles of threads are cemented to a base suitably formed from glass threads, smooth or rough surfaces, with coloured or plain patterns being obtainable. The process has been worked during the past year by the "Kristallco" Co., which has produced a series of fine articles such as lamp-shades, etc.

GENERAL

Chemical Society

The von Baeyer Memorial Lecture will be delivered by Prof. W. H. Perkin, F.R.S., in the lecture hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, on Thursday, May 10, at 8 p.m.

It is announced that the Chemical Society Research Fund Committee will meet early in June. Applications for grants should be made on forms obtainable from the Assistant Secretary, Chemical Society, Burlington House, W. 1, and must be lodged with him by June 1.

The Ordinary Scientific Meeting to be held on May 17 at 8 p.m. will be followed by an informal meeting.

The Salt Industry

Mr. W. J. Lewis lectured before the Geographical Association at Birmingham University on April 12 on the geography of Central Cheshire, with special reference to the salt industry. He said there were two layers about ninety feet thick, and it had been shown recently that the salt field extended a good deal further south than was previously thought. Making a very conservative estimate, it was probable, at the present rate of output, that the Cheshire salt field would last another thousand years. The salt trade grew steadily until the early 'eighties, after which it went down to 57 per cent. of the record output of over two million tons in 1884, and now stood at about 72 per cent. of that record. The decline was due to the development of other salt fields in the British Isles; to the competition of Central Europe, where there were pure deposits of natural rock salt; to the development in America; to the competition of tropical countries where sea salt could be produced; and, to some extent, to tariff barriers. In the early 'eighties the Cheshire industry dominated most of the world markets, but since then many of its customers had developed their own resources, and the future of the industry lay with the development of the alkali trades based upon salt.

The World's Production and Consumption of Copper

In 1913 the United States was not only the chief producer of copper, followed in order of importance by Japan, Mexico, Australia and Chile, but also the chief consumer, followed by Germany, the United Kingdom, France and Russia. Figures for post-war years are not yet available, but it appears that Chile has replaced Japan as the second largest producer, whilst the Belgian Congo has substituted Australia, and possibly exceeds Mexico as a source of copper. During 1922 Chile exported 76,000,000 lbs. of copper to the United States and Great Britain and a certain amount to other countries. The copper deposits in the Katanga region of the Belgian Congo are amongst the largest in the world. and the output has grown from 12,000,000 lbs. in 1913 to about 70,000,000 lbs. in 1921, mostly directed to England. Australian copper production has declined from 101,000,000 lbs. in 1913 to 42,000,000 lbs. in 1921 owing to labour troubles and lack of transport facilities. Exports of copper from Japan, which in pre-war years averaged 82,000,000 lbs., have declined by over three-fourths. The output of copper in smelters in the United States totalled 981,000,000 lbs. in 1922, most of the production being refined electrolytically.—(*Ch. Comm. J.*, *April* 6, 1923.)

New Paper-making Materials

Appended is an account of results of examination at the Imperial Institute of paper-making materials from various parts of the Empire.

Talipot palm-leaf stalks. Different parts of this palm (*Corypha umbraculifera*) have been put to a variety of native uses, and the leaf stalks have recently been examined as a paper-making material. It was found that the stalks are a promising material as they furnish a fairly good yield of pulp. Unbleached pulp yields a strong brown wrapping paper, and fairly white paper of good strength can be made, but the pulp bleaches with difficulty, requiring a large quantity of bleaching powder. It is therefore doubtful whether the manufacture of white paper from the stalks would be remunerative.

Betel-nut husks. Trials of pulp made from betel-nut (*Areca catechu*) husks, showed that these are not very suitable for paper making, and could only be employed in conjunction with longer fibred materials for producing low-grade brown papers or boards, but their utilisation even in this way is not very promising.

Elephant grass. Promising results were obtained some years ago in paper-making trials with samples of elephant grass (*Pennisetum purpureum*) from Uganda. Further trials of pulp from Nigeria were equally satisfactory, but exportation of the grass to the United Kingdom would not be remunerative, and it is recommended that the grass be used locally for the production of " half stuff " for export.—(*Bull. Imp. Inst.*, XX, No. 3, 1922.)

Bismuth Industry in Transbaikalia

It is reported that the Russian Trade Delegation in Germany is negotiating for the participation of foreign capital in the exploitation of bismuth mines in the Transbaikalia territory. The bismuth deposits are situated about 70 kilometres from Chita, and a railway, coal mines, and sufficient labour are available locally. Bismuth, it is stated, is extracted by a new process from the ore, the reserve of which is estimated at 1500 tons.—(*Raw Materials Rev.*)

The Artificial-Silk Industry

The artificial-silk industry continues to progress, and interesting information on this subject has been given at the annual meeting of the Société de la Soie de Tubize on March 13. During the past year this company made an agreement with the Dreyfus-Clavel group and the British Cellulose and Chemical Manufacturing Co., which will enable the former company to manufacture cellulose-acetate silk and market it in Europe. Cellulose-acetate silk has certain special qualities not possessed by other artificial silks so far manufactured. This new silk has been given the name of " célanèse " by the Tubize Co., and owing to its elasticity, fineness, insulating qualities and physical appearance, could replace for many purposes the natural product, over which it has a marked advantage in price. A factory to manufacture 500 kg. of célanèse per day is being built at Tubize, and the company has already rented a works at Grand Querilly, near Rouen, belonging to the Cie. Générale des Produits Chimiques de Normandie. This works was built during the war to manufacture cellulose acetate by the Dreyfus process. The Tubize Co. already manufactures 6000 kg. of artificial silk per day at Tubize, and an associated company at Tomazof produces over 1500 kg. per day, whilst the Tubize Artificial Silk Co. of America produces 10,000 ℔. per day at Hopewell. The demand for artificial silk continues to exceed the production, although the output is continually increasing. The Tubize Co. proposes to establish a factory to spin acetate silk at Rouen or at Lyons, but apparently does not intend to manufacture acetate silk at Grand Querilly as long as importation of the product from England is possible. Only if competition—and it seems that this could only come from the Usines du Rhône—prevents importation, will acetate silk be manufactured at Grand Querilly. The Tubize Co. is now carrying out experimental manufacture of the silk to acquire experience of the process. In addition to the factories at Lyon and Besançon, which manufacture Chardonnet silk, those at Givet, Izieux, etc., which produce cuproammonium silk, and that at Arques la Bataille which turns out viscose silk, new factories are being founded at Lyon (acetate silk), Rennes (Chardonnet silk), Strasbourg, etc.

Austrian Coal and Iron Industry in 1922

According to the Association of Austrian Mine-owners 3,130,701 tons of coal was won during 1922, as compared with 2,697,689 t. in 1921, the quantities of brown coal being 2,967,915 t. and 2,469,425 t. in the two years, respectively. A falling-off in orders followed the stabilisation of the krone, becoming more and more noticeable from October to December, though the position in Lower Austria continued to improve. A summary of the output from various areas follows :—

District	Brown coal (tons)	Hard coal (tons)
Styria	2,864,160	387
Upper Austria	425,320	2,623
Lower Austria	183,839	159,776
Burgenland	393,709	—
Carinthia	100,819	—

Iron ore production in Austria during 1922 amounted to 2,793,087 t., of which Styria and Carinthia produced 2,065,269 t. the remainder coming from Salzburg and Lower Austria. The output of pig-iron in 1922 was 322,822 t., compared with 606,655 t. in 1913.

The Occurrence and Uses of Bentonite

Bentonite, a mineral whose remarkable properties have attracted considerable attention of late, is a variety of clay which has so great an affinity for water that it will absorb more than three and up to eight times its own volume of liquid, swelling up considerably and producing a colloidal mass resembling thick starch paste. The mineral is usually hard, dull and powdery, but waxy on a freshly-cut surface, and varies in colour from yellowish-green to almost black. Like other clays bentonite consists essentially of aluminium silicate, but varies in composition, typical analyses running as follows, per cent. :—Silica, 59·84—69·52 ; alumina, 11·84—26·58 ; ferric oxide, 2·46—3·35 ; calcium oxide, nil to 2·90 ; magnesia, 0·21—2·76 ; alkalis, nil to 4·47 ; loss on ignition, 5·45—13·80. The chief known deposits of bentonite occur in North America, beds being found in Wyoming, Montana, South Dakota, California, Utah, etc. in the United States and in Alberta and British Columbia in Canada. Already the uses of bentonite are numerous, and in addition to those recorded previously in these columns (*Cf. Chem. and Ind., p.* 80, 1923), it is now stated that bentonite clays can be utilised in making ceramic products. It appears that the mineral will attain considerable commercial importance, and deposits of clay throughout the Empire should be examined to see if bentonite is present. Bentonite can be readily detected by dropping into water, when it swells and assumes the consistency of soft soap, and finally goes completely into suspension ; further, the edges of a piece of bentonite fuse readily in a blowpipe flame, whereas clay will not. The Imperial Institute requests that promising samples should be forwarded for investigation.—(*Bull. Imp. Inst.*, XX, *No.* 3, 1922.)

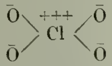
REVIEWS

The Structure of Atoms. *By* Alfred Stock. *Translated from the second German edition by* S. Sugden, M.Sc. *Pp. viii*+88. *London : Methuen and Co., Ltd.*, 1923. *Price* 6*s. net.*

Dr. Stock's little book represents the substance of a series of lectures delivered at the Farbwerken vorm. Fr. Bayer and Co. at Leverkusen in September, 1919. The fact that such a series of lectures should be given at all is remarkable ; but the author has justified fully his choice of a subject by the skill with which he has unfolded the fascinating story of recent developments in " Ultrastrukturchemie." In reading the book one constantly comes across dramatic statements such as the following : " Von Laue assumed that Röntgen rays were the same kind of vibration as common light, but of much smaller wave-length. On this view one would no more expect them to be diffracted by an ordinary spectroscope grating than one would expect to produce a spectrum from ordinary light by means of the rails of a fence." " A gram of thorianite is found to contain 9 c.c. of helium gas ; from the thorium content of this mineral it can be calculated that only $3{\cdot}7 \times 10^{-8}$ c.c. of this gas are produced annually ; hence at least 240 million years must have elapsed since this mineral was first formed." Or, " A gram of radium disintegrated completely into helium and electrons would develop 10^{11} cals., a quantity a million times that developed by the most violent chemical reaction hitherto observed. If this energy could be utilised it would form by far the most important source of power for industrial purposes."

But whilst the lectures were of a popular character, and were delivered to an audience a large part of which must have been unfamiliar even with the outlines of the subject, there are plenty of passages which will appeal by their novelty to readers who are much more sophisticated. Some of these statements challenge thought and invite comment. It is, for instance, interesting to note that " P. Pfeiffer regards crystals as compounds of very high molecular weight which have a structure in accordance with the laws of co-ordination of the well-known theory of Werner." This is the converse of the view which the reviewer has recently laid before the readers of this *Journal*, namely, that co-ordination represents at least in part the effect of crystal forces and crystal structures persisting in solution.

In view of its country of origin it is perhaps only natural that Dr. Stock's book should assign most of the credit for formulating the electronic theory of valency to Kossel. It is, however, surprising to see that, whilst Langmuir is quoted with three other authors as the creator of " later theories " which " were based on Kossel's work and have little advantage over it," the epoch-making work of G. N. Lewis, on which Langmuir's papers were based, is not even mentioned. This omission is of course necessary in order to maintain the view that the current theories of valency were *later* than Kossel's work and *based upon it*; but this is grossly untrue in the case of Lewis. A comparison of the theories of Kossel and of Lewis shows that, whilst the former is already obsolete in several points, the latter is just as valid to-day as it was when first put forward in 1916. The existence of non-polar valencies was, indeed, admitted by Kossel; but he did little more than pay lip-service to them, and worked out nearly all his formulæ on the assumption of a transfer of electrons. The result of this is a piling up of electrostatic charges that makes the formulæ quite unnecessarily complex. For instance, in the perchlorate ion, ClO'_4. Kossel assumes that the chlorine first parts with seven electrons, to form an ion which must be formulated as $Cl^{+++++++}$; the single negative charge of the ClO_4 ion is then attributed to a preponderance of one electron on the four negatively charged oxygen ions O^{--} O^{--} O^{--} O^{--}. In this case, the system of Lewis represents the chlorine atom as completing its octet by acquiring *one* electron from the hydrogen of the acid, and then sharing four duplets with the four oxygen atoms, so that the formula of the ion becomes



In the case of elements such as chlorine, oxygen and nitrogen, Kossel is obliged to admit the existence of a non-polar bond; but he assumes "that the stable ring of electrons contains, in the molecule of nitrogen 10, in that of oxygen 12, and in that of chlorine 14 electrons, which are symmetrically arranged between the two similar nuclei." The assumption that in nitrogen gas there are no electrons at all of the L-series specifically attached to either atom, but that ten of them chase one another round an intermediate orbit finds no support whatever from the physical study of the gas. For instance, "Sommerfeld has deduced from the optical properties of nitrogen that the molecule of this gas contains two nitrogen nuclei, which each carry seven positive charges. Each nucleus is surrounded by four firmly-held electrons, whilst six more loosely-bound electrons form a ring between the two nuclei and hold them together." Sommerfeld's conception is completely at variance with Kossel's structure, but differs from that of Lewis only in that the six loosely-bound electrons which hold the two nuclei together are formulated by Lewis as three duplets. Lewis' views are also in close accordance with the facts of stereochemistry, a branch of science which Kossel appears to have overlooked complctely. It appears therefore that whilst Kossel may claim with Lewis an equal share in the development of the idea of valency based on the transference of electrons, the credit for the idea of valency based on electron-sharing belongs almost exclusively to Lewis.

Dr. Stock claims that: "The lion's share in the future development of this subject will probably be appropriated by physics." "The chemist who is not at the same time a physicist, will have to stand aside and view the working out of these things with somewhat mixed feelings." He also quotes von Weinberg as saying that: "The further development of the structural problems of organic chemistry can scarcely be attempted until the problem of the fine structure of electrons in atoms has been solved." In the opinion of the reviewer the chemist will not be dismissed from his post so easily as Dr. Stock imagines. The clear enunciation of electron-sharing as a factor in chemical combination was due to a physical chemist and not to a physicist; and even at the present time physicists are still speculating as to the way in which they can best appropriate this idea and assimilate it into their scheme of quantum orbits. Even in so simple a case as that of hydrogen-gas, it is not yet clear that a satisfactory physical mechanism of electron-sharing has been developed; and there are as yet no indications that the phenomena of stereochemistry are within the grasp of the physicist even in so simple a case as that of methane. Dr. Stock admits, perhaps a little reluctantly, that "chemistry should really go hand in hand with physics in the working out of these problems"; but this is actually the only way in which the wide gap which now separates the theories of the physicist from the facts of the chemist can be bridged. The contribution of the chemist towards the bridging of this gap is to bring together a bewildering array of phenomena, and to group them in such a way that they can be understood and appreciated by the physicist. Thus the real value of phrases such as "unsaturation," "conjugation" and "co-ordination," is that each of them summarises a vast collection of detailed experimental facts. The share of the physicist is to devise a mechanism by which these phenomena may be referred to a common origin based upon a theory of the structure of the atom; but in this work the physicist is not necessarily superior to the chemist, any more than an office boy is necessarily superior to a mechanic because he handles words rather than things.

The work of translation has been very well done by Mr. Sugden, but a few errors remain to be corrected in a subsequent edition, *e.g.*, on page 33 Planck's constant is confused with the quantum itself; on page 49 there is an obvious inaccuracy in the equations $232{\cdot}18 - 32{\cdot}00 = 206{\cdot}18$ and $225{\cdot}96 - 20{\cdot}00 = 206{\cdot}07$; and on page 80 the formulæ for sulphuric and perchloric acids have slipped into error. It is also an eyesore to see Bunsen spelt with a small "b."

It is unfortunate that four years have elapsed between the delivery of the lectures and the appearance of this translation. This has prevented the introduction of Bragg's complete system of Ångström units, which forms so valuable an aid to the study of atomic and molecular magnitudes; it also accounts for the omission of Bohr's table of quantum orbits, which the reader naturally expects to see in a book dealing with the structure of atoms and published in 1923. There must, however, be many readers who will find pleasure in this popular account of modern theories; and the style in which the book is issued contributes a share to the attractiveness of the volume.

T. M. LOWRY

(1) DIE LUFTSTICKSTOFF-INDUSTRIE. *By* Dr. BRUNO WAESER. *Pp. vii*+586. *Leipzig: Otto Spamer*, 1922. *Price, including export tax*, 42,000 *marks*.

(2) THE NITROGEN INDUSTRY. *By* Dr. J. R. PARTINGTON *and* Dr. L. H. PARKER. *Pp. xv*+336. *London: Constable and Co., Ltd.*, 1922. *Price* 21*s*.

(1) This substantial German treatise by Dr. Waeser forms one of a series on monographs on chemical technology edited by Professor Binz, of Berlin. Its compilation was commenced before the war, when the synthetic-nitrogen industry was quite in its infancy. The information it contains is said to have been obtained in part directly from a number of leaders of German chemical industry, but much has evidently been culled from technical papers.

The work is divided into three main sections: first, introductory and general; second, historical and economic; third, technical. It has not been possible to read the whole volume critically, but from a general perusal it is evident that while the treatise is one which should in some respects be of considerable value, a certain amount of the information it contains is quite unreliable, and has evidently been derived in a number of instances from the claims made for projects which never came to fruition, rather than from records of actual fact. Nevertheless the book contains a good deal of quite useful material, especially as regards German developments. For example, the section dealing with the Haber-Bosch synthetic-ammonia process, although giving less information about the actual manufacturing operations than Messrs. Partington and Parker's volume, includes many details as to the products made at the factories of the Badische Anilin und Soda Fabrik Company at Oppau and Merseburg. It is interesting to note that at both works the gypsum process for fixation of ammonia as sulphate is now employed on quite a large scale, thus obviating the necessity for large quantities of sulphuric acid, now a relatively expensive product, needing for its manufacture, imported sulphur or pyrites. The necessary gypsum is obtained from the company's own deposits in the Hartz Mountains. The different fertiliser products made by this company, including the now notorious ammonium nitro-sulphate, which was the cause of the Oppau explosion, are fully described.

A good feature of the book is that in most cases references are given, and it is obvious that a very large number of patent specifications has also been consulted. On the whole, the work is uncritical, and care does not appear to have been taken to differentiate sufficiently between processes which are obsolescent or already obsolete, and those which are at the present moment of great technical importance.

(2) The important work by Prof. Partington and Dr. Parker is much smaller, but more readable than the German treatise. It bears the impress of a thorough acquaintance with the subjects discussed, and, in contrast with the German work, which in general is not critical, does not hesitate to criticise many of the processes and statements under review.

Part I gives a general introduction to the nitrogen problem, and discusses the extraction and refining of Chile nitrate in considerable detail. Part II comprises a review of the by-product ammonia and ammonium-sulphate industry, whilst Part III, divided into four sections, deals mainly with the synthetic ammonia, cyanamide and arc processes, and the oxidation of ammonia.

Throughout the whole volume extensive use is made of the work of the Nitrogen Products Committee, and many of the tables and statistics, given in the Report of the Committee and in the Statistical Supplement to the same compiled by the writer are reproduced and discussed. In the Committee's Report attention was chiefly devoted to the general, statistical, and financial aspects of the different nitrogen-fixation processes, great stress being laid throughout on factors of cost, both of the capital expenditure involved and the cost of production of the different products. In the present work, however, more detailed descriptions are given of the processes themselves, and illustrations are added depicting various items of plant employed; mention should be made of the excellent plates, giving views of some of the more important nitrogen-fixation factories of the world. The volume may be regarded as bearing the same sort of relation to the Nitrogen Products Committee's Report as Mr. and Mrs. Sidney Webb's Commentary to the famous Minority Report on the Poor Law. Many people seem to have a prejudice against blue-books of any kind, and to these the volume will certainly make a special appeal.

Section (1), describing the synthetic-ammonia process, and consisting of about forty pages, is less detailed than some other parts of the book, although good descriptions are given of the German plants. One of the most interesting features of this chapter is a short history of the developments of the process in England, France and America. *Section* (2), also of about forty pages and dealing with the cyanamide process, is more complete, but the information given is mainly statistical, rather than practical. *Section* (3) is devoted to the arc process. Of special interest are the first few pages summarising the history of this process. Due credit is given to the late Lord Rayleigh for the pioneering work he accomplished in measuring for the first time the relation between the energy expended and the amount of nitrogen fixed. It is a somewhat astonishing fact that even in the largest and most successful modern plants, employing furnaces of 4000 kw. capacity, the increase in the yield obtained per kw. expended, over that given by Lord Rayleigh's primitive apparatus does not exceed 50 per cent. *Section* (4), on the oxidation of ammonia, is one of the best in the book. This was rather to be expected, since it was with this particular division of the work of the Nitrogen Products Committee's Research Laboratory that the authors were at one time associated. Descriptions are given of the various forms of converter employed, as well as details of their operation. Although a considerable amount of interest was taken in England in the oxidation process during the war period, present day statistics of importation indicate that the country's comparatively modest peace-time requirements of ammonium nitrate (necessary for manufacture of blasting explosives) are now being obtained from abroad, all the ammonium-nitrate works which operated during the war having apparently been dismantled.

An unusual feature, not often to be met with in a technical work of this character, is that the authors do not hesitate to discuss and criticise most severely the ineffectiveness of British Government policy and comparative lack of actual achievement in nitrogen matters. In some respects their outspokenness is justified, but a certain number of their statements are not in accord with the facts.

We have been accustomed to hear some of those, who are pleased to think themselves chemical engineers, deride so-called " academic " chemistry, and scoff at " laboratory " experiments, as distinct from those carried out on a works scale. It is, therefore, perhaps not surprising that occasionally the " pure " chemist engaged in research should don his armour, enter the lists and joyfully seize his opportunity of having a fling back. We find scattered throughout this book from the preface onwards, quite a number of instances where the authors digress to preach the value of abstract research, and to rub in the sentiments expressed in Davy's somewhat extravagant jibe of a hundred years ago that " the chemical manufacturer has rarely discovered anything ; he has merely applied what the philosopher has made known."

J. A. Harker

Fuels, Gas, Water and Lubricants. *By* S. W. Parr. *Pp.* 250. *London: McGraw-Hill Publishing Co.*, 1923. *Price* 12*s.* 6*d.*

The author of this book is Professor of Applied Chemistry at the University of Illinois. He points out that the work, which is in its third edition, is the result of over 10 years' effort to arrange a chemical course intended primarily for mechanical and railroad engineers in their junior year. It is admitted in the third edition that something has been added to render the work more likely to be of value to junior students in chemical engineering. Although the title of the book is very comprehensive the subjects treated at length are coal, gas and water, and these are looked at very strictly from the industrial point of view. Those portions of the book dealing with other than the abovementioned subjects only amount to a dozen pages or thereabouts.

The work is divided into two sections, the first dealing in a general manner with the subject and the second giving details for the laboratory examination of the products dealt with. In the first section it is interesting to note that a complete chapter is devoted to the important subject of sampling. A good deal of space is devoted to the consideration of expression of results and the important subject of the drawing-up of coal contracts is discussed in a separate chapter. The methods of analysis employed are for the most part those recommended by the American Society for Testing Materials, and this applies particularly to coal and oil analyses. As is customary in American books, practically all the references contained in the work are to American literature. Although all tabular matter and analyses refer to American coal and American waters, this reduces the value of the work for European students in comparatively small degree, since the points which it is thought to emphasise are of general applicability. The sections on coal and boiler-water are excellent and many interesting tables of analytical data are given relating to the classification of American coals. There is also a number of tables contrasting waters from various sources in the United States, including some which are naturally alkaline.

The author mentions the difficulty of finding sufficient time in the crowded course of an engineering student to deal adequately with the important subjects treated, and refers to the limitations of chemical knowledge when the student commences that particular course. The book is of undoubted value to the engineering student and the practical bearing of all the technical work is so brought into prominence that chemical students about to enter a works laboratory would find much profit from its perusal. As is customary with books published by the McGraw-Hill Co., the work is well got up and adequately indexed.

W. R. Ormandy

THE ORIGIN OF SPECTRA. *By* P. D. FOOTE *and* F. L. MOHLER. *American Chemical Society: Monograph Series. Pp.* 250. *New York: The Chemical Catalog Co., Inc.* 1922.

This book is another of the valuable monographs now being published by the American Chemical Society as the outcome of the Inter-Allied Conference for Pure and Applied Chemistry held in 1919. The authors state that it was their intention to discuss the quantum theory chiefly from the experimental point of view, but to do this they were obliged to discuss the theory itself. This is fortunate, as it enables the inexperienced reader to follow the lucid descriptions more easily. The book is divided into eleven sections: Quantum Theory of Spectroscopy; Energy Diagrams; Ionisation and Resonance Potentials for the Elements; Line Absorption-Spectra of Atoms; Line Emission-Spectra of Atoms; Cumulative Ionisation; Thermal Excitation; Thermochemical Relations; X-Rays; Photo-electric Effect in Vapours; and Determinations of h Involving Line Spectra. In the Appendix there are given Computational Data, Periodic Tables, and Bohr's Theory of Atomic Structure. It is impossible to give a detailed account of the work owing to its concentration, but the authors discuss the work of Bohr, Sommerfeld, Stark and Zeeman, and give preference to the theory of Bohr over that of Langmuir as being more in accordance with spectroscopic phenomena. Excellent illustrations of spectra are given in addition to clearly reproduced drawings and diagrams. The volume appears to the reviewer to be a model of concentration, and it should be indispensable for every student in the field of spectroscopy. H. E. FIERZ

DIE ERDOLLAGERSTÄTTEN: GRUNDLAGEN DER PETROLEUMGEOLOGIE. *By* DR. E. BLUMER. *Pp. xv+*442. *Stuttgart: F. Enke*, 1922. *Price* 12*s*. 6*d*.

This book, by the well-known petroleum geologist Dr. E. Blumer, is the result of many years of experience, and represents the first attempt to summarise the known facts of the geology of petroleum in a way that will appeal to the expert as well as to the non-technical reader. The book, admirably printed and illustrated, is strikingly different from the usual scientific treatises in being written with a clarity and precision rivalling that of A. von Humbolt's "Cosmos." According to the author, petroleum is of purely oceanic origin, and is still being formed in enormous quantities, and attention is drawn to the deplorable waste which is now going on. The book will appeal to many who are not specially interested in geology, and it is not only valuable from the purely scientific point of view, but is also refreshingly original in these dull and prosaic times.

H. E. FIERZ

OUTLINES OF THEORETICAL CHEMISTRY. *By* DR. F. H. GETMAN. *Third edition. Pp. xi* +625. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.*, 1922. *Price* 18*s*. 6*d*.

The domain of physical chemistry is becoming so large that it is not easy for the writer of a text-book to cover the ground within a reasonable number of pages. Thanks to a concise and lucid style, Dr. Getman has succeeded in doing so without sacrifice of clarity or interest. All the usual branches of physical and electrochemistry are adequately treated, and in addition are included up-to-date chapters on colloids, the electrical theory of matter, radioactivity and atomic structure. The treatment of electromotive force and of photochemistry is especially good, and the periodic classification of the elements is dealt with in a short but illuminating chapter.

As stated in the preface, "with the exception of a few paragraphs in which the application of the calculus is unavoidable, no use is made of the higher mathematics"; where Dr. Getman has (most rightly) felt constrained to employ the calculus, the exposition is so clear that the mathematical facility required for its comprehension should be within the reach of every Honours student. A number of good numerical problems is appended to most of the chapters.

The elementary principles of thermodynamics including derivations of the Clapeyron-Clausius and Gibbs-Helmholtz equations, are dealt with in 19 pages, and here the reviewer feels that brevity has been overdone. Students almost invariably find it difficult to grasp the principles of thermodynamics, but easy to apply them once they are throughly understood, and a more ample discussion of the fundamentals of the subject would have been welcome.

A few misleading statements have been noticed. The statement that ". . . when the external work, resulting from a change in volume, is not included in the heat of reaction, the process is said to take place at constant volume" might be misunderstood. Hess's law of constant heat summation is stated and applied without qualification, whereas it is only valid for reactions taking place at constant volume or at constant pressure. In the statement of the phase rule, the term "independent variables" is applied to the components of a system; it more properly related to the degree of freedom. The velocity constant of a multimolecular reaction does not depend on the initial concentration, as implied; it is the time required for the completion of a given fractional change that varies in the manner stated.

The diagrams are clear and well chosen; the indexing, printing and general arrangement are good. The book is to be highly recommended, both for private reading and as a class text-book.

D. C. HENRY

COMPANY NEWS

THE UNITED PREMIER OIL AND CAKE CO., LTD.

At the annual meeting held on March 27, Mr. H. Guedalla, who presided, said that business prospects were improving, costs of production decreasing, and there was a good chance of regaining the export trade. During the past year the debenture stock had been reduced by £9,900, leaving £384,350 outstanding. The reserve fund stood at £54,508 after writing off a loss of £10,147 incurred in selling an investment in a margarine company, which had not been successful. It was decided to pay a dividend of 5 per cent., less income-tax, out of the net balance of £48,174, leaving £20,517 to be carried forward.

THE ELECTRO-BLEACH AND BY-PRODUCTS, LTD.

At the annual meeting held in Manchester on March 21, it was decided to pay dividends of 5½ per cent. (making 9 per cent. for the year) on the preference shares, and of 18 per cent. on the ordinary shares, absorbing a total of £29,000; £14,116 was transferred to reserve, and £1,244 carried forward. The total profit made in 1922 amounted to £51,281. The issued share capital of the company comprises £200,000 preference shares, and £100,000 ordinary shares.

THE UNITED GLASS-BOTTLE MANUFACTURERS, LTD.

After providing for depreciation, income-tax and debenture interest, the profit during 1922 was £37,867 (compared with a loss of £139,713 in 1921); including a credit of £29,077 the available balance was £66,944, the stock reserve £12,500, and the carry forward £54,444. Owing to the general conditions of the trade, the directors did not feel justified in recommending resumption of payments of dividends on preference shares at present.

THE UNITED ALKALI CO., LTD.

The accounts for the period January 1, 1921, to December 31, 1922, show a total net profit of £578,214. After transferring £30,000 to debenture redemption and £76,991 to reserve the sum of £156,695 is brought into the accounts and a dividend is to be paid of 2s. per share on the ordinary shares, less tax. Owing to a change in the methods of manufacture at the North American Chemical Co.'s works, part of the plant has been sold for £273,009, which has been carried to reserve. It is proposed to capitalise £300,000, part of the undivided surplus, and allot it to ordinary shareholders at the rate of one share for every two ordinary shares, thus reducing the carry-forward to £86,735. It is also proposed to increase the capital of the company to £4,500,000 by creating 900,000 new ordinary shares of £1 each, and to sub-divide the 300,000 preference shares of £10 each into 3,000,000 of £1 each.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Nauru Phosphates

Sir R. Sanders, replying to Mr. Blundell, said that experiments with phosphates from Nauru and Ocean Islands were in progress, but results of the trials were not yet available. During the 2½ years ended December 31 last, the import of phosphate from Nauru and Ocean Islands was about one-tenth of the amount to which the United Kingdom was entitled under its agreement with Australia and New Zealand.—(Apr. 16.)

Exports of Milk Powder

In reply to Mr. H. Simpson, Viscount Wolmer said that the export of milk powder of home manufacture in 1922 was 51 tons, valued at £5602; the re-exports of milk powder of foreign and colonial manufacture during the same period totalled 545·5 t. valued at £36,052.—(Apr. 17.)

Exports of Coke and Pig Iron

Answering Mr. J. Davison, Viscount Wolmer said that during, 1922 1,602,671 tons of coke (other than gas coke), 651,212 t. of pig iron and 142,704 t. of ferro-alloys were exported, compared with 902,666 t., 462,175 t., and 117,334 t., respectively, in 1920.—(Apr. 17.)

Replying to Mr. Hardie, Viscount Wolmer said that the export of metallurgical coke during the first quarter of 1923 was 489,237 t., an amount actually less than in the last quarter of 1922 by over 2000 t. per week.—(Apr. 18.)

Non-ferrous Metal Industry

In a written answer to Mr. Hancock, Lieut.-Col. Lane-Fox stated that the number of lead mines closed since the war was 52 and of tin mines 55, representing a loss of employment for 1000 and 3282 persons respectively.—(Apr. 17.)

Smoke Abatement

Mr. Chamberlain informed Sir W. Sugden that any possible assistance would be given to individual firms desiring to limit the output of black smoke. The local Council, however, was the smoke authority and to it application should be made.—(Apr. 18.)

Disinfectants

In a written answer, Mr. Chamberlain informed Mr. Becker that he had no evidence to show that disinfectants devoid of bactericidal action were being sold to the public, but he was aware that disinfectants differed considerably in their bactericidal power. He could not adopt the suggestion that disinfectants for sale should comply with a test. Advice as to choice of disinfectants for particular purposes could generally be obtained from local health offices.—(Apr. 18.)

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for April* 19)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia	Tinplate, steel, brass, copper plates	498
Belgium	Lead and copper ingots	505
Brazil	Tin, tinplate, linseed oil, soap, perfumery	526
British West Indies	Cement	499
Canada	Drug specialities, proprietary medicines	501
"	Cut glass	*
Colombia	Paint, varnish	527
Czecho-slovakia	Toilet soap	507
Denmark	Oilseed, linseed, cottonseed	508
"	Brass sheets	509
"	Pickled and close annealed sheets	7315/F.R./E.C./2
Egypt	Paper (tender)	**
Italy	Anhydrous sodium sulphate	510
"	Metals and alloys	512
Netherlands and Netherlands East Indies	Corrugated iron	517
New Zealand	Gas mantles, lighting glassware	503
Rumania	Copper sulphate (tender)	10486/F.E./C.C./2
Switzerland	Hardware and ironmongery	522
United States	Fertilisers, palm, palm kernel and coconut oils, copra	524
" "	Scientific apparatus	10891/E.D./C.C./2
" "	Cement	19237/F.W./M.C./2

* Canadian Government Trade Commissioner, 73, Basinghall Street, E.C.2.

** Sudan/Stores/Reg./39-2. Inspecting Engineer, Egyptian Government, Queen Anne's Chambers, S.W.1.

TARIFF CUSTOMS EXCISE

Bolivia.—Exports of silver have been made dutiable at rates to be fixed according to the price of silver on the London market.

Esthonia.—The exportation and transit of precious metals, etc. has been prohibited, except under a special permit.

Germany (*Occupied*).—The statistical tax will be levied on foreign goods imported into the Occupied Territories. The issue for April 19 gives information concerning the treatment of imported and exported samples.

Mexico.—The export tax on copper has been reimposed. On chilte an export duty of 50 cts. per 100 kg. (gross weight) has been imposed.

Poland.—The duty on sugar is increased from 60,000 to 150,000 Polish marks per 100 kg. net, and on petroleum from 50 to 150 Polish marks per kg. net. Exports of copper, nickel, cadmium, brass, German silver, Britannia metal and all other metal alloys in shavings, splinters and cuttings, have been prohibited, but the exportation of mineral, sperm and cylinder oil is permitted.

Portugal.—Further information regarding the new customs tariff is given in the issue for April 19.

Roumania.—In the April 19 issue a list is given, showing certain modifications in the import and export duties. The list includes cement and sulphate of iron.

Siam.—A law has been passed restricting the importation of habit-forming drugs.

REPORT

Report on the Economic and Financial Conditions in the British West Indies, June, 1922. *By* A. W. H. Hall, *Officer-in-Charge, H.M. Trade Commissioner's Office, Trinidad. Department of Overseas Trade. Pp.* 32. *H.M. Stationery Office,* 1922. *Price* 1s. 0*d.*

In most of the West Indian colonies sugar is by far the most important industry, and duties on sugar and its products provide a large proportion of the revenues, but the future of the industry is uncertain and, especially in Jamaica and British Guiana, unless a bigger demand arises within the British Empire, production will fall (*cf.* J., 1922, 266 r). The prospects of cocoa planters are not considered hopeful, and though Trinidad, the chief producer, exported 432,674 cwt. during the period January-June, 1921, the following crop was disappointing and only 300,219 cwt. was exported in the same period of 1922. The output of petroleum in Trinidad in 1921, 82,395,595 galls., surpassed the previous record, 72,905,907 galls., in 1920. There are now 607 oil wells in Trinidad (*cf.* J., 1922, 402 r). It has been proposed to cater for the large cement trade by the erection of a factory in Jamaica and possibly also one in Trinidad (*cf. Chem. and Ind.*, 1923, 20).

The total value of imports into Jamaica in 1921 was £5,473,790 (of which the United Kingdom supplied 29·3 and the United States 54·6 per cent.), compared with £10,313,282 in 1920 (U.K. 29·7%, U.S. 58·6%). Detailed statistics are not given, but in 1920 the imports were very varied. Exports (not valued) included sugar, 28,729 tons; rum, 958,758 gallons; copra, 1,570,262 lbs.; logwood, 4,512 t.; logwood extract, 6,951 packages (*cf.* J. 1922, 132 R).

In 1921, Trinidad imported goods to the value of £6,905,694 (U.K. 25·0, U.S. 35·6%), compared with £8,376,912 in 1920 (U.K. 26·5, U.S. 41·5%), including:—Cement, £67,933; chemicals, £22,292; manures, £43,034; coal, £199,149; glass, china, etc., £45,879; paints and colours, £22,838; soap, £75,173. Exports included sugar, 46,695 t.; rum, 162,423 galls.; copra, 4,163,103 lbs.; petroleum, 39,315,828 galls.; asphalt, 93,318 t.

Imports into Barbadoes totalled £2,642,273 in 1921 (U.K. 35·9, U.S. 22·2, Canada 22·5%), against £5,145,537 in 1920 (U.K. 30·3, U.S. 35·7%). The chief export was sugar, 26,344 t.

British Guiana imported in 1921 goods valued at £3,239,471 (U.K. 46·4, U.S. 25·1%), against £4,722,709 in 1920 (U.K. 41·3, U.S. 33·3%). Exports consisted chiefly of sugar, 108,270 t., and rum, 2,228,164 galls.

These figures show that British trade is not unsatisfactory in the West Indies; apart from the preferential rates of duty which operate in favour of goods from the United Kingdom and Canada there is a genuine desire to obtain British articles where possible. Although competition with the United States must in some lines be regarded as almost hopeless, it would be possible with some little effort to capture others from American merchants, *e.g.*, soaps, boot and other polishes, and painters' colours and materials, including turpentine substitutes.

THE SUGAR BEET INDUSTRY

At the eighth annual meeting of the British Sugar Beet Growers' Society, Ltd., the chairman, Mr. G. H. Roberts, reviewed the sugar market, and said that it was doubtful if the duty on sugar was reduced whether the consumer in this country would get any advantage as American speculators might be able to force up the price. In presenting the Mason Cup for sugar-beet growing to Mr. T. Hardy, of Peterborough, for a yield of 18 tons 6 cwt. per acre with an average sugar content of 15·4 per cent., Mr. Roberts said that these figures did not indicate the average yield for the whole sugar-producing area; the average of the Kelham and Cantley companies, for instance, varied from 8 to 11 tons per acre. At the luncheon Sir F. Floud described the steps which led to the building of the Kelham beet sugar factory, and said that the movement deserved support because it was of such great assistance in helping to maintain the arable area of this country. The Ministry anticipated a great increase in beet growing, and beet could be grown equal in quality to any in the world.

MARKET REPORT

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The market for heavy chemicals continues good, and in many cases where there is evidence of short supply there is a tendency for prices to harden. Stock Exchange quotations are the soundest indicators of the trade position, and as such they point to a continuation of the recent improvement in chemicals generally.

Acid Acetic 40% tech.	£23-£25 per ton. No change in position.
Acid Hydrochloric	4s.-5s. per carboy d/d.
Acid Nitric	£24 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid, 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Still in good demand.
Alumina, Sulphate of	It is reported that British makers' prices are now competing with those ex the Continent, and trade is, therefore, better.
Arsenic (White)	£70-£75 per ton. Not much trade passing.
Bisulphite of Lime	£7 per ton. Packages extra.
Bleaching Powder	£10 10s. per ton d/d. In slightly better request.
Calcium Chloride	£6 per ton d/d.
Copper Sulphate	£27 per ton. Somewhat firmer.
Potash Caustic	£35 per ton. Position still firm, with limited supply.
Potassium Bichromate	5¾d.-6d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.-£5 per ton. Considerably firmer, with no very large quantity on offer.
Soda Caustic, 76%	£20-£21 per ton. Continues in good demand.
Sod. Acetate, 97/98%	£26 per ton.
Sod. Bicarbonate	£10 10s. per ton.
Soda Crystals	£5 10s. per ton. No change.
Sod. Bisulphite Powder, 60/62%	£19-£20 10s. per ton, according to quantity.
Sod. Chlorate	3d. per lb. Small inquiry.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, conc.	£16 per ton, carr. paid. A considerably better market.
Sod. Sulphite, Pea Cryst.	£17-£17 10s. per ton, according to quantity.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£26-£28 per ton, according to quantity.

Carbon black	1s. 5½d. per lb. ex wharf. Supplies very scarce—production in U.S.A. falls very short of demand.
Chromium Oxide	1s. 5d. per lb.
India Rubber substitutes, white and dark	5½d.-6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£10 15s. per ton d/d.
Grey	£20 5s. per ton d/d.
Liquor	9d. per gall., 32° Tw.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall., 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 10s. per ton d/d.
Brown Sugar of Lead	£40 per ton d/d.

The prices of wood distillation products have advanced slightly, and a fairly good demand has been maintained.

TAR PRODUCTS

Acid Carbolic, Crystals	1s. 6d. per lb. Makers fully sold for prompt delivery. Slightly lower prices are quoted for forward delivery.
crude 60's	3s. 6d.-3s. 9d. per gall. Not much enquiry.
Acid Cresylic, 97/99	2s. 2d.-2s. 5d. per gall. Good demand.
Pale 95%	2s.-2s. 4d. per gall Market firm.
Dark	1s. 10d.-2s. 0½d. per gall. Market firm.
Anthracene Paste, 40%	4d. per unit per cwt. Price nominal. No business.
Anthracene Oil—	
Strained	9½d.-11d. per gall. Numerous enquiries.
Unstrained	9d. gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8½d. per gall.
Pure	2s.-2s. 2d. per gall.
Toluole—90%	1s. 9d.-2s. per gall.
Pure	2s. 2d.-2s. 6d. per gall.
Xylol	2s. 9d.-3s. 3d. per gall.
Creosote—	
Cresylic 20/24%	11d.-1s. 1d. per gall. Not much inquiry.
Middle Oil	8¾d.-10¼d. per gall. Market fairly steady.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d.-9¼d. per gall.
Solvent 90/160	1s. 7d.-1s. 9d. per gall. Fair business doing.
Solvent 90/190	1s. 6½d.-1s. 8d. per gall.
Naphthalene, Crude—	
Drained Creosote Salts	£7-£9 per ton. More inquiry.
Whizzed or hot pressed	£11-£14 per ton. Market firm and active.
Naphthalene, Crystals	£17 10s. per ton.
Naphthalene, Flaked	£16 10s. per ton.
Pitch, Medium Soft	180s.-200s. per ton. Price nominal. Little inquiry for this season.
Pyridine—90/140	11s.-12s. 6d. per gall.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

There is very little change in the position with regard to Aniline Dyestuffs during the present week. Orders have been just a little freer and there is a tendency on the part of consumers to look a little further ahead and buy in rather larger quantities than they have done in the past. Buyers seem to have regained some of the confidence in trade generally as there seems to be more tendency to inquire for contracts for forward delivery than there has been for some time.

There is no tendency whatever for prices to be reduced; in fact, prices are very firm, with an upward tendency in one or two specialities.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhydrous	1s. per lb. d/d.
Aniline Oil and Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlor Phenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	Fair demand with advanced prices in sympathy with Carbolic prices.
m-Cresol 98/100%	2s. 3d. per lb. Fair demand.
p-Cresol 32/34° C.	2s. 3d. per lb. Fair demand.
p-Dichlor Benzol	£70 per ton.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene—	
48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d. Packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
α-Naphthol	2s 9d. per lb.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d.-8d. per lb.
Nitronaphthalene	1s. per lb. d/d.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s 6d. lb. 100% basis d/d.

R Salt	3s. 3d. per lb. 100% basis d/d.
Sod. Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid Acetic 80%	£52 10s. per ton.
Acid Acetyl Salicylic	3s. 2d.-3s. 6d. per lb. Best makes advanced and strongly held.
Acid Benzoic	2s. 3d. per lb. Remains steady.
Acid Citric	1s. 8½d.-1s. 9d. per lb., less 5% for ton lots. Dearer. Demand good and improving. Higher prices probable.
Acid Gallic	3s. per lb. for 2-cwt. lots, 3s. 3d. per lb. for 56lb. lots.
Acid Pyrogallic, cryst.	5s. 9d. per lb.
Acid Salicylic	2s. 2d.-2s. 6d. per lb. Any increase in demand would, it is thought, result in higher prices being quoted.
Acid Tannic	3s. 3d. per lb.
Acid Tartaric	1s. 4d. per lb., less 5%. In addition to the increased demand for the home trade, there is much enquiry from the Continent and the U.S.A. consequent upon the failure of supplies from Germany. Italian manufacturers are understood to be booked up with orders well ahead, having sold largely in the U.S.A., so that supplies from that market in appreciable quantities are not to be looked for here. Raw materials continue to advance, so that a further rise in the price of Acid is anticipated.
Amidol	9s. per lb.
Acetanilide	1s. 8d. per lb. Much firmer. Spot supplies much smaller.
Amidopyrin	13s. 6d. per lb. Still little demand at this figure.
Ammon. Benzoate	3s. 9d. per lb.
Ammon. Carbonate B.P.	£37 10s. per ton.
Barbitone	18s. per lb. Firmly held at this figure.
Benzaldehyde	3s. per lb.
Bismuth Salts	Unchanged.
Bromides	Still very firm. Ammon. 10d. per lb., Potass. 8d. per lb., Sod. 9d. per lb.
Calcium Lactate	2s. 9d. per lb.
Chloral Hydrate	4s. per lb. Unchanged.
Hexamine	4s. 6d. per lb. with higher prices looked for in the near future.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots.
Magnesium Carbonate, Light Commercial	£38 per ton.
Magnesium Oxide, Light Commercial	£85 per ton.
Menthol	31s. per lb. original cases. Smaller quantities 32s. per lb. nett.
Methyl Salicylate	2s. 8d. per lb. for carboys is the advanced rate.
Methyl Sulphonal	14s. 6d. per lb., showing no change in value.
Mercurials	Market somewhat easier owing to drop in price of mercury.
Paraldehyde	1s. 7d. per lb. Stocks more firmly held at this price.
Phenacetin	6s. 6d. per lb. Without prospect of immediate reduction.
Phenazone	7s. 6d. per lb. still wanted.
Phenolphthalein	5s. 6d. per lb. Firmer.
Potass. Bitartrate—99/100% (Cream of Tartar)	95s.-98s. per cwt. Dearer, but price has not advanced in correspondence with that of the raw material.
Potass. Iodide	15s. 8d. per lb. in cwt. lots. Good steady demand.
Potass. Permanganate	10½d.-11d. per lb. No supplies are now available under this quotation.
Potass. Sulphoguaiacolate	5s. per lb. quoted, being a low value.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. Steady demand.
Resorcin	5s. 9d. per lb. Slightly firmer.
Salol	2s. 9d. per lb. Some holders want 3s. per lb.
Saccharin	Slightly better demand.
Sod. Benzoate	2s. 3d. per lb. No alteration has been made, though an advance in price is expected.
Sod. Citrate	U.S.P. quality 2s. 2d. per lb. for cwt. lots. Rather quiet.
Sod. Hyposulphite—Photographic	£15-£17 per ton.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d. per cwt. Poor demand.
Sod. Salicylate	Advanced for best makes to 2s. 9d. for Powder, 2s. 11d. per lb. for Crystal. Lower prices from 2s. 4d.-2s. 6d. per lb. quoted in some quarters.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. per ton f.o.r., London, 1-cwt. wooden kegs included.
Sulphonal	14s. per lb.
Tartar, Emetic	1s. 4d. per lb.
Thymol	18s. per lb. for good White Crystal still quoted, though a lower price would probably be accepted for a large quantity.

Prices for all pharmaceutical chemicals are well maintained and the general position is much steadier in view of slightly increased demand both for home and export consumption.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil, Red Ship Brand	2s. 1d. per lb.
Bergamot Oil	12s. 6d. spot, 13s. 6d. forward.
Cananga Oil, Java	9s. per lb.
Cassia Oil 80/85%	8s. 3d. per lb.
Cinnamon Oil, Leaf	4¼d. per oz.
Citronella Oil—	
Java 85/90%	4s. 3d. per lb.
Ceylon	3s. 3d. per lb.
Clove Oil	8s.-8s. 6d. per lb.
Eucalyptus Oil 70/75%	1s. 9d. per lb.
Lavender Oil, Mont Blanc, 38/40%	13s. per lb.
Lemon Oil, Spot	3s. 1d. per lb. Higher prices are asked for forward delivery.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet, Spot	11s. 6d. per lb.
Otto of Rose Oil—	
Anatolian	24s. per oz.
Bulgarian	30s. per oz.
Palma Rosa Oil	17s. per lb.
Peppermint Oil—	
English, Mitcham	80s. per lb.
Wayne County	13s. per lb.
Japanese	6s. 3d. per lb.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	2s. 6d. ,, ,,
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (melting point 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate	3s. ,, ,,
Cinnamic Aldehyde—	
98/100% Natural	14s. 9d. ,, ,,
Coumarin	15s. 6d. ,, ,,
Citronellol	22s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	18s. 6d. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palma Rosa)	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	7s. 6d. per lb.
Iso Eugenol	16s. 6d. per lb.
Linalol, ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	22s. 6d. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Ketone	35s. ,, ,,
Musk Xylol	9s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	24s. per lb. Better demand.

TRADE NOTES

German Chemical Trade in 1922

The following table gives particulars of exports from Germany in 1922 of a few important chemical products:—

	Metric tons				
Destination	Coal-tar dyes	bronze colours	Lithopone	Ammonium nitrate	Potassium nitrate
Great Britain	468	124	—	2,677	3,584
Belgium	143	50	655	685	—
Denmark	175	—	—	—	—
Italy	1,339	69	494	—	1,189
Netherlands	1,010	34	918	689	349
Austria	1,195	—	831	1,029	256
Czechoslovakia	3,035	—	—	765	—
Sweden	625	—	—	313	—
Switzerland	504	—	—	—	159
Spain	950	—	—	—	579
British India	2,608	—	—	—	—
China	8,924	—	—	—	—
Japan	3,798	—	—	—	955
United States	206	469	3,244	9,036	—
Total to all countries	36,011	1,162	11,043	19,892	12,117
Value in millions of paper marks	26,173	1,075	1,280	4,260	1,290

In 1913, 64,288 t. of coal tar dyestuffs, valued at 164 millions of gold marks, was exported, 1016 t. going to Great Britain and 13,855 t. to the United States; this shows how much the demands in these markets have fallen. Before the war Great Britain and France were large buyers of lithopone, but here again the demand has fallen off. Potassium nitrate was exported in 1913 to the extent of 16,058 t., valued at 6,985,000 gold marks. Great Britain then, as now, was the largest buyer, taking 7516 t.

Prices of Chemicals in Germany, 1922

The following table shows how the index figure representing chemical prices changed in the last quarter of 1922, and offers a comparison with those for industrial materials, wholesale trade prices, and the value of the dollar. Each figure shows the ratio of the price in point to the corresponding price in 1913.

Month	Chemicals	Industrial materials	Wholesale trade	Dollar
October	531·7	569·4	566·0	757·7
November	1167·9	1307·8	1151·0	1711·1
December	1893·9	2060·7	1474·8	1807·8

German Potash Industry

Sales of German potash were estimated in 1922 to about 1,300,000 tons of pure potash (K_2O), a record figure, that for 1921 being 900,000 t. In December prices were increased by about 58 per cent. and this, together with enormously increased costs of transport, caused a diminution in home sales during January and February.

The Russian Chemical Industry, 1922

The following particulars are given in a recently published Soviet report on the chemical industry, relating to 12 out of a total of 17 factories:—

	1922	
	July	August
Average number of workers	3,576	3,663
Working days performed (1000's)	81·5	1,059
Working days missed (1000's)	28·0	6·1
Production of important commodities:—	Tons	
Sulphuric acid	1,378	1,231
Hydrochloric acid, commercial	798	643
Saltcake	576	514
Bisulphate	212	235
Soda ash	—	1,446
Caustic soda	—	603

Chemical Trade of the United States in 1922

Only three groups of exports from the United States showed increases in 1922. "Chemicals and Allied Products" was one group, and although the gain was but 1·4 per cent. this must be contrasted with decreases ranging from 8 to 31 per cent. for other groups. Chemical products constitute one of the smaller groups of the United States' exports, their value being only 2·8 per cent. of the total for 1922. Under chemical products, however, are included dyestuffs—a new industry—and paints and varnishes, an industry which has faced abnormal conditions for some time. The value of the total exports of chemicals was $106,101,562, compared with $104,639,941 in 1921, the increase being due to gains of 50 per cent. made by explosives, 33 per cent. made by perfumery, etc., 11 per cent. by medicinal and pharmaceutical preparations, and 3 per cent. by fertilisers. Exports of pigments, paint and varnish made a good recovery from the stagnation prevailing early in the year, the total being only 5 per cent. less than in 1921, but exports of general chemicals were 4 per cent. below the level of 1921. Statistics of the exports of chemicals in 1921 and 1922 are given below:—

	1921		1922	
	lb.	$	lb.	$
Copper sulphate	3,582,933	217,491	5,250,556	256,432
Acetate of lime	18,239,740	404,528	27,596,106	591,599
Bleaching powder	18,447,579	483,752	41,069,188	679,775
Glycerin	2,394,714	361,507	2,870,463	425,891
Potassium chlorate	375,401	49,709	562,986	51,066
Sodium silicate	20,789,095	247,761	29,131,925	302,511
Sal soda	10,354,513	204,616	11,463,418	186,284
Sodium bicarbonate	11,703,183	307,138	15,853,945	341,385
Caustic soda	49,865,219	2,041,236	146,739,406	5,271,528
Calcium carbide	11,808,252	606,999	12,835,916	633,297
Soda ash	35,042,791	850,369	29,627,574	678,983
Formaldehyde	(1)	349,089	1,940,577	209,386
Ammonia and ammonium compounds (other than ammonium sulphate)	(1)	(1)	7,247,480	990,111
Aluminum sulphate	(1)	(1)	26,450,857	388,447
Acetic acid	(1)	(1)	5,080,519	367,717
Boric acid	(1)	(1)	1,968,996	197,265
Borax	4,061,633	269,771	17,242,571	867,417
Sulphuric acid	12,814,344	317,720	12,470,389	201,267
Medicinal and pharmaceutical preparations	—	12,724,430	—	14,193,065
Crude drugs, essential oils, dyeing and tanning materials	—	5,888,577	—	6,451,422
Peppermint oils	—	—	128,606	298,743
Essential oils	—	—	—	585,072
Logwood extract	—	589,756	—	448,713
Dye extracts	—	1,203,155	—	459,861
Explosives	10,433,830	2,285,849	19,212,449	3.400,391
Dynamite	9,567,442	1,815,999	14,105,017	2,406,398
Mineral earth pigments	—	—	27,631,228	981,905
Lithopone	—	—	3,231,722	169,982
Enamel paints	—	—	1,501,520	418,521
Red lead and litharge	1.095,173	115,500	3,366,375	294,133
White lead	10,321,415	993,130	9,196,656	710,765
Paints, stains, etc.	—	6.490,414	—	4,908,013
Linseed oil	3,512,228	406,460	2,702,634	332,781
	Gallons		Gallons	
Varnish	—	—	775,095	1,271,088
	Tons.		Tons.	
Phosphate rock	182,594	2,592,541	202,300	2,548,587
Land pebble phosphate	544,425	4,627,875	512,777	3,269,179
Other phosphate rock	6,293	99,721	4,217	40,401
Superphosphates (acid phosphate)	4,278	96,303	24,373	360,402
Ammonium sulphate	102,614	6,098,406	147,331	8,736,611
Calcium cyanamide	—	—	2,556	26,112
Nitrogenous materials	—	—	1,576	78,047
Prepared fertiliser mixtures	—	—	14,416	690,972
Bone phosphates	—	—	273	15,095
Other fertilisers	—	—	25,189	882,966

The total value of rubber exports was $33,450,832, a gain of $3,242,877. Coal exports declined from 2,652,827 tons valued at $12,257,038 in 1921 to 11,083,112 tons valued at $65,891,740 in 1922; but exports of coke increased from 273,888 tons ($2,760,939) to 456,733 tons ($43,195,383).—(*U.S. Comm. Rep., Feb.* 12, 1923.)

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EDITORIAL

THE Swiss Legation asks us to notice Mr. R. Hofmann's book, *Interdépendance*, published by Librairie G. Oudin, Paris, price 9 francs. Although not dealing particularly with chemistry, the subject of his book, how to achieve a prosperous Europe, is of considerable consequence to the inhabitants of this country, whether chemists or not. The book is pleasantly written, and the majority of the arguments are unanswerable. Mr. Hofmann shows very clearly how dependent all the countries of Europe are on each other, and how duties, reparations and restrictions of all kinds interfere with that easy flow of trade which is necessary to the well-being of Europe. The book appears at a time when the French occupation of the Ruhr has introduced a formidable complication, and there is no doubt that this occupation is the prime obstacle at the moment to international progress. If all the nations of Europe made the prosperity of the Continent their prime interest, Mr. Hofmann's solution would be very satisfactory. It seems to us that the British, the Swiss and the Scandinavians all wish to see Europe prosperous so soon as possible, but is this statement true of Europe generally ? Do the Russians wish for a prosperous Russia or a prosperous Europe ? Do the Turks and the Greeks let the prosperity of these countries play a very important part in their plans ? Does France wish to see Germany as prosperous as she was before the war, and, if so, when ? Do the Germans desire a prosperous France ? Who can give an answer to these questions ? Whether the French should trust their future to the benevolence of Germany is a problem which is very easy to state and to which it is very easy for everyone of us to hazard an answer. Probably the less we know of the facts, the more certain we shall be that our opinion is right, but these difficulties stand in the way of the adoption of any scheme which depends on mutual good will, mutual trade and the removal of the barriers which cross Europe in all directions. A correspondent who has just returned from the occupied zone in Germany tells us that the greater number of factories have ceased to work, having no outlet for their goods beyond the demand of the local population. It is the opinion of the German industrialists that the occupation by the French will continue for a long period, and active steps are being taken to transfer their works to other areas, amongst others to the Magdeburg district, where brown coal is available. More than one chemical factory, in addition to Krupps, is stated to be making this move ; it is significant of past prosperity as well as of present enterprise that the losses involved in such a transfer can be faced with equanimity. We commend Mr. Hofmann's book as a careful and moderate statement of the economic conditions necessary for the encouragement of international trade. Few people in this country will dispute them, but the process of the restoration of international trade in this disturbed continent will be slow, and not until Germany and France can come to a reasonable understanding will it be possible to translate Mr. Hofmann's doctrines into actual practice. It may be that France has too much at stake to find any advice useful at the moment, and it is not clear yet that Germany is imbued with such a feeling of kindliness and good will to all her late enemies that she cares, at present, to face the situation in a way which is essential for the benefit of Europe.

* * *

In our columns of to-day there appears an advertisement announcing that the Government have decided to dispose of their interests in the series of patents taken out during the war period for processes and inventions worked out by members of the staff of the Research Laboratory of the Nitrogen Products Committee. Some of these were originally secret patents, but we believe that all have now been published. It is understood that the list in question includes about 25 separate inventions for which completed patents have been granted in Great Britain, and that for the same subject matter, a very considerable number of foreign and colonial patents have either been granted or are on the way, but are not yet completed.

The inventions fall into four main groups, the first being those relating to the synthesis of ammonia as worked out mainly by the late Dr. Harold Greenwood. Among these may be mentioned the basic patent whereby by use of high circulation velocity, very large yields of ammonia could be obtained from a given quantity of catalyst, and the output of a given apparatus could be increased very much beyond that obtained in the original German process. A second relates to a cyclic method of removal of ammonia from the circulating gases, and a third to the type of catalyst bomb evolved ultimately from which the large yields previously mentioned were obtained.

The second group relates to the oxidation of ammonia and the manufacture of nitric acid and nitrates, and embodies several interesting new processes, some of which have been tried out on a semi-technical scale. Among these may be mentioned a process for the production of nitrates free from nitrites, by the direct absorption in alkalis of oxides of nitrogen; also a method for the direct synthesis of solid ammonium nitrate free from nitrite by bringing together gaseous ammonia, nitrogen peroxide, steam and oxygen. A third invention of this group is a process for the oxidation of ammonia by means of enriched air, or oxygen, in which the danger of explosion is obviated by using steam as a diluent to take the place of nitrogen. This steam is removed in a simple manner, and by this method a very high efficiency may be reached, using a very small tower system, and the by-product oxygen of a nitrogen fixation factory, may be satisfactorily utilised. In the third group, comprising inventions dealing with the preparation and purification of hydrogen and other gases, may be mentioned a promising catalytic method for sulphur removal, and also a process for the purification of hydrogen from carbon monoxide, by which this latter gas may be reduced in two-stage working to the very small concentration necessary in the manufacture of synthetic ammonia. The miscellaneous section includes two different forms of detector for indicating the presence of water vapour or either of its gaseous constituents in gaseous mixtures, and also an improved method for the production of nitric oxide by the Häusser bomb explosion process. We understand that when the Government factory at Billingham-on-Tees was sold to Messrs. Brunner Mond and Co., this company obtained a non-exclusive licence to use all these patents and that now the Government are desirous of disposing of their rights subject to this licence.

REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY

Every year it becomes more and more difficult for the scientific worker to keep abreast of the increasingly large output of scientific literature and, through lack of opportunity, he has, only too often, to neglect subjects with which he is not especially concerned. Such forced neglect is all the more unfortunate in that it means a loss of the valuable stimulus derived from the consideration of problems which, although belonging to some other branch of technology, yet may contain the germ of a philosophical principle of general applicability. The JOURNAL of the Society of Chemical Industry, with its ample index, certainly provides a complete and concise directory to current technical chemical literature, but the worker who desires to obtain a general idea of progress in some branch other than his own, can do so only at the expense of much time and labour. It was for this reason that the Society of Chemical Industry, recognising the need for some general guide to the literature of chemical technology, undertook to issue the Annual Reports of the Progress of Applied Chemistry, the seventh volume of which, covering the year 1922, is now being published.

This volume, edited, like the previous ones, by Mr. T. F. Burton, B.Sc., contains 24 articles covering the whole range of applied chemistry, each article being written by an expert, who provides a critical review of the year's literature relating to his own subject and indicates, not only what progress has been made, but often the lines on which progress is desirable. Such a unique conspectus of the various activities in applied chemistry is certainly primarily of interest to the technician, but the volume will prove of value to engineers desirous of obtaining information about chemical plant and constructional materials, to biologists who require information on vitamins, enzymes, and the recognition of plant products, to industrialists wishing to ascertain the position of various industries, and to many others; and it should certainly be read by all those who are interested in the progress of the chemical industry, an industry whose well-being is so intimately associated with our national prosperity.

Although no startling discoveries may have been made during the past year, yet a perusal of the whole volume leaves a gratifying impression of the sound and steady development throughout chemical industry. Space is not available for more than a rapid consideration of the reports, but it may be of interest to indicate a few of the topics of more general interest.

In the section on "Plant and Machinery," Mr. W. H. Coleman discusses the all-important process of heating and cooling and draws attention to the remarkable development in machinery for extremely fine grinding, a subject which is also referred to in the sections on paints and pigments, cellulose, sugars, and fertilisers.

Corrosion, treated by Mr. Coleman, finds mention on many other pages, and the presentation of the different aspects of this crucial problem of to-day will be found of much interest. A valuable feature of the Reports is that subjects are often discussed from different view-points by different authors, and this is exemplified in the chapter on "Fuel," by Prof. J. W. Cobb and Mr. H. J. Hodsman, the subject of the utilisation of fuel being treated to some extent in many other sections. Smoke abatement receives due attention, and householders will no doubt benefit from the information on the efficiency of domestic heating appliances and from the accusation that our smoke nuisance is essentially of domestic origin. With the cause, the remedy—low-temperature carbonisation and smokeless fuels—is also presented. Coal receives further consideration in the section on "Gas—Destructive Distillation," in which Dr. G. Weyman shows the importance of the "combustibility" of fuel and relates recent work concerning this aspect of the fuel problem. The much-debated questions connected with the supply of town gas are discussed and some space is devoted to peat, the utilisation of which still presents so many fascinating problems. The petroleum industry is dealt with by Mr. J. E. Hackford, the section including notes on the origin, nomenclature, and treatment of petroleum and on the progress made in the evolution of substitute motor fuels.

In view of the importance attaching to the establishment of the dyestuffs industry in this country, the account of "Colouring Matters and Dyes," by Mr. E. A. Bearder, possesses particular interest, especially as dyes are finding new applications as photographic sensitisers and desensitisers and even seem likely to attain importance as bactericidal agents; dyes are discussed from this point of view in the sections on photography and sanitation. "Fibres, Textiles, Cellulose and Paper," by Mr. F. L. Barrett, is a section that shows how much more general the application of science to industrial problems is becoming. Many methods of testing fibres find mention, as well as improved methods of treating yarns and fabrics, and the problems of the constitution and properties of cellulose and its products receive full discussion. Under the heading "Wood" an account is given of recent work on the chemistry of the lignins, and of various methods of producing wood pulp, and "Paper" includes subjects such as raw materials, sizing, etc. The section on "Bleaching, Dyeing, Printing and Finishing," by Mr. W. Harrison, M.Sc., contains an interesting account of the various aspects of mercerisation, but many will no doubt turn to the description of processes for dyeing cellulose acetate silk, a problem now apparently solved.

"Acids, Alkalis, Salts" are dealt with by Mr. H. J. Bailey, who provides a valuable summary of the present position of the industrial fixation of nitrogen, discussing each process separately. In this, as in other sections, the Safeguarding of Industries Act, the industrial treatment of fumes and dusty gases are considered, and attention is drawn to Prof. J. W. Hinchley's important paper on "Evaporation."

Dr. M. W. Travers, in the section on "Glass," notes that the output of scientific work from the Department of Glass Technology in the University of Sheffield does not diminish; indeed, as in other years, the bulk of the work on questions such as durability, appears to be done in this country. In "Ceramics and Building Materials," Mr. W. Emery records progress in the investigation of the nature of the clay molecule and describes various improvements in firing technique and in kilns; refractories and building materials also come under this section.

The effect of the industrial depression and the consequent need for economical working is well illustrated in Prof. C. O. Bannister's account of "Iron and Steel," a heading which naturally includes the subject of corrosion. The section on "Non-Ferrous Metals," by Dr. C. A. Edwards and H. I. Coe, illustrates the ever-increasing importance of froth flotation and of electrometallurgical methods of treatment. Of particular interest in the portion on "Alloys" is the description of alloys of aluminium. Recent advances in the "Electro-chemical and Electrometallurgical Industries" are recorded by Dr. J. N. Pring, whose account of the electrothermal treatment of various ores, steel alloys, etc., is of considerable interest.

A valuable review of the vegetable-oil industry is provided in the chapter on "Oils, Fats and Waxes," by Mr. John Allan, who treats of subjects ranging from the synthesis of fatty acids and the reactions involved in the drying of oils, to the properties of marine-animal oils and hardened fats. Drying oils are also included in the section on "Paints, Pigments, Varnishes and Resins," by Dr. R. S. Morrell, who discusses the theory of catalysis from the standpoint of the mechanism of the drying of vegetable oils and describes recent work on the constitution of the resins. The pages devoted to paints and varnishes further illustrate the growing application of science to industry.

As might be expected, Mr. B. D. W. Luff, in the section on "India-rubber," directs attention to the situation of the rubber growers and writes at length of the industrial possibilities of the latest development of the industry, viz., the use of rubber latex in making paper, adhesives, etc.; accelerators, rubber analysis and testing are also dealt with. In the section on "Leather and Glue," Mr. D. Woodroffe comments on the depressed state of the leather industry and records recent developments in leather machinery and the progress made in the scientific control of soaking, liming, and bating processes, due reference being made to the interesting results obtained by Dr. Pickard and his co-workers; the vexed question of the analysis of tanning materials is reviewed. The importance of fine-grinding, referred to by many other contributors, is brought forward by Mr. H. J. Page, who, in "Soils and Fertilisers," discusses the effect of finely grinding phosphatic fertilisers on their availability to the plant. Those interested in nitrogen fixation will find, in this section, a discussion of the subject from the agricultural point of view, and an account is also given of progress in preparing artificial organic manure from straw and in the agricultural utilisation of activated sludge.

Mr. J. P. Ogilvie, in "Sugars, Starches and Gums," points out the importance in sugar manufacture of eliminating colloidal matter in the sugar juice and discusses the various filtration devices suggested for attaining this end. The beet-sugar industry, so new to this country, is considered at length, and an account is given of the technical applications of decolorising carbons. The general economic depression is again met in the "Fermentation Industries," dealt with by Mr. H. Lloyd Hind, whose contribution contains interesting accounts of advances in brewery practice, and a full discussion of various enzymes, yeast, vitamins, and of cellulose fermentation. The section on "Foods," by Dr. G. W. Monier-Williams, is dominated to some extent by the recent work on vitamins and on food-poisoning due to canned foods, and under "Sanitation and Water Purification," Dr. H. T. Calvert deals at length with the activated sludge process of sewage treatment and its modification, the bio-flocculation process, as well as with the disposal of various forms of solid town's refuse.

The chief advance recorded by Dr. H. King, in the section on "Fine Chemicals, Medicinal Substances and Essential Oils," is the preparation of a pancreatic extract containing the hormone "insulin," but reference is also made to valuable researches on the constitution of the alkaloids and of the sesquiterpene group, which lies between the perfume-bearing terpenes and the polyterpenes, exemplified by rubber and cholesterol. Of interest is the suggestion to use acetylene as an anæsthetic, and dyes are discussed in the light of their bactericidal action.

The phenomenal expansion of kinematography is discussed in "Photography," by Mr. R. E. Crowther, who describes developments in the use of sensitisers and desensitisers, and work on the theory of development, and concludes by pointing out that when photographic products can be produced with the regularity and certainty that characterise other chemical industries enormous expansion in the application of photography may be safely prophesied.

From this rapid review of the reports some idea may be gained of their wide scope, and it is to be hoped that all those who have realised their utility will assist in "broadcasting" their value so that they may be utilised to the fullest extent, and justify the labour expended in preparing them.

THE EXISTENCE OF AMMONIUM HYDROXIDE IN SOLUTION

By PROFESSOR R. M. CAVEN

Professor T. S. Moore, in an article on "The Existence of Ammonium Hydroxide in Solution" (*Chemistry and Industry*, 1923, p. 343) criticises some conclusions of mine in a paper on "The Basic Strength of Ammonia and Allied Bases" (*Chemistry and Industry*, 1923, p. 164). I wish to reply to his criticisms.

1. With regard to the relation between the di-hydrated double salts of the type $CuSO_4$, M_2SO_4, $2H_2O$. Since the cæsium double salt, when heated freely in the air is shown to lose water sensibly at a lower temperature than the other alkali double salts (Caven and Ferguson, *Chem. Soc. Trans.*, 1922, **121**, 1407), Professor Moore assumes that its vapour pressure, measured when it is in equilibrium with the anhydrous salt, will be greater than that of the other salts under similar conditions. This by no means follows, as is shown by experiments by Mr. Ferguson and myself recorded in the same place. Thus when the two salts $CuSO_4$, $(NH_4)_2$,SO_4, $6H_2O$ and $CuSO_4$, Rb_2SO_4, $6H_2O$ were compared it was found that whilst the former salt rapidly lost water at 42°, the latter could be heated to 55° before perceptible loss began, although the vapour pressure curve of the rubidium salt was found to lie above that of the ammonium salt throughout its whole length. So the rubidium double salt possesses a greater power of resistance to thermal dissociation than the corresponding ammonium salt, and dehydration in is consequence delayed. Therefore no conclusion regarding vapour pressure can be drawn from the exceptionally low temperature at which the salt $CuSO_4$, Cs_2SO_4, $2H_2O$ loses water; and, moreover, comparative measurements of the vapour pressures of the di-hydrates have not yet been made. So the argument which Professor Moore quotes from the paper from Mr. Ferguson and myself is not invalidated by his objection.

2. The position of ammonium in the series of the alkali metals has been established firmly by the laborious researches of Dr. Tutton, and the conclusion reached by him requires no support from me; but the work on vapour pressures differs from that of Tutton in providing a thermodynamic argument, and numerical values for the relative affinities of the basic radicles concerned. It is a satisfaction, however, to know that our conclusions have been welcomed and endorsed by Dr. Tutton (*Chem. Soc. Ann. Reports*, 1922, p. 260).

With regard to Professor Moore's work on the nature of a dilute aqueous solution of ammonia, which I regret to say I had overlooked, I accept his experimental results, but I do not draw his conclusions from them.

Let it be granted that a N/100 solution of ammonia contains 51 per cent. of this substance as an equimolecular compound of ammonia and water. On what grounds does Professor Moore assert that this is ionisable ammonium hydroxide ? Before a compound can be said to be ionisable in the usual sense there must be evidence of progressive ionisation under conditions progressively favourable to this process. Is there any such evidence ? If a larger proportion than 4 per cent. NH_3 exists as ammonium ions in a more highly diluted solution, it cannot be affirmed that these ions have been formed by the ionisation of NH_4OH, for there is an alternative process by which they may have been formed. In respect of this alternative ammonia and its derivatives are unique amongst the bases.

Why does this large proportion of a non-ionised compound of ammonia and water exist in dilute ammonia solution ? What hinders ionisation ? The view expounded in my former article, to which I still adhere, is that it is the presence of the elements of water in combination which is the hindering cause ; and that this is why only the tetra-alkylated ammonium hydroxides reveal a basic strength comparable with that of the alkali-metal hydroxides. It is of secondary importance whether the compound Professor Moore has shown to exist in solution is formulated as NH_4OH or $NH_3{\cdot}H_2O$; though I prefer the latter formulation because it better expresses the fact of non-ionisation.

Moreover, if $[H_2O{\cdot}H_2O]$ exists, why not $[H_2O{\cdot}NH_3]$? for H_2O and NH_3 are interchangeable in amines and some crystallohydrates.

Professor Moore's argument in the last sentence of his article that ammonium hydroxide is a weak base appears to be founded upon the ratio of the concentration of the non-ionised compound to that of the ammonium ion, and to ignore all other evidence of the strength of the ammonium radicle. According to this argument there would be no question of ammonium competing with the alkali metals in basigenic power ; it would be hopelessly outclassed. Yet it does not require the work of Tutton nor that upon vapour pressures to show that ammonium must take its place somewhere amongst the alkali metals. This fact, and at the same time my own point of view, are well expressed in the following words of Holleman ("A Textbook of Inorganic Chemistry," Eng. Edn., 1916, p. 335) :—

"The great tendency of ammonium hydroxide to break up into ammonia and water is the reason for the very feebly basic reaction of an aqueous solution of ammonia, for we should expect ammonium hydroxide, so far as it is formed, to be extensively ionised, like strong bases, inasmuch as the ammonium salts of strong acids, such as the chloride and the nitrate, react neutral, and the carbonate and the cyanide react alkaline, in harmony with the similar reactions of the corresponding salts of the alkali metals."

Royal Technical College,
Glasgow

FORTHCOMING EVENTS

May 4. SOCIETY OF CHEMICAL INDUSTRY, Chemical Engineering Group, Engineers' Club, Coventry Street, W. 1, at 6.30 p.m. Annual General Meeting, followed by an Informal Dinner at 7.30 p.m., and later by a Social Evening. Members of the Group may introduce non-members to the Dinner and subsequent proceedings.

May 4. UNIVERSITY OF LONDON, University College, Gower Street, W.C. 1, at 5 p.m. "Some Scientific Principles of Chemical Industry," by William Macnab, F.I.C. Also on May 11 and 18.

May 4. INSTITUTION OF CIVIL ENGINEERS, Great George Street, S.W. 1. "The Interdependence of Abstract Science and Engineering," by Sir R. T. Glazebrook, K.C.B., F.R.S., at 6 p.m.

May 4. THE SOCIETY OF CHEMICAL INDUSTRY, *Manchester Section*, The Textile Institute, 16, St. Mary's Parsonage, Manchester, at 7 p.m. (1) "Reflections on Patents," by H. Cheetham. (2) "The Melting-Point of Coal Ash," by Messrs. F. S. Sinnatt and A. B. Owles, and N. Simpkin. (3) "The Behaviour of the Principal Celluloses Towards Iodine and Dyestuffs," by Messrs. J. Huebner and J. N. Sinha.

May 7. THE SOCIETY OF ENGINEERS. Ordinary Meeting at The Geological Society, Burlington House, W. 1, at 5.30 p.m. "The Pneumatic Handling of Petrol and Other Inflammable Liquids," by Pierre Mauclère.

May 7. SOCIETY OF CHEMICAL INDUSTRY, *Yorkshire Section*. Annual General Meeting at the Queen's Hotel, Leeds, at 7.15 p.m. "The Adulteration of Olive Oil," by F. W. Richardson, F.I.C.

May 7. SOCIETY OF CHEMICAL INDUSTRY, *London Section*. Annual Meeting at Engineers' Club, Coventry Street, W., at 8 p.m. Sir F. Nathan, K.B.E., will open a Discussion on "The Action of Bacteria on Cellulose Materials."

May 7. ROYAL SOCIETY OF ARTS (Howard Lecture), at 8 p.m. "The Development of the Steam Turbine," by S. S. Cook (Lecture 2).

May 7. INSTITUTION OF RUBBER INDUSTRY, Engineers' Club, Coventry Street, Piccadilly, W. 1. "The Use of Rubber Products as Dielectrics," by W. S. Flight, A.M.I.E.E.

May 8. INSTITUTION OF PETROLEUM TECHNOLOGISTS. Seventy-first General Meeting at the Royal Society of Arts, John Street, Adelphi, W.C. 2, at 5.30 p.m. "Heavy Grade Egyptian Crude Petroleum," by W. A. Guthrie, F.I.C.

May 9. THE UNIVERSITY OF LONDON, University College, Gower Street, W.C. 1, at 5.15 p.m. "Phases of Indian Geology," by Hon. Sir Thomas H. Holland, F.R.S. Also on May 23 and 30.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

Reading Tilden's "Famous Chemists" the other evening, I came across a paragraph which had some bearing on the present controversy with regard to the title "Chemist." Tilden tells us that Liebig, after visiting England, complained in a letter to Berzelius, which he wrote in 1837, that in England "die Chemiker schämen sich Chemiker zu heissen, weil die Apotheker, welche verachtet sind, diesen Namen an sich gezogen haben." A curious observation to be made by Liebig, that, the despised apothecaries having appropriated the title, the chemists were ashamed to call themselves "chemists." A lot of water has flowed under London Bridge since then, but human nature has remained much the same. I still think that a Conference between the Chemists and the Pharmacists would hasten the time when the word "pharmacist" will become so well known to the public that we shall hear no more of this controversy.

The Correspondence Columns of this paper last week were certainly the most interesting we have had since it became a weekly newspaper. Mr. Kingzett's letter, commenting on what I said a few weeks ago, made me look up some old records which I have collected from time to time, and I can confirm what he says. Both Mr. Kingzett and the late Michael Carteighe were original subscribers to the Institute of Chemistry, and were, I believe, members of its first Council. I was always told in my young days that there would have been no trouble between the Institute and the Pharmaceutical Society but for the interference of some of the Government Departments. This is not an invitation to my readers to point out how unchanging and unchanged our rulers are.

One of Our Big Industrialists, who returned from Germany last Saturday, gave me the most recent news, and as he is a very competent observer, I have no hesitation in quoting them. Before he went over I told him of a report which was current to the effect that the Ruhr district was stocked with chemicals which the Germans were unable to get out. On his return he tells me that this is only true to a very limited extent. Firms with factories both within and without the Ruhr have closed those within and transferred the staffs to those without the district, which are being operated to their fullest extent. The output of the factories outside the area, together with the stocks in Hamburg, accumulated prior to the French occupation, and now rapidly diminishing, just about supply the German chemical market. There is at the moment, therefore, an opportunity for this country to export chemicals to the Continent for consumption chiefly in Germany.

Will Our Manufacturers Act Quickly? It seems to me that if this news is correct, and I am quite ready to believe it is, they must do so. Of two things, one: either the French occupation of the Ruhr will come to an end soon, and the German factories within the area will be re-started; or, it will continue, and the Germans will proceed to develop their factories outside the area. In either case, by a manipulation of the exchange and the free use of the printing press, we should again be placed in an unfavourable position. That is why it seems to me that at once this commercial opportunity ought to be seized.

Reading of the Scenes at Wembley reminded me to make some enquiries as to the progress being made with the Chemical Section of the Exhibition. I hear that a definite space of about 37,000 square feet has been secured in the great Industrial Hall, and I should not be surprised to learn that this is in the best position in the hall. This space is practically all earmarked for about ninety firms, although no actual sites have been allotted to individual firms. The Science Section within this space is gradually taking shape with an absence of friction which is very gratifying. An eminent architect is to be engaged to prepare plans which, while leaving ample room for individuality within the section, will make a most attractive scheme of colour and design for the section as a whole.

The Supply of Fine Chemicals made in this country continues to grow, and the latest list of fine and research chemicals issued by the British Drug Houses, Ltd., is a stupendous one. Many of these are doubtless sold as an ordinary piece of business, but there must be a great many of them which are required so seldom and by so few people that their manufacture is a pure piece of public spirit, occasioned by the desire to help British chemists to obtain reagents so as to help on the achievements of pure science. Pure chemistry has done much for the industry, and it is very pleasant to find manufacturers with so nice a sense of gratitude as this instance affords. Not only is the list very full, but it is also well printed and conveniently arranged.

NEWS FROM THE SECTIONS

NOTTINGHAM SECTION

At a meeting held on April 25 the result of the election of officers for the ensuing year was announced as follows :—Chairman : J. M. Wilkie. Vice-chairmen : S. F. Burford, H. D. Richmond. Hon. Treasurer : S. J. Pentecost. Hon. Secretary : E. B. R. Prideaux. Committee :—T. H. Adams, W. T. T. Ainsworth, L. Archbutt, H. Calam, J. B. Firth, G. F. Hardcastle, F. S. Kipping, J. Marshall, W. P. Skertchly, S. R. Trotman, J. T. Wood, and W. Woodhouse. The Annual Report and Treasurer's Report were read, and a vote of thanks was passed to the College Council for granting facilities for the holding of meetings in the College buildings.

The first paper, by Dr. J. B. Firth and Mr. J. Higson, dealt with the reactions which occur when cupric chloride is treated with sodium hyposulphite at various concentrations and at various temperatures. The reaction took place in an atmosphere of carbon dioxide, and the precipitates, after washing and drying in such a way as to avoid oxidation or decomposition, were analysed. At the lower temperatures and hyposulphite concentrations, the precipitate was essentially cuprous chloride. At the higher concentrations of hyposulphite at 15° C., and at all concentrations from 30° upwards, considerable quantities of sulphur were present. In a certain range of concentrations at 15° the precipitate was chiefly copper, with no chlorine and only a little sulphur. The compounds present were cuprous chloride, cuprous sulphide, cupric sulphide, as well as metallic copper, which was highly pyrophoric. The production of these compounds was explained and the principal equations given.

In answer to questions by Mr. H. Droop Richmond, Dr. Prideaux and Mr. Wilkie, the authors stated that the very reactive copper interacted with colloidal sulphur to give sulphide. Variable mixtures of cuprous chloride and sulphide were obtained by slight variations in the conditions.

The second paper, by Dr. J. B. Firth, on " The Absorption Activity of Carbon," gave an account of investigations carried out with a view to (*a*) the production of a highly reactive carbon, or (*b*) increasing the activity of a moderately active carbon or reactivating one which had deteriorated. In industry, the wood or other carbonaceous substance was mixed with milk of lime, or soluble chlorides or sulphates before carbonisation. In the experiments conducted by the Royal Society recently the effect of salts of lime was investigated. The product of the first carbonisation was extracted with acid, and again heated, giving a highly active charcoal. Some experiments were described in which sugar charcoal was activated by simple heating, or by heating after activation by the introduction of zinc chloride in the preliminary carbonisation. The activities were determined by titrating the iodine absorbed from a solution of iodine in dry chloroform. They were found to be considerably improved by heat treatment and by previous admixture with zinc chloride and also with kieselguhr. The catalytic activities in the decomposition of hydrogen peroxide were also investigated, and found to be in the same order as those exhibited in the sorption of iodine. The activity decayed considerably after a course of years. Theories concerning the activation and deactivation were put forward, namely, that the activity was closely associated with the molecular complexity of the carbon ; the greater this was, the less the force available for sorption. Replying to various questions the author said that the sorptive activity for iodine did not give much information as to the activity in absorbing gases. Coconut charcoal was effective for the latter, ineffective for the former. It had been shown by Henry long ago that hard woods gave an effective charcoal. A bulky charcoal such as was produced in a magnesium nitrate ignition showed a slightly higher sorption in the first five minutes. Experiments were in progress which might furnish a reply to Mr. Higson's question on the relation between the activity of a carbon and the complexity of the organic compound from which it was derived. Carbon derived from the action of iron on carbon dioxide was fairly active.

Mr. Richmond then gave an account of a remarkable case of corrosion of a glass bottle by potassium carbonate stored in it (*cf. Chem. & Ind.*, 1923, p. 405). The potassium carbonate had been found to contain 10 parts of arsenic and 80 of lead per million, and samples sent to him had given the same results for arsenic but were even higher in lead. The bottle contained both arsenic and lead and had been long in stock. The samples of potassium carbonate stored in it had been traced and were all below the pharmaceutical limits, and new samples put in the bottle gained lead.

Mr. Wilkie sketched the methods used for the analysis of lead glasses, which were now not used in the manufacture of storage bottles. The glass, even when in pieces, was easily brought into solution by fusion with alkaline carbonates. Potassium carbonate could absorb water, then cake, and give a film of saturated solution, to which the corrosion was probably due. Mr. Coad Prior said that this glass was an extraordinary sample. It contained, per cent., PbO 13·25, SiO_2 67, CaO 2·3, As_2O_3 0·38, and alkalis, by difference, 17·7. It was necessary to keep alkalis down, especially if lead was present. There might be 0·1 to 1·0 per cent. of arsenic in white glasses. He had confirmed the solution of lead from the glass by experiments with a paste of potassium carbonate.

Mr. Butler referred to the variations in the supply of glass bottles for the wholesale drug trade, and enquired what composition might be expected? Mr. Coad Prior, in reply, mentioned the composition of the principal kinds. The old bottles, which were hand blown, were low in alkalis and stable, but the mechanically made glass bottles were apt to be high in alkali owing to difficulties in manipulation and partly to the diminution in limestone with the object of keeping the iron low. He would like to see a definite standard of stability specified by the chemical industry to which glasses must conform. Alkalis should never be more than 16 per cent., and manufacturers were aiming at a minimum of 10 per cent. lime.

MEETINGS OF OTHER SOCIETIES

PHYSICAL SOCIETY

At the meeting held on March 27, the Research Staff of the General Electric Co., Ltd., London, presented a paper on "The Analysis of Bubbles in Glass." A piece of the glass containing bubbles is placed in one limb of a small quartz U-tube, the other limb of which is three-quarters filled with mercury. The tube is evacuated, precautions being taken against the presence of gas absorbed on the walls, and is then sealed off from the pump. The limb containing the glass is then heated until the glass is just soft: it is then plunged into cold water and the cold mercury from the other limb simultaneously thrown on the hot glass. The process is repeated several times, if necessary, until the glass is broken into fragments and the gas contained in the glass liberated. The spectrum of the gas is examined for nitrogen. If this gas is present, the bubbles in the glass have probably arisen from the introduction of air or furnace gases during ladling, stirring or pouring. If nitrogen is absent, the bubbles have probably been produced by generation of gas in the glass itself.

Dr. H. P. Waran described "A Simple Regenerative Vacuum Device," designed to deal with difficulties arising from residual traces of air fouling the vacuum above the mercury column in barometers, siphon gauges, mercury-vapour lamps, etc. The device consists of a small capillary tube bent into S-form and ending in a bulb fused on the top of the barometer or other tube. By inclining the tube, residual air may be pushed into the bulb, and its subsequent return to the tube prevented by mercury in the capillary.

Messrs. H. Shaw and E. Lancaster-Jones submitted a paper on the "Application of the Eötvös Torsion Balance to the Investigation of Local Gravitational Fields," in which determinations of the variations of gravitational attraction in the laboratory due to walls, pillars, etc., substantiate the claim made for the instrument both as regards consistency and sensitivity.

CORRESPONDENCE

THE JOURNAL

Sir,—You have received so many letters commending your weekly Journal that I fear this may not be of special interest, but I cannot help telling you that I have come to look forward to its arrival with much pleasure. Its appeal to me consists in the content of real science expressed in pleasing form for the reader. I have just read an example of this in Prof. Louis' article on "The Production of Lead in Great Britain," which recalls the Rev. B. V. White's promise to write something about lead in storage batteries.

This type of writing should make a special appeal at the present time to your American readers. They are making an effort through *Science Service*, directed by the American Chemical Society, to put real chemistry before the eyes of the newspaper-reading public, and the women's clubs are helping by having lectures on chemistry at their meetings.

I undertook to interest the women's club of this city in the question by calling on the president one afternoon and reading to her the "Notes from Heathfield." It seems as though the women of Leaminster with its English name should be interested in the chemistry of England so charmingly told. Such seems to be the case, and I hope to bring your Journal again to the attention of the women here.

This popular appeal is not only of value to the general public, but reacts to benefit the chemist himself who will find the preparation of a subject for a lay audience a clarifying process. It is very easy to say that certain matters are not within the compass of the average understanding. This may be partly the fault of the chemist himself who, lacking a clear concept, fails to express himself adequately. I have found many flaws in my chemical reasoning when trying to get it in form to explain to someone unfamiliar with my subject.

Even an audience of chemists is often for the most part unfamiliar with the subject of the speaker and usually welcomes a lecturer who employs a simple, non-technical diction. A few facts prepared for easy assimilation will be retained by the ordinary mind whereas one can hardly be on the alert to catch continuous bursts of genius throughout an entire lecture. The same is true within reason in reading, and while it would not do to fill the journals with too much irrelevant matter, there is surely no harm in having the reading part simple. Your Journal has, to my mind, struck a happy medium in this respect, and I think it should serve as a model for chemical society publications.—I am, Sir, etc.,

Clarence Joyce

Leaminster, Mass., U.S.A.
April 11, 1923

"AN EMPIRICAL RULE FOR SUBSTITUTION IN THE BENZENE SERIES"

Sir,—I have already shown (*Chemical Age*, Oct. 28, 1922) that even a very long series of coincidences is insufficient to prove the truth of an empirical rule. To Miss Hoffert's rule (*Chem. and Ind.*, 1923, p. 348), there is the following further objection :—Since the successive members of a homologous series must have a constant difference of six valency electrons, the directing effects must follow in cyclic order the series—(*i*) o.p. (*ii*) o.p. ; m. (*iii*) m. ; o.p. (*iv*) m.

Experimental results in any family of homologous benzene derivatives—e.g., alkylbenzenes, alkylanilines, phenyl alkyl ethers, alkyl benzoates —show that the directing effect is, on the contrary, practically constant.

A similar cyclic order should hold for substitution in the series $C_6H_5[CH_2]_n.X$, where X is any monovalent group and $_n$ is 1, 2, 3, etc.

Further, $.OCH_3$ is one of the most powerful *o.p.*-directing groups—a fact scarcely indicated by the sum of its valency electrons (13).—I am, Sir, etc., Cecil Hollins

Research Department,
British Dyestuffs Corporation,
Manchester
April 10, 1923

THE TITLE "CHEMIST"

Sir,—A discussion on the title of chemist can at the present time have no practical result ; it is obviously logical that persons engaged in the science and practice of chemistry should be termed "chemists," in fact, there is no other word in the English language which is effective for describing them ; it must be remembered that chemistry, as it exists to-day, is a young science, and a century ago there were no chemists, and it was the pharmacist of the day who came most nearly to the practice of chemistry.

Pharmacy has developed contemporaneously with chemistry, but along gradually diverging lines, and though it is not entirely divorced from chemistry, this science now enters to but a minor degree, and the description chemist as applied to a pharmacist has ceased to be a true one to the logical mind. Nevertheless, it still remains, and cannot at the present time be displaced ; the Pharmacy Acts have conferred a legal right on the pharmacist to be a chemist—public opinion holds that he is a chemist—and within the last few years a powerful vested interest has arisen.

It is true that the law can be changed, but the difficulties of making such a change in face of public opinion and vested interests are insuperable. In addition, few, if any, chemists have a real grievance ; what class of "chemists" desires the change ? The academic chemists show no signs, the analysts and consultants are not up in arms, the technical chemists are not clamouring, and it seems that it is really people whose knowledge and skill in chemistry are so small that their recognition as chemists is problematical who are most desirous of getting the—or a—title.

Our friends the pharmacists who have the legal right to be chemists have never made the least effort to prevent any bona fide student or practitioner of chemistry from calling himself a chemist, so long as he refrained from keeping open shop, and from their side the subject has been regarded with a reasonable spirit of compromise ; while the leaders in pharmacy recognise, as do the leaders in chemistry, that the change is bound to come eventually, and the chemist will some day be called a chemist and the pharmacist a pharmacist, they know the time is not yet ripe. Let us therefore continue the compromise and devote our attention to the education of public opinion. —I am, Sir, etc., H. Droop Richmond

Boots Pure Drug Co., Ltd.,
Nottingham
April 21, 1923

THE CHEMICAL SOCIETY'S LIBRARY

Sir,—As a member of the Society of Chemical Industry I visited the Library of the Chemical Society to seek information on a subject which is interesting me at the moment.

With your acquiescence, I would like to record my appreciation of the services which the staff on duty in the Library rendered on this occasion. The volume I required was not available for reference or immediate loan ; but, notwithstanding the meagre ideas I conveyed to them on the subject, they spared no efforts to find other volumes or references which might aid me.

Perhaps other members of this Society in difficulties would welcome the sympathy meted by this excellent staff, and, no doubt, some will be able to confirm my experience.

In any case, it is certainly a sign of the bonds of good fellowship which exist between the Chemical Society and the Society of Chemical Industry.—I am, Sir, etc.,

Acton, W. 3 David M. Freeland
April 26, 1923

THE TAXATION OF MOTOR-FUEL

Sir,—I have no desire to enter into a controversy with Dr. Ormandy, nor indeed any intention of doing so, and much of his criticism would have been relevant and logical had I proposed the calorific value as a basis of the selling price of motor spirits and not merely of their taxation. We all know that calorific value is not the only point of importance in choosing a fuel, and also that the engine, and especially its compression, must, to get the best results, be suited to the fuel used, but the choice and the price he is prepared to pay may safely be left to the motorist himself, as it is at present, and, in my opinion, this is not a matter in which the Government should interfere. In any case, the basis I have proposed does not tell against the use of alcohol as Dr. Ormandy seems to suggest, since its calorific value being low, the tax per gallon would also be a low one. If, as is true, alcohol is taxed unfairly already by the use of expensive denaturants, the natural remedy would be to allow it to be mixed under bond, with benzol or some other suitable spirit, which would in itself be a sufficient denaturisation. A flat rate on all motor-fuels would almost exclude the use of alcohol, which, alone, is unsuitable for most of the cars at present on the road, and it was largely to avoid this that I proposed the calorific basis.

The taxation of motor fuels on any basis will be a problem of much difficulty, and if a separate rate is to be fixed for each of the hundreds of possible variants, an insuperable one, whilst a "flat rate" would, at least for the present, tend to exclude all fuels such as alcohol, of which the fuel-value is low; and to get over these difficulties, some sort of a physical standard seems to me essential.—I am, Sir, etc., HENRY R. PROCTER

Newlyn, Penzance
April 27, 1923

THE NITROGEN INDUSTRY

SIR,—In his careful and informative review of the book by Dr. Parker and myself, in the issue of April 27, Dr. J. A. Harker, F.R.S., has made one or two statements which it seems desirable to comment upon. I take it that the best practice in these matters is for authors to accept the opinion of a reviewer if he says a book is bad—a circumstance which, I believe, is not in evidence here; but if there are statements on matters of fact on which the author and reviewer differ, then it is perhaps of general interest that there should be a little discussion. In this case it must be with the realisation that, but for the reviewer, neither of us would ever have found himself in the position of being an author of any book on the nitrogen industry. In the first place, I think Dr. Harker has been a little unfair in suggesting that the book is written around the Reports of the Nitrogen Products Committee. When we had to deal with statistical matters we turned, naturally, to these; but even here not exclusively, as the reader will see. The bulk of the information contained in the book has no relation to these Reports.

The statement that: "The volume may be regarded as bearing the same sort of relation to the Nitrogen Products Committee's Report as Mr. and Mrs. Sidney Webb's Commentary to the famous Minority Report on the Poor Law," is, therefore, probably exaggerated, although, as I am not acquainted with either of these latter documents, I cannot speak with certainty.

I believe that our criticism of national policy with regard to nitrogen fixation is amply justified by the statement made by the reviewer that, although ammonium nitrate formed 80 per cent. of the principal explosive used in the past war, it is now imported from abroad: "all the ammonium nitrate works which operated during the war having apparently been dismantled." If dyes and optical glass *must* be maintained in being for national safety, what are we to say on this matter?

Dr. Harker states that a certain number of our statements "are not in accord with the facts." In a subject which is moving rapidly this may be unavoidable, but I believe that, apart from inevitable errors, the statements as to "the ineffectiveness of the Government policy and the comparative lack of actual achievement in nitrogen matters," to which he seems to refer, were completely justified when they were written, and, to a large extent, are true to-day. At any rate, we have no information to the contrary, much as we should welcome it. I believe that the "technical experts" will take our thrusts in the joust as cheerfully as we "pure" chemists have taken theirs in the past. Perhaps we have taken them lying down too long, and signs of life in us will not, I feel sure, impair that fine chivalry which has so long been associated with knightly encounters—at any rate, during the period when knights were liable to be called upon to defend their titles. When we have our armour off we shall, I hope, continue to find mutual satisfaction in a joint existence. Davy's "jibe" may, as we ourselves point out, have been rather extravagant, but even in a dog-fight one likes to see both parties getting fair play, and in recent years one dog has usually been bigger and has barked louder than the other.—I am, Sir, etc.,

J. R. PARTINGTON

East London College,
University of London
April 27, 1923

CALCIUM LACTATE

SIR,—I note in the *Journal* of the 27th inst., just to hand, under the Market Report, the price of calcium lactate is given as being 2s. 9d. per lb. It may interest you to know that I have recently seen a German quotation for B.P. calcium lactate at £18 per ton in barrels, U.K. port: payment to be made 26 per cent. in Customs Dues, the balance by draft on Bank.

This low price, taken into consideration with the result of the experiment made here in the course of the Ministry of Agriculture and Fisheries' work on the utilisation of whey, of which I sent you a note on December 23 last, much concerns, but does not discourage, me; for, if in the preparation of the lactate from whey a multiple effect evaporator be used, it is still possible to compete with the outrageously low figure quoted.—I am, Sir, etc.,

J. C. STEAD

Lactose Factory, Haslington, Crewe
April 27, 1923

PERSONALIA

The Faraday Medal of the Institution of Electrical Engineers is to be presented to the Hon. Sir Charles A. Parsons, at the meeting on May 10, at 6 p.m.

Mr. A. R. Warne, A.Inst.P., M.I.Mech.E., has been elected President of the Hull Chemical and Engineering Society for the year 1923-24.

Dr. H. H. Dale, C.B.E., of the Medical Research Council, has been appointed a member of a committee constituted to investigate the comparative therapeutic value of various cocaine substitutes, and the evidence of risk, if any, that such substitutes may become drugs of addiction.

It is announced that Dr. C. E. K. Mees, who, it will be remembered, left England in 1908, to become the first director of the Eastman Research Laboratory, has now been made a director of the Eastman Kodak Co.

NEWS AND NOTES

FRANCE

Notes from Paris

It has already been announced that the centenary of the birth of Pasteur will be commemorated on May 26 to 30 in Paris, then at Strasburg from May 31 onwards. In Strasburg, in the presence of delegates from all over the world, the monument to Pasteur erected in front of the University from an international fund will be unveiled. In addition, the Pasteur Museum, situated near the Institute of Hygiene and Bacteriology of Strasburg, will also be opened. This museum will be devoted to exhibits illustrating Pasteur's researches, ranging from crystallography, ferments, silk-worm disease, fowl cholera, anthrax, diseases of beer, to alcohol, fermentation and applications to medicine and surgery. On June 1 the Industrial Exhibition will be inaugurated showing the vast bearing of Pasteur's discoveries on the progress of hygiene and agriculture. In the section for hygiene will be shown the various applications to military, marine, colonial and other uses. Exhibits will also be devoted to chemistry, chemical industry, agriculture, cold-storage, etc. Particularly at this moment when the question of nitrogen fixation is attracting the attention of so many nations, it should not be forgotten that it is thanks to the researches of Pasteur that it is now possible to elucidate the action of soil bacteria, nitrifying and other organisms, and it is permissible to prophesy that in the future the soil will be fertilised by means of selected bacteria that, without any consumption of high-potential energy, human effort or limitation of working life, will return to the soil certain of the fertilising principles removed by the plants.

UNITED STATES

The Artificial Silk Industry

The production of artificial silk in the United States during 1922 was 24,406,000 lb., as compared with 15,000,000 lb. in 1921, 5,828,000 lb. in 1918, and 1,566,000 lb. in 1913. Figures are not available of the imports of artificial silk in 1922, but it is believed that the amount will be less than in 1921, when 3,667,180 lb. was imported.—(*Ch. Comm. J., Apr.* 27, 1923.)

GENERAL

The Norwegian Carbide and Cyanamide Industry

There are now eight modern carbide factories in Norway, three having been built during the war. With a total h.p. of 170,000, the plants have a total output-capacity of 250,000 tons of carbide per annum, and when in full operation employ about 3000 men. At present several factories are closed and others are operating at reduced capacity. The anticipated increase in consumption after the war, which led the industry to expand its capacity to 80 per cent. of the world's total output (350,000 t. per annum) in 1913, has thus proved illusory. The sole cyanamide factory in Norway, situated at Odda, has been closed for over a year, and it is unlikely that this factory or the carbide factory in the same district will ever be operated again, unless new uses are found for both carbide and cyanamide.

The Uses of Zinc Dust

An interesting list of the uses of zinc in the powdered state is quoted in a recent issue of *Chemical and Metallurgical Engineering* (Apr. 9, 1923). The chief properties for which zinc dust is used may be summarised as follows :—(*a*) Reducing properties, as in the dye industry, for reducing nitro compounds to organic amines and in preparing sodium hydrosulphite for the reduction of vat colours ; (*b*) the property of precipitating metals from their solutions, in purifying zinc-sulphate solutions for electrolysis or for the manufacture of lithopone ; (*c*) the property of combining with dry oxygen only at a high temperature, and of giving with moist air a basic carbonate or with sea air an oxychloride which protects the metal from further alteration. These properties have led to application in painting iron objects, sherardising (*i.e.*, immersing iron objects in zinc dust at 300° C.), galvanising cast-iron and metallisation (*i.e.*, deposition by projection of a layer of zinc on the surface of a metal). Zinc dust is usually obtained as a by-product from zinc smelters, but it is also made by blowing gas against a stream of liquid zinc or by grinding. Such dusts contain varying amounts of impurities, some of which are undesirable for certain uses. Microscopic examination has shown that the grains of zinc dust consist of metallic globules coated with crystals of zinc oxide which prevent the globules from uniting.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for April* 26)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Chemicals, coal-tar oil, hides	559
Canada	Earthenware	11000/E.D./G.C./2
,,	Plant for distillation of alcohol	11007/E.D./C.C./2
,,	Stearin, palm oil	*
Cuba	Soap	561
Kenya Colony	Paper-pulp, paper (tender)	11077/E.D.
Netherlands	Photographic chemicals, fertilisers	547
New Zealand	Drugs, medical supplies	534
,,	Asbestos sheets, chemicals, enamel and aluminium ware, gas mantles	535
Rumania	Iron (tender)	10517/F.E./E.C.
South Africa	Iron and steel	537
,,	Sodium arsenite (tender)	11059/E.D./C.C./2
Sweden	Steel	7209/F.R./E.C./2
Switzerland	Upper leather	19117/F.W./M.C./2
,,	Pharmaceutical specialities	19094/F.W./C.C.
United States	Iron and steel	554
,,	Steel	18677/F.W./E.C.

* Canadian Government Trade Commissioner's Office, 73, Basinghall Street, E.C. 2.

TARIFF CUSTOMS EXCISE

British India.—Numerous amendments have been made to the Indian Customs Tariff, among which are the imposition of an import duty on saccharine at the rate of Rs. 20 per lb. instead of 25 per cent. *ad valorem*; and the reduction of the export duty on raw hides and skins from 15 to 5 per cent. *ad valorem*.

Egypt.—The prohibition of the importation of sugar and glucose has been withdrawn.

France.—A law has been passed which fixes the duties on compound medicines. The export and re-export of ammonium sulphate has been prohibited.

Germany.—Export duties have been reduced or withdrawn on a number of articles, including cement, lime, chalk, graphite, emery, wood pulp, and mica.

Germany (*Occupied*).—Import duties have been levied on perfumes containing ether or ethyl alcohol, essences, tinctures and waters.

Norway.—The stamp tax on chocolate and sugar goods has been renewed.

Poland.—An additional duty of 90,000 Polish marks per 100 kg. is to be charged on coarse and refined sugar, and the duty on acetic acid has been increased to 3000 Polish marks per kg. of undiluted acid.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Petroleum Exploration in Great Britain

In reply to Mr. Houfton, Lieut.-Col. Lane-Fox said that the total expenditure on exploration for petroleum in Great Britain, allowing for amounts realised by sales of oil, plant and machinery, was roughly £564,000. Oil was found in appreciable quantities at only two of the eleven borings, and these two bores had been sold—the D'Arcy bore to a Scottish syndicate and the Hardstoft bore to the Duke of Devonshire—in order to prevent further loss.—(Apr. 24.)

Opium Production in British India

Replying to Mr. Ponsonby, Earl Winterton said that in the year ending October 31, 1921, the number of chests of opium manufactured in British India was 12,524, of which 5800 chests were for export and 6724 chests for internal consumption; during that year, the opium poppy was grown on 116,056 acres.—(Apr. 24.)

Tar for Road Works

Lieut.-Col. Campion, in a written answer to Col. Ashley, said he could not admit that the use of ordinary crude gas-tar for road-works had generally given satisfactory results. To secure a tar of known constituents and qualities, the Roads Department had drawn up a specification, which must be observed to obtain grants from the Road Fund, but Local Authorities were not debarred from using crude tar.—(Apr. 21.)

Home-Grown Sugar

Mr. Baldwin informed Mr. Barnes that the difficulties which British Home Grown Sugar, Ltd., had to face were due mainly to the fact that this very technical industry was in its infancy in this country. The recent reconstruction of the company and the improvement now in hand of the Kelham sugar-beet factory should result in the establishment of the industry on a firm basis.—(Apr. 26.)

REVIEW

Soap Making Manual. *By* E. G. Thomssen, Ph.D. *Pp. viii*+243. *New York: D. van Nostrand Co.; London: Crosby Lockwood and Son*, 1922. *Price* 12*s*. 6*d*. *net*.

In this book, the material for which appeared some time ago in the *American Perfumer and Essential Oil Review*, the author has attempted to deal with soap-making processes and glycerin recovery from the purely practical standpoint. Whilst much of the information is necessarily of the usual kind associated with the ordinary text-book on soap manufacture, a very fair account is given of processes which are, or have been, recently in use in modern practice.

A practical description is given of the ordinary boiling process, which shows a working acquaintance with the subject, and the saponification of rosin and the preparation of " closed " or " glued-up " soaps are treated satisfactorily. Cold process, half-boiled soaps, shaving soaps and creams are treated in the conventional manner, but in the section on transparent soaps the author's assertion that they are of little use because they must contain an excess of alkali cannot, of course, be accepted.

The whole of the information regarding the composition and nature of household and laundry soaps is obviously written for American readers, and the oils and fats are not necessarily those used for corresponding soaps in Europe. The section on textile soaps is not satisfactory and in some respects the book is very unevenly written, the desire to be practical overcoming in some cases the clearness of the text.

The chapter on glycerin recovery is much on the ordinary lines, but the optimism of that dealing with the future of hydrogenated oils as soapmaking materials is quite out of date, the information contained therein being the views of twelve or fifteen years ago.

The latter half of the book is occupied with simple analytical data and a complete report of the standard methods of analysis of commercial fats and oils adopted by the American Chemical Society.

The illustrations, which are all placed at the end of the book, although poorly printed, represent up-to-date machinery in a modern American factory. An appendix also contains a collection of tables of strengths of solutions and specific gravities, and whilst on the whole the book cannot be said to contain much that is new, it is more practical than many which have been published on the subject.

F. G. Reynolds

At the recent Toronto meeting of the American Biochemical Society, P. A. Schaffer was elected president, and H. C. Sherman, vice-president, for 1923.

MARKET REPORT

This market report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

A continuation of recent improvement in the demand for chemicals is accompanied by a firm tendency in prices, especially so in the cases where supplies from Germany show a falling off. Makers have reduced the delivered prices of one or two products in conformity with the promised reduction in railway rates from May 1, and have thus passed on the advantage to buyers where possible. The position of Acetic Acid is at present particularly uncertain, as anticipated large demand in America has resulted in a reported advance of Acetate of Lime to about £23 per ton, and the state of the market is now chaotic with practically nothing available.

Acid Acetic, 40% tech. ..	£23-£25 per ton. Still firm but position seems slightly easier owing to more foreign acid entering than of late.
Acid Hydrochloric ..	4s.-5s. per carboy d/d.
Acid Nitric	£24 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric— 94% Arsenical ..	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d.-£8 per ton. Demand still improving.
Arsenic (White) ..	£70 per ton. Price more or less nominal.
Bisulphite of Lime ..	£7 per ton, packages extra.
Bleaching Powder ..	Spot £11 7s. 6d. d/d. Contract £10 7s. 6d. d/d.
Calcium Chloride ..	£5 17s. 6d. per ton d/d. Reduction of 2s. 6d.
Copper Sulphate ..	£27 per ton.
Potash Caustic	Spot about £35 per ton. Small quantities available.
Potass. Bichromate ..	5¾d.-6d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.-£5 per ton. Export inquiry well maintained.
Soda Caustic 76% ..	£20-£21 per ton.
Soda Crystals	£5 10s. per ton. No change.
Sod. Acetate 97/98% ..	£26 per ton. Very scarce.
Sod. Bicarbonate ..	£10 10s. per ton. No change.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton, according to quantity.
Sod. Chlorate	3d. per lb. No change.
Sod. Nitrite 100% basis	£28 per ton d/d.
Sod. Sulphide, conc. ..	£16 per ton carr. paid. Decided improvement for both home and export.
Sod. Sulphite, Pea Cryst.	£17-£17 10s. per ton, according to quantity.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.

Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£26-£28 per ton according to quantity.
Carbon Black	1s. 5½d. per lb. ex wharf.
Chromium Oxide	1s. 5d. per lb.
India Rubber substitutes, White and Dark	5½d.-6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber ("Rubpron")	£16-£18 per ton.
Sulphur, Finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£10 15s. per ton d/d.
Grey	£20-£23 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 10s. per ton d/d.
Brown Sugar of Lead	£40 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 6d. per lb. Still fair inquiries but prices are slightly lower for delivery second half of year.
Crude 60's	3s. 9d. per gall. Market steady but demand rather less.
Acid Cresylic—97/99	2s. 2d.-2s. 5d. per gall. Fair demand.
Pale 95%	2s.-2s. 4d. per gall. Steady business.
Dark	1s. 10d.-2s. 0½d. per gall. Steady business.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. Market stagnant.
Anthracene Oil—	
Strained	9½d.-11½d. per gall. Fewer inquiries.
Unstrained	9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8½d. per gall.
Pure	2s.-2s. 2d. per gall.
Toluole—90%	1s. 9d.-2s. per gall.
Pure	2s. 2d.-2s. 6d. per gall.
Xylol	3s. 3d.-4s. per gall., according to quality.
Creosote—	
Cresylic 20/24%	11d.-1s. 1d. per gall. Little business passing.
Middle Oil	8½d. to 11d. per gall. Market somewhat easier.
Heavy	
Standard Specification	
Naphtha—Crude	9d.-9½d. per gall.
Solvent 90/160	1s. 7d.-1s. 9d. per gall. Fair business passing.
Solvent 90/190	1s. 6½d.-1s. 8d. per gall. Not much demand.
Naphthalene, Crude—	
Whizzed or hot pressed	£11-£14. Supply still scarce.
Drained Creosote Salts	£7-£10 per ton. Market firm.
Pitch, Medium Soft	No business for this season. Prices for autumn delivery 140s.-150s. per ton.
Pyridine—90/140	11s.-12s. per gall. Price nominal. Very few inquiries.
Heavy	8s.-9s. Price nominal. No inquiries.

INTERMEDIATES AND DYES

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhydrous	1s. per lb. d/d.
Aniline Oil and Salts	9½d. per lb. naked at works. Good demand.
Antimony Pentachloride	1s. per lb.
Benzidine Base	8s. 6d. per lb. 100% basis.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlor Phenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
p-Dichlorbenzol	£70 per ton.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrophenol	£140 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d, packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
α-Naphthol	2s. 9d. per lb.
β-Naphthol	1s. 1d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	7d.-8d. per lb. Market very brisk.
Nitronaphthalene	1s. per lb. d/d.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sod. Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid Acetic 80%	£52 10s. per ton.
Acid Acetyl Salicylic	3s. 6d. per lb. Firmly held.
Acid Benzoic	2s. 3d. per lb. In very short supply.

Acid Citric	1s. 8¾d.-1s. 9d. per lb., less 5%. Demand good and prices firm.
Acid Gallic	3s. per lb. for 2-cwt., 3s. 3d. per lb. for 56 lb. lots.
Acid Pyrogallic, cryst.	5s. 9d. per lb.
Acid Salicylic	2s. 6d. per lb.
Acid Tartaric	1s. 3¾d.-1s. 4¼d. per lb. Demand good and prices still advancing.
Ammon. Carbonate B.P.	£37 10s. per ton.
Barbitone	18s. per lb. still quoted without much demand.
Benzonaphthol	4s. 6d. per lb. higher.
Bromides	Nothing now coming forward from the Continent at London spot prices, which are consequently showing a firmer tendency.
Chloral Hydrate	3s. 9d. per lb. Would be accepted for 5-case lots.
Creosote Carbonate	10s. per lb. Dull at this figure.
Formaldehyde 40%	£87 10s. per ton.
Guaiacol Carbonate	8s. per lb. lower.
Hexamine	4s. 6d. per lb. Still fully maintained.
Homatropine Hydrobromide	30s. per oz.
Magnesium Carbonate—	
Light Commercial	£38 per ton nett.
Magnesium Oxide—	
Light Commercial	£85 per ton nett, less 2½%.
Heavy Commercial	£28 per ton nett, less 2½%.
Menthol	35s. per lb. spot. Advanced.
Methyl Salicylate	2s. 8d. per lb. for carboys still quoted.
Methyl Sulphonal	14s. 6d. per lb.
Paraformaldehyde	4s. per lb., showing no alteration from last quoted rates.
Paraldehyde	1s. 7d. per lb.
Phenacetin	6s. 6d. per lb.
Phenazone	7s. 6d. per lb.
Phenolphthalein	5s. 6d. per lb.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	98s. per cwt., less 2½%. Firmer.
Potass. Iodide	15s. 8d. per lb. in cwt. lots. Good steady demand.
Potass. Permanganate	11d. per lb. is the general price for quantity. No parcels appear to be on offer at a lower figure.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz.
Saccharin	Increasing demand.
Salol	2s. 9d. per lb. Unchanged.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 4d. per lb. is now wanted. In very short supply.
Sod. Citrate	U.S.P. quality 2s. 2d. per lb. for cwt. lots. Good orders have been taken at this figure.
Sod. Hyposulphite—	
Photographic	£15-£17 per ton.
Sod. Salicylate	2s. 9d. Powder, 2s. 11d. per lb. Crystals, best makes.
Sod. Sulphite, anyhdrous	£27 10s.-£28 10s. per ton. f.o.r. London, 1-cwt. wooden kegs included.
Sulphonal	14s. per lb.
Thymol	16s. 6d.-18s. per lb.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil, Red Ship Brand	2s. per lb.
Bergamot Oil	12s. 6d. spot, 13s. 6d. forward.
Cananga Oil, Java	9s. per lb.
Cassia Oil, 80/85%	8s. 3d. per lb.
Cinnamon Oil, Leaf	4½d. per oz.
Citronella Oil—	
Java 85/90%	4s. per lb.
Ceylon	3s. 2d. per lb.
Clove Oil	8s.-8s. 6d. per lb.
Eucalyptus Oil 70/75%	1s. 9d. per lb.
Lavender Oil, Mont Blanc, 38/40%	13s. per lb.
Lemon Oil, Spot	3s. 1d. per lb. Higher prices asked for forward delivery.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet spot	11s. 6d. per lb.
Otto of Rose Oil—	
Anatolian	24s. per oz.
Bulgarian	30s. per oz.
Palma Rosa Oil	17s. per lb.
Peppermint Oil—	
English Mitcham	80s. per lb.
Wayne County	13s. ,,
Japanese	6s. 3d. per lb.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,,
Amyl Acetate	2s. 6d. ,,
Amyl Butyrate	8s. ,,
Amyl Salicylate	3s. 6d. ,,
Anethol (melting point point 21/22° C.)	4s. 3d. ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,,
Benzyl Alcohol free from Chlorine	3s. ,,
Benzaldehyde, free from Chlorine	3s. ,,
Benzyl Benzoate	3s. ,,
Cinnamic Aldehyde, 98/100% Natural	14s. 9d. ,,
Coumarin	15s. 6d. ,,
Citronellol	22s. 6d. ,,
Citral	9s. 6d. ,,
Ethyl Cinnamate	18s. 6d. ,,
Ethyl Phthalate	4s. 3d. ,,
Eugenol	11s. 6d. ,,
Geraniol (from Palmarosa)	30s. ,,
Geraniol	5s. 6d.-12s. 6d per lb.
Heliotropine	8s. per lb.
Iso Eugenol	16s. 6d. ,,
Linalol ex Bois de Rose	21s. ,,
Linalyl Acetate	22s. 6d. ,,
Methyl Benzoate	8s. 6d. ,,
Musk Ketone	35s. ,,
Musk Xylol	9s. 6d. ,,
Phenyl Ethyl Acetate	10s. ,,
Phenyl Ethyl Alcohol	17s. 6d. ,,
Rhodinol	45s. ,,
Terpineol	3s. 1d. ,,
Vanillin	23s.-24s. per lb. Market well maintained. Demand brisker.

TRADE NOTES

BRITISH

Trade Information

Chemical Lime.—The Callow Rock Lime Co., Ltd., has issued an interesting booklet describing the history, production and uses of chemical lime. The various properties of lime and their importance in chemical processes are discussed and an extensive list of uses is detailed. After describing the methods of producing Callow Rock lime, an interesting series of tables is given showing the chemical and physical characters of this lime, concluding with a list of the special products made by the company. Those interested can obtain copies of the booklet on application to the Callow Rock Lime Co., Ltd., 811, Salisbury House, London, E.C. 2.

Glassware.—We have received from Messrs. Ackroyd and Best, Ltd., of Beacon Works, Morley, Yorks, an illustrated catalogue of the specialities produced by this firm. Special interest attaches to the safety lamps made by this company, which also turns out a large variety of glassware, including opal, clear and heat-resisting glass for lighting and other purposes.

Necol Plastic Wood is a pliable material of use for moulding intricate parts of patterns, and for filling holes, etc. in woodwork. The material, made by Necol Industrial Collodions, Ltd., a constituent company of Nobel Industries, Ltd., of London, is waterproof, dries hard quickly, and can be cut to shape with tools and even turned on a lathe. Further information is given in a booklet issued by Nobel Industries, Ltd., who will supply further particulars to inquiriers.

Messrs. Chas. Page and Co., Ltd., inform us that their address is now 37—39, King William Street, London, E.C. 4, where all their departments are now housed.

Messrs. Munton and Baker (Bedford), Ltd., have transferred their head office from Mark Lane to the "Muntona" Works, Bedford.

FOREIGN

Industrial Notes from France

Owing to the arrival of coke from the Ruhr, a few blast furnaces have been relit in Lorraine, the Société Métallurgique de Knutange, the Aciéries de Rombas, and the Mines et Usines de Redange Dilling having each relit a furnace.

The Etablissements Kuhlmann, in co-operation with the Société Algérienne de Produits Chimiques et d'Engrais and of the Crédit Commercial de France, has founded the Cie. des Superphosphates et Produits Chimiques du Maroc, which will operate a superphosphate factory at Casablanca under a contract signed with the Cherifien Government in September, 1921.

Dutch Vegetable Oil Industry

The output of vegetable oils in Holland during 1921 totalled 157,437 tons as against 106,733 t. in 1920, an increase of over 50 per cent. above the figures for 1913. Of individual oils, the production was as follows:—Linseed oil 73,017 metric tons, coconut oil 64,942 m.t., peanut oil 12,632 m.t., and rape-seed oil 5,238 m.t., in addition to smaller quantities of sesame, soya-bean and palm-kernel oils, the production of which has declined steadily since the war.

PUBLICATIONS RECEIVED

Buyers' Guide for the Chemical Industry: a Classified List giving Sources of Supply of Chemical Products, Dyes, Raw Materials, Plant, Equipment, Etc. *Pp.* 64. *Issued gratis by the Advertisement Department, Society of Chemical Industry,* 46 *and* 47, *Finsbury Square, London, E.C.* 2, 1923.

Publications of the United States Geological Survey. *Department of the Interior. Washington: Government Printing Office,* 1922:—

High-Grade Clays of the Eastern United States, with Notes on Some Western Clays. *By* H. Ries, W. S. Bayley, and Others. *Pp. xiv*+314. *Bulletin* 708.

Contributions to Economic Geology, 1921. Part II. Mineral Fuels. *By* D. White and M. R. Campbell. *Bulletin* 726. *Pp. x*+322.

The Occurrence and Uses of Peat in the United States. *By* E. K. Soper and C. C. Osbon. *Bulletin* 728. *Pp. x*+207. *Price* 50 *cents.*

Die Beziehungen zwischen den Fettkonstanten. *By* Jakob Lund. *Reprint from the Zeitschrift für Unterschung der Nahrungs und Genussmittel sowie der Gebrauchsgegenstande. Vol.* 44. *Part* 3. *Pp.* 75. *Berlin: Julius Springer,* 1922.

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JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

Official Organ of the Federal Council for Pure and Applied Chemistry

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EDITORIAL

WE feel sure that if the objects of the Federal Council Fund were better understood there would be a more speedy response to the appeal made for it. The Federal Council, as has already been explained, has two objects in view; the first, to have such a fund as will enable the annual expense of sending delegates to meetings of the Union Internationale and the occasional expense of holding a meeting in this country to be provided; the second, to have a fund which will steadily be augmented and accumulated as a nucleus ready for the time when steps may be advantageously taken for that closer co-operation between the various societies represented on the Federal Council, which appears to be so desirable, and will in course of time, certainly be brought about. What form such co-operation will take no one can at the moment predict, nevertheless, it is already obvious that one building to provide accommodation for a number of such chemical societies will be necessary, and some capital sum sufficient to enable chemical publications, whether periodical or otherwise, to be issued in a manner worthy of our science and our country.

The funds necessary for all such purposes are considerable, and soon a real campaign must be started for their collection. This means an appeal in a more or less public manner, and one of the first essentials is a preliminary list of subscriptions as evidence that the movement for co-ordinating the social, literary, academic, industrial and commercial activities of chemists, has the support of all the great classes concerned. Such a public appeal cannot be long delayed.

In the meantime the nucleus fund is growing, but so slowly that steps must be taken to stimulate its growth. The invested funds of the Federal Council are now merely £300 in 5 per cent. War Loan, £150 Funding Loan, and £150 Victory Bonds. The response from those who felt disposed to contribute £10, £20 and £50 was fairly quick, but up to now the promises of smaller sums, the half-guineas, guineas and two guineas, have been singularly few. Now, if we are to realise the hope of placing chemistry in its proper place in the eyes of the public, all must lend a hand. There is no reason why four or five thousand of our readers should not promise some donation; those who are unable to give a large sum can help by sending a small one. The promise of a number of small sums stimulates the comparatively wealthy members of the community to be generous, and every name added to the list of subscribers is a stimulus to a number of friends and acquaintances to do likewise. We hope shortly to be in a position to publish the first provisional list of subscribers, and shall be very glad if our readers will let our editor know in the course of the next three weeks the assistance which may be expected. Some readers may like to contribute a sum the payment of which may be spread over two or three years; the large capital sum is not needed in the course of this summer. What is needed is a constant effort spread over the next five or ten years, so that the £1000 already promised will shortly grow to £5000 or £10,000. This will give us chemists a chance of keeping the capital intact and paying the necessary expenses out of a portion of the interest, accumulating the residue and continuing the appeal with confidence. The time will then come when we can ask for large donations, and see our way to tackling the large problem. At the moment the need is for a considerable number of small sums, and we hope that when we are authorised to publish the first list of promises it will be a really long one.

* * *

It was to be expected that the isolation of insulin and its production on a certain scale would lead to the publication of further work bearing on the subject. Some weeks ago, it was announced by Messrs. Winter and Smith that a substance similar to insulin could be obtained from yeast and that this substance, when administered to diabetic patients, acted like insulin in freeing the blood from sugar. In addition, Mr. J. B. Collip, of the University of Alberta, states in a cable to *Nature* that his previous prediction that wherever glycogen occurred in Nature an insulin-like substance would be found, has been corroborated by experiments with clam tissues and later with yeast. But Mr. Collip has also found that extracts made from various plants (onion, barley, lettuce) produced marked hyperglycæmia in normal rabbits, and that extract of green onion tops given to a depancreated dog reduced the blood-sugar content by over one-half. The name proposed by Mr. Collip for this new plant hormone is "Glucokinin," and it is to be hoped that not too long a period will elapse before something more will be known of plant and animal hormones and, indeed, of vitamins, than their names and some of their less recondite reactions. The importance of such work can hardly be over-estimated, for it means not only that alleviation is being procured for human suffering, but that knowledge is gradually being acquired of the mechanisms of vital reactions, with the promise of ultimate consequences that may surpass the wildest fantasy. Another discovery of far-reaching importance is the elaboration, by a member of the staff of the Imperial Cancer Research Fund, of a saline solution in which body tissues can be sustained in more or less continuous life and growth. Thus kidney cells grow in such a solution and produce sheets or lumps of tissue which, however, do not reproduce the special structure of the original organ; but if pieces of living connective tissue such as gristle are added, the cells take on the characteristic microscopic structure of the kidney; further, if broken-down healthy tissue or extract of cancer tissue be added, the rate of growth is greatly increased. The vital significance of such work is obvious and our only regret is that there are not more workers in the field, so that progress could be made more quickly.

* * *

It is pleasant to see how some of the great problems are gradually being solved. The utilisation of the great mass of nitrogen in the air is one of these. It is something like eighty years since the subject was first investigated, and we have become accustomed to think of nitrogen as an inert, dull and dreary gas, a mere diluent, but its properties in such substances as ammonium nitrate and T.N.T. show that the stability of its molecule is only evidence of the power and activity of its atom. Professor W. A. Bone has quite recently carried the story a little further. By exploding carbonic oxide and nitrogen together he obtains an active form of nitrogen, which in this state will combine with oxygen, and no doubt can be stimulated to form other compounds.

THE USE OF CO-ORDINATION COMPOUNDS IN ANALYSIS

By PROF. T. MARTIN LOWRY, F.R.S.

1. Analytical Separation of the Transition-Elements

The analysis, both qualitative and quantitative, of the metals of the three transition series has been revolutionised completely by the use co-ordination-compounds. Thus Matthey, in 1879, after carrying out an extremely tedious process of purification according to the ordinary methods of analysis, had to acknowledge that the purest iridium that he could prepare still contained traces of ruthenium, rhodium and possibly iron; indeed, at that time, the complete separation of the platinum metals appears to have been only less difficult than the separation of the rare earths. This position has been completely altered by making use of the fact that consecutive elements of these groups, although they differ from one another by only one planetary electron and exhibit in their ordinary compounds an almost constant valency of 2, 3 or 4, are extremely sensitive in relation to the processes of co-ordination, which may be thrown completely out of gear by the addition or removal of a single electron. This sensitiveness finds its most striking illustration in the compounds which have been selected for use in analysis, since only the most rigid discrimination between consecutive elements will meet the requirements of a complete qualitative separation or of an exact quantitative analysis. A few examples of co-ordination-compounds which fulfil these stringent requirements are set out below.

2. Metallic Carbonyls

"*A very complete separation of nickel from cobalt may be effected by reducing to the metallic condition and removing the nickel in the form of volatile nickel carbonyl by heating in a current of carbon monoxide. Cobalt does not yield a carbonyl under the same conditions.*"

Nickel with 10 electrons in its outer shell requires only 8 more to make up the stable system of 18 electrons which is characteristic of the inert gas krypton; it secures these by sharing 4 pairs of electrons with 4 molecules of carbonic oxide in nickel tetracarbonyl, NiC_4O_4 or $[Ni.4CO]$. Cobalt also unites with 4 molecular proportions of carbonic oxide; but, since it contains 1 electron less than nickel, the stable grouping of 18 electrons is attained by sharing 1 pair of electrons between 2 atoms of cobalt, giving rise to a *dicobalt octacarbonyl*, $Co_2C_8O_8$ or $[Co.4CO]_2$. The conditions for the formation and decomposition of this carbonyl, as well as its properties, differ widely from those of nickel carbonyl. Thus whereas nickel carbonyl, $Ni(CO)_4$, is a colourless liquid, boiling at 43·2° (f.p. -25°) and is produced at atmospheric pressures, and at temperatures below 50°, cobalt carbonyl, $Co_2(CO)_8$, forms orange-coloured crystals melting at 51°, and is produced at 150° under a pressure of 40 atmospheres. These differences, although they depend on the elimination of only a single planetary electron on passing from nickel to cobalt, are sufficiently wide to render possible a perfect separation of the two metals.

3. Double Cyanides

In order to separate nickel and cobalt "*the cyanides are precipitated and redissolved by the addition of potassium cyanide. By boiling a solution with a drop of acetic acid, the cobalt is converted into potassium cobalticyanide and cannot then be precipitated by sodium hypochlorite, whilst nickel remains as a simple double cyanide and is at once precipitated.*"

Potassium cobalticyanide owes its stability to the fact that it contains a tervalent cobaltic atom with only 6 electrons in its outer shell; the full complement of 18 electrons is therefore secured by sharing 6 pairs of electrons derived from 6 cyanogen groups. The tervalent anion, [Co.6CN], is therefore an extremely stable complex. Potassium ferricyanide, $K_3[\overset{+++}{Fe}.6CN]$, is also a fairly stable compound, although the anion contains 1 electron less than the anion of the corresponding compound of cobalt; but this missing electron is very readily acquired and the compound then passes over into the ferrocyanide, which contains the same stable configuration of electrons as the cobalticyanide. In the case of nickel this stable configuration could only be developed by the loss of 4 electrons. Since the valency of nickel in its salts is limited to two, the element is unable to form a double cyanide of sufficient stability to resist oxidation by sodium hypochlorite, and can therefore be separated quantitatively both from cobalt and from iron.

4. Double Nitrites

"*Potassium nitrite yields a yellow precipitate of potassium cobaltinitrite, $K_3Co(NO_2)_6$, when added to a solution of a cobalt salt containing free acetic acid.*" "*It is a bright yellow, crystalline powder, insoluble in water, and on account of its stability or inertness is used as an artists' pigment. It is a very pure compound when prepared as indicated above, for neither iron nor nickel yields a corresponding derivative; it is therefore valuable for painting porcelain, because the blue colour produced on baking is correspondingly pure and beautiful.*"

The nitrites are amongst the least stable of metallic salts and are usually decomposed even by organic acids. The extreme stability of potassium cobaltinitrite is due to the fact that a cobaltic ion with 6 electrons in its outer shell is able to make up the stable complement of 18 electrons by sharing 6 pairs of electrons derived from 6 nitrite groups. Nickel is unable to form a similar complex because the bivalent ion of the metal carries an excess of 2 electrons as compared with the tervalent ion of cobalt. Iron, on the other hand, is unable to form a similar complex because the ferric salts do not possess the number of electrons required to make up the stable grouping; and the ferrous salts which carry the right number of electrons are unable to persist under the oxidising conditions created by the presence of nitrous acid. Similar compounds are, however, formed by rhodium and iridium, the homologues of cobalt, the tervalent ions of which require 12 electrons to complete the complement of 18 electrons in the case of rhodium and 32 electrons in the case of iridium.

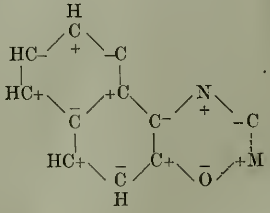
5. Glyoximines

"*Nickel may be precipitated from its ammoniacal or acetic acid solution by addition of an alcoholic solution of α-dimethylglyoxime. The voluminous scarlet precipitate is filtered through a Gooch crucible packed with asbestos and dried at 110° to 120° C. The nickel is either weighed as $C_8H_{14}N_4O_4Ni$, which contains 20·33 per cent. of metal, or ignited and weighed as oxide. Even more sensitive is α-diphenylglyoxime (α-benzil dioxime), which gives with nickel compounds a bulky red precipitate, insoluble in water, alcohol, acetone, ammonia and 10 per cent. acetic acid. It becomes reddish yellow on boiling. One part of nickel per 5,000,000 of water may be detected by this reagent. The estimation of nickel is conducted in a precisely similar manner to that with the dimethyl derivative, the precipitate being dried at 110° to 112° C., and containing 10·93 per cent. of nickel. The formula of the precipitate is $C_{28}H_{22}N_4O_4Ni$.*"

"*The method is available in presence of cobalt, iron, manganese, zinc, magnesium and chromium.*"

The nickel derivatives of the glyoximes are amongst the most remarkable compounds in the whole range of analytical chemistry. Tschugaeff, in describing dimethylglyoxime, HON:CMe.CMe:NOH, as a reagent for nickel (*Ber.*, 1905, 38, 2520) claimed that one part of nickel could be detected in 5000 parts of cobalt. In addition to their insolubility in water, and the highly selective character of the processes by which they are formed,—two *properties* which make them of special value in analysis—the *dioximines*, as Tschugaeff calls them, are possessed of quite remarkable stability. Thus the scarlet *nickel dimethyldioximine*, Ni(O.N:CMe.CMe:N.OH)$_2$, can be sublimed unchanged at 250°. Alkaline hydroxides and carbonates do not attack it, nor does hydrogen sulphide; weak acids also have no action, but with strong acids a reversible double decomposition takes place. The corresponding *palladium dimethyldioximine*, Pd(O.N:CMe:CMe.N.OH)$_2$, with a molecular weight of 365, can be sublimed without decomposition in a vacuum. The *platinous dioximines*, *e.g.*, Pt(O.N:CMe:CMe:NOH)$_2$, are even more stable than the corresponding compounds of nickel, since potassium cyanide appears to be the only agent which easily and completely decomposes them with separation of the free glyoxime; they are soluble in dilute alkalies and take up bromine to form dibromides. Like the palladium compounds, they can be sublimed without decomposition in a vacuum.

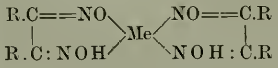
It is of interest to inquire into the origin of the stability of the complexes formed by these three metals, as well as into the highly-selective character of the action. By way of contrast it may be noted that, whilst cobalt can be precipitated quantitatively by means of nitroso-β-naphthol, the solution must be free from *copper*, *chromium* and *iron*. In this case the stability of the co-ordination-complex depends largely on the formation of a conjugated ring-system as shown in the formula I, in which the metallic ion $\overset{+}{M}$ acts as a member of a pseudo-aromatic ring. This action does not therefore possess the highly selective character which is exhibited in the case of the glyoximes.



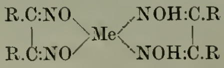
I

The structure of the dioximines is less obvious. Tschugaeff set out as possibilities the two alternative formulæ II and III.

II

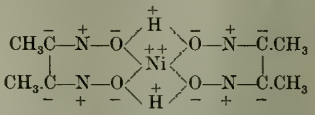


III



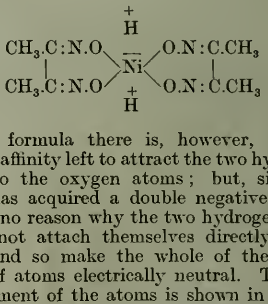
In the first of these the two "principal valencies" of the metal are attached to oxime groups on *two different molecules* of the glyoxime, whilst in the second both principal valencies are attached to *the same molecule* of the glyoxime, the other molecule being held (like a double salt) by "subsidiary valencies" only; in both cases, however, ring-formation was regarded as an important factor in promoting co-ordination. Assuming, provisionally, that Tschugaeff's first formula is correct, it is still by no means clear how the subsidiary valencies are brought into play, since the metal might conceivably be co-ordinated with any one of the three atoms of the oxime group, :NOH, or even with the group as a whole. By making use of the system of polar double bonds a clearer interpretation becomes possible since, of the three atoms of the oxime group, only the oxygen is shown as negatively charged. The secondary valencies of the positively-charged nickel must therefore be associated with the negatively-charged oxygen atoms of the oxime groups. This gives rise to the symmetrical formula IV:—

IV



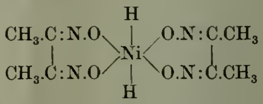
in which, however, a further element of symmetry has been introduced by assuming that the two hydrogen atoms are each co-ordinated with *a pair* of oxygen atoms, just as the bivalent nickel is co-ordinated with *two pairs* of oxygen atoms. In this scheme the nickel is shown as building up a shell of 16 electrons by sharing 4 pairs of electrons with 4 co-ordinated oxygen atoms. This sharing has the effect of uniting the metal by covalencies to the 4 oxygen atoms; but it also transfers to the nickel 1 electron from each oxygen atom. This makes the 4 oxygen atoms neutral (compare the 6 chlorines in Sidgwick's formula for the platinichlorides (*Chemistry and Industry*, April 26, 1923), whilst the nickel acquires a double negative charge, as in formula V.:—

V



In this formula there is, however, now no residual affinity left to attract the two hydrogen-nuclei to the oxygen atoms; but, since the nickel has acquired a double negative charge, there is no reason why the two hydrogen nuclei should not attach themselves directly to the metal and so make the whole of the central group of atoms electrically neutral. The final arrangement of the atoms is shown in formula VI, where the nickel is united by covalencies to 2 neutral hydrogen atoms and 4 neutral oxygen atoms.

VI

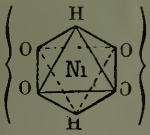


The substantial correctness of this method of representation is proved by the fact that whilst the parent glyoximes are ionisable, and interact readily with a large range of metallic salts, the dioximines are not ionisable, although the conventional formulæ, $M(O.N{:}CR.CR{:}N.OH)_2$, show them as still containing an oxime group. The hydrogen of this second oxime group cannot, however, be displaced even by alkalis; and, indeed, it is actually the custom to precipitate the dioximines in presence of an excess of ammonia, since they are even less soluble in alkaline than in acid solutions.

By way of contrast it may be noted that in the cobalt dioximines the metal is tervalent; the complex therefore acts as a univalent kation and forms a series of soluble univalent salts. The co-ordination-number of the cobaltic ion is, however, 6 and not 4; the cobaltic dioximines therefore combine with 2 molecules of ammonia, and are usually isolated in the form of complex ammines such as $[Co(O.N:CMe.CMe:N.OH)_2.2NH_3]Cl$.

As regards the spatial arrangement of the groups in nickel dioximine, it is at least likely that the 6 co-ordinated atoms are distributed round the central atom of nickel in an octahedral pattern; and, further, that the 4 oxygens occupy a plane of symmetry of the octahedron, whilst the 2 hydrogen atoms are situated at opposite apices. This arrangement is shown in formula VII, where the lines now indicate the directions of the octahedral edges instead of the bonds between the atoms.

VII



This formula is of special interest on account of the fact that we may perhaps find here a clue to the origin of the special facility with which nickel, palladium and platinum are able to bring about catalytic hydrogenation and dehydrogenation. Thus in formula VII the metal is united simultaneously to 2 atoms of hydrogen and to 4 atoms of oxygen, the latter being grouped into 2 pairs by nitrogen-carbon bridges. If these bridges were eliminated the formula might equally well be used to represent a complex, formed by the union of $Ni+H_2+2O_2$ or $Pd+H_2+2O_2$ or $Pt+H_2+2O_2$, in which the hydrogen molecules are activated by being split into two atoms, and the oxygen molecules by the opening out of their double bonds. Similar formulæ can be devised to show the simultaneous association of ethylene and hydrogen with the metal.

As Tschugaeff points out, these extremely stable dioximines belong to the general type of Peyrone's salt $[PtCl_2.2NH_3]$, with which, moreover, they agree in that the platinous dioximines yield *dibromides* analogous to the platinic ammines of the type $PtCl_4.2NH_3$, in which the bivalent metal has become quadrivalent. The dioximines, therefore, like so many other of the co-ordinated nickelous, palladous and platinous complexes, are 2 electrons short of the number required to complete the ring system of the next inert gas. The tolerance of a shortage of electrons, which was discussed in the second article of this series (*Chemistry and Industry*, March 29, 1923) appears here to become a positive preference. Thus the cupric dioximines (which contain only one electron too few) are less stable towards reagents than the corresponding nickel, palladium and platinum salts; they are also soluble in water and cannot be sublimed without decomposition even in a vacuum. Again, the zinc salts, in spite of containing the "correct" number of electrons, do not appear to form co-ordinated dioximines; at least, it has been proved that they do not interfere with the estimation of nickel by this method. In this peculiarity we appear to be face to face with a fundamental problem of atomic structure, for a solution of which we may perhaps look to the physicist, who, in his periodic classification of the elements, has at least drawn a series of rectangles, which enclose nickel, palladium and platinum, but exclude copper and zinc.

6. Summary

(*a*) The use of co-ordination compounds has provided a complete solution of the difficult problem of the separation and estimation of the metals of the transition series.

(*b*) The separations by means of carbonyls, double cyanides and double nitrites depend on the formation of complexes in which the electrons in the outer shell of the metal are made up to the number present in the next inert gas by a process of sharing electrons with co-ordinated groups.

(*c*) In the dioximines, the complex contains 2 electrons less than the number required to complete this total. These compounds are, however, remarkably stable, and can be used to effect a complete separation of nickel, palladium or platinum from other metals. The simultaneous presence of hydrogen and oxygen in the complex may perhaps afford a clue to the special value of these three metals in catalytic hydrogenation and dehydrogenation.

BRITISH FINE CHEMICALS

The British Drug Houses, Ltd., has recently issued a further catalogue, in which are listed over 3000 pure chemicals for use in research, analysis and teaching. The extensive range of rare chemicals stocked has been further increased, and inquiries are invited for any that are not included in the present list. Not only is the catalogue continually being enlarged, but we are informed that British Drug Houses, Ltd., will be pleased to purchase any reasonable quantity of new pure compounds from institutions or persons willing to co-operate in making the list more complete. Copies of tests and standards relating to the various substances listed can be supplied on request, and the firm also makes a speciality of indicators for the determination of hydrogen-ion concentration, and of preparations, such as stains, etc., for use in microscopy. Such an endeavour to make this country self-supporting in the matter of fine chemicals deserves every commendation.

LABORATORY ORGANISATION

By T. CALLAN, M.Sc., Ph.D.

The idea of a co-operative laboratory is one which in this country has not met with much support. Many progressive manufacturers and firms in a comparatively small way of business appreciate the value of a chemist, or as the authors of the book* under review would say, a scientist, thereby including the metallurgist, physicist, bacteriologist, etc., and would willingly employ one if the magnitude of their business would allow it. The co-operative laboratory idea simply means that the manufacturer or firm who cannot afford to employ, say, a whole-time chemist agrees to employ a part-time one—in other words, a group of manufacturers or firms, either representing the same interests or alternatively representing carefully-chosen non-competitive interests, guarantees the salaries and laboratory working expenses of a scientific organisation working solely for them on such problems, including and in many cases wholly consisting of, routine analyses which they submit to the laboratory. Such an organisation is in direct competition with professional analysts and technologists who are apt to see in it a diversion of work which would otherwise in part, at least, come to them. It is just such professional men, however, with whom the small manufacturer, who only makes use of scientific advice and assistance when actually compelled to, comes chiefly into contact, so that those who are in the best position to bring the co-operative laboratory idea to the small manufacturers' attention are least likely to do so.

The co-operative laboratory differs fundamentally from the Research Associations recently set up by most industries in being run on purely commercial lines. In the writer's opinion the development of such co-operative laboratories is much to be encouraged. There is no reason why every manufacturer's federation should not have its own industrial laboratory which could be made use of by every member not in a sufficiently large way of business to employ a whole-time chemist.

To the small manufacturer desirous of tentatively introducing a moderate measure of scientific control, either from conviction or by pressure of competition, the cost of providing laboratory accommodation and an adequate salary for a trained chemist is often prohibitive, so that the idea is either abandoned or a junior from the local Technical College is appointed with the dignified title of "our chemist," with inevitable subsequent disappointment. The co-operative laboratory offers another alternative and an excellent example of such an organisation is afforded by the Midland Laboratory Guild, Ltd., formed by a number of Birmingham manufacturers of brass and copper alloys, and its formation, equipment and complete organisation form the subject-matter of this exceptionally well-written volume.

These firms agreed to join with each other to establish a co-operative chemical and physical laboratory; each firm paid an entrance fee which in the aggregate was estimated to be required to equip completely the building, and further agreed to guarantee a minimum sum per annum for its upkeep. The laboratory then undertook all the work, chemical, physical and metallurgical, submitted by its constituent proprietors, the cost of running the laboratory being charged against the constituent firms proportionately to the amount of work carried out for each. The volume commences with a description of the laboratory and its equipment, and careful details are given as to arrangements of service pipes and general layout of benches, sinks, ventilation, fume chambers, etc., to ensure maximum efficiency—efficiency being measured in terms of speed and accuracy and the ability to deal with the requisite work with the smallest number of operators and a minimum cost for materials. As the authors rightly say, this standpoint from which to measure efficiency is often neglected in planning a new laboratory. It is unfortunate, however, that after the authors' earnest advocacy of efficient ventilation that *Plate I* showing the interior of the chemical laboratory should show a gas-fired combustion furnace on the open laboratory bench without hood. The authors devote considerable attention to the organisation of the laboratory, and this section of the book is well worth the attention of all who have to control industrial laboratories. They rightly say there is ample room in most of them for an improved organisation. How quickly can the figure of an analysis or the results of an investigation made a year ago be ascertained? How many tests of a certain kind have been made in a given period? What percentage of clerical errors is made? In the event of an error or dispute, how readily can the error be traced to its proper source? The answers to these and similar questions all depend on efficient organisation, and the authors' method is detailed at full length from the receipt and labelling of the sample or problem to the final report and filing of records.

A necessary corollary to an efficient system of laboratory organisation is a system of costing laboratory output; and a special chapter is devoted to this important subject. The authors' method is extremely simple and apparently effective. A standard unit determination is arbitrarily chosen, in the authors' case the volumetric determination of copper, and the relative values of other analyses or investigations are estimated against this unit as regards time spent, material consumed and skill required; thus against the unit stated, the determination of copper in white metal is worth 3 units, the saponification of an oil 2·5 units and so on, the values being adjusted as found necessary from time to time. The output of the laboratory, and indeed of each individual worker thus becomes available in terms of units of work done as well as the total capacity of the laboratory determined at some period during which the whole staff is fully engaged, so that the cost per unit is readily arrived at from the total running expenses, salaries, etc., and can then be used to give a correct allocation of costs to the proprietary firms supporting the laboratory. This system, the authors point out, is particularly well adapted to laboratories where it is essential that no profits be made, as, for example, the analytical laboratory of a large concern receiving samples from various departments where the cost of the analytical laboratory requires to be charged proportionately against those departments making use of its services. The sections dealing with laboratory equipment, organisation and costing, with an excellent chapter on the selection and training of the personnel of the laboratory, constitute about half the volume and form a most valuable contribution to subjects usually much neglected and yet on which the financial success of a commercial laboratory, whether run for profit as a private enterprise or as a co-operative organisation, largely depends. The remaining half of the book consists of a series of wholly delightful essays on the scientist in relation to this, that and the other, the mentality of the scientist, and the position of the scientist in industry, and although, strictly speaking, these have little to do with the subject covered by the title of the book the authors may readily be forgiven for having introduced them, for anyone interested in laboratory organisation cannot fail to find them extremely helpful and suggestive, and a real help in trying to see the other man's point of view, whether the other man be manufacturer or laboratory worker.

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* "A Tested Method of Laboratory Organisation." By Seymour Pile, M.A., and R. Johnston. Pp.xx+98. London: H. F. & G. Witherby, 1923. Price 7s. 6d.

CHINESE OUTPUT OF GALLNUTS

Gallnuts grow in many parts of China, but the chief producing areas are in the north-west of the province of Hunan, near the Hupeh border; in Szechwan (south-east corner); in Kwangsi (north-west of Kingyuan); and on the Kweichow-Szechwan border. As in pre-war days, Germany is the largest buyer of Chinese gallnuts, followed by Japan, but exports to both countries have decreased compared with pre-war totals. The United States, Great Britain, France and Belgium are also important purchasers. Exports have decreased from 65,890 piculs in 1910, to 47,234 piculs in 1920 and 34,365 piculs in 1921. (picul=133·3 lbs.)—(*Ch. Comm. J., Mar.* 9, 1923.)

FORTHCOMING EVENTS

May 11. The Iron and Steel Institute, Annual Meeting at Great George Street, Westminster, S.W. 1, commencing at 10 a.m.

May 11. The Royal Institution of Great Britain, 21, Albemarle Street, at 9 p.m. "Gaseous Combustion at High Pressures," by Prof. W. A. Bone.

May 11. Institution of Engineering Inspection, Royal Society of Arts, John Street, W.C. 2, at 7.30 p.m. "Some Notes on 'Ciment fondu'—a Cement of High Initial Resistance—with Results of Chemical Analysis by H. F. Knight, F.I.C.," by H. J. Davey, M.B.E.

May 11. University of London, University College, Gower Street, W.C. 1. "Some Scientific Principles of Chemical Industry," by W. Macnab, F.I.C., also on May 18, at 5 p.m.

May 14. The Biochemical Society, Joint Meeting with the London Section of the Institute of Brewing, in the Engineers' Club, 39, Coventry Street, W. 1, at 7.30 p.m. (1) "Biochemical Aspect of Fermentation," by Dr. A. Slator. (2) "Physiological Aspects of Germination," by Prof. V. H. Blackman, F.R.S. (3) "Chemical Aspects of Germination," by J. L. Baker and H. F. E. Hulton.

May 14. Institution of Rubber Industry, Meeting at the Midland Hotel, Manchester. "The Scope and Progress of the Research Association," by B. D. Porritt, M.Sc.

May 14. Royal Society of Arts (Howard Lecture), at 8 p.m. "The Development of the Steam Turbine," by S. S. Cook. (Lecture 3).

May 16. The Royal Institute of Public Health. The Scarborough Congress, 1923. Among other papers the following will be read:—(1) "Ultra Microscopic Viruses," by F. W. Twort, L.R.C.P. (2) "Autolysis and Bacteriophagy," by Dr. D'Herelle. (3) "Mineral Constituents of Milk," by W. Godden, B.Sc. (4) "Dried Milk," by G. E. C. Pritchard, M.A. (5) "The Milk Problem," by H. Scurfield, M.D. (6) "Stability of Vitamins," by H. Jephcott, M.Sc. (7) "The Handling of Chemical and Bacterial Problems in Preserved Foods," by Miss C. M. Dugdale, A.I.C. (8) "Present Position of Glycosuria and Diabetes," by Prof. H. Maclean, M.D. (9) "The Influence of Atmospheric Conditions on the Health of Industrial Worker," by H. M. Vernon, M.A. (10) "Industrial Lighting," by D. R. Wilson, M.A. (11) "Industrial Dermatitis," by W. J. O'Donovan, M.D. (12) "The Causes of Fur Dermatosis," by R. P. White, M.D. The Congress continues until May 21, inclusive.

May 17. The Royal Institution of Great Britain, at 3 p.m. "Engineering Problems," by Prof. E. G. Coker.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

Again the Correspondence Columns indicate the extent to which this Journal makes its appeal. It can only be a brief space of time before advertisers realise this. Clarence Joyce's letter from America recalls one of the objects with which the Committee who were charged with the duty of bringing out this weekly paper started. It was felt that with the growth of scientific education in all schools there was a public growing up who would welcome a scientific weekly paper. A paper which, while catering for the thousands of members of the Society of Chemical Industry would appeal to the industrialist, and even to that growing mass of the public who, having had some amount of scientific training no longer yearn for the classical, the poetical, or the inane in literature. We have nothing in this country quite like the *Scientific American*, which I have read regularly for years, and which has now become so popular that it has made its appearance on the railway bookstalls. So has *Chemistry and Industry.* Some day I shall see them cheek by jowl, and then it will not be long before we see some illustrations appearing in our paper.

The German Offer which has been eagerly awaited but largely discounted before it arrived, leaves matters in the occupied areas very much where they were. As it compared unfavourably with Mr. Bonar Law's scheme which met with such little enthusiasm in France, there was little likelihood of its meeting with a better fate. Yet, in one way, it does make a tentative advance towards a settlement, it is a definite, although inadequate, offer. Such is the German way; prolonged argument always had to precede the actual doing of business. In the meantime the exchange has again been subject to violent fluctuations, and the German printing presses have been turning out paper currency at an increased rate. Little else is being exported, and the stream of dyestuffs and fine chemicals has dried up. What the end will be is difficult to foresee, but the increasing bitterness against France and England as well which is heard on all sides in Germany is indicative of the desperate condition of that country.

Japanese Dyestuff Firms according to the Special Correspondent of the *Times Trade Supplement* are going through a difficult time. There are only two companies of much substance, the Japan Dyestuff Manufacturing Company, which is the special pet of the Government, and the Mitsui Dyestuff Works under the Mitsui Mining Company. In the latter part of 1920 Japan was flooded with German dyes and the smaller companies were forced out of business. At the present time there are large stocks of German dyes in Yokohama and Kobe and although small speculative purchases of British chemicals and dyestuffs were made when the Ruhr trouble commenced, the presence of these stocks has prevented anything like a real demand on this country.

In his Third Cantor Lecture on "Nitrates from the Air" Mr. Kilburn Scott dealt mainly with the Haber process and I was interested in the particulars which he gave with reference to the progress at Billingham. Too little information has been available as to what is, perhaps, the most important plant in this country from the point of view of national safety. We are now told that for a considerable time several tons of pure ammonia have been made per day in a small plant. There has been a ready sale for this, and Messrs. Brunner Mond & Co., Ltd., hope to start producing on the manufacturing scale 120 tons of sulphate of ammonia daily some time this year. The plans, however, provide for a much larger output being made if circumstances should require it. I was very glad to hear Dr. Harker during the discussion which followed the lecture. He has made this subject peculiarly his own, but I sometimes wish I could hear his case stated by someone else. I have a feeling there is more in it than he sometimes makes it appear. Mr. Scott's reply to the discussion included one complaint which I have voiced in this column already. He said we were very fine fellows, but that we lacked the habit of working together. Very true. We are better than we were, but there is still lots of room for improvement in this direction.

The Dyers' Company during the past few weeks has added to the number of its liverymen three persons who have in different ways some knowledge of the position of dyestuffs in this country. Sir William Alexander, of the British Dyestuffs Corporation, will bring with him the prestige and knowledge which his position as Chairman of the Corporation gives him. Mr. Sutcliffe Smith of the Bradford Dyers' Association, as Chairman of the Colour Users' Association, has played a very important part in guiding a somewhat intractable body of men. That he has been successful, places him in the front rank of those who are called "tactful." You need to be honest if you would succeed in a post of that kind. Mr. Woolcock was no doubt included by reason of his Chairmanship of the Development Committee under the Dyestuffs Acts.

SOCIETY OF CHEMICAL INDUSTRY

THE ANNUAL MEETING

Cambridge, June 20 to 23, 1923

The following is the programme of arrangements, of which a full account has been sent to every member of the Society :—

Wednesday, June 20. 8.30 p.m. Smoking Concert (place to be announced later).

Thursday, June 21. 10 a.m. Council Meeting in the Arts School, Bene't Street. 11 a.m. Welcome by the Vice-Chancellor of the University (Rev. E. C. Pearce, D.D.) in the Arts School. Annual General Meeting of the Society. Address by the President, Dr. E. F. Armstrong, F.R.S. During the afternoon there will be visits to Gardens and Colleges, Boating, Tennis, etc. 5 p.m. Reception by the Vice-Chancellor of the University in the Fitzwilliam Museum, where tea will be provided. 9 p.m.—2 a.m. Reception in the Guildhall by the President and Mrs. Armstrong, to be followed by a Dance.

Friday, June 22.—11 a.m. Presentation of the Society's Medal to C. C. Carpenter, Esq., C.B.E., D.Sc., M.Inst.C.E., in the Arts School. Address by Dr. Carpenter. About 2.30 p.m. Address by Dr. F. W. Aston, F.R.S., on " Isotopes," in the Arts School. Garden Party at Sidney Sussex College. Tea will be served during the afternoon in the gardens (in the Hall, if wet). 7.30 p.m. Annual Dinner of the Society in the Hall of Trinity College, at which a large number of Cambridge guests will, it is hoped, be present.

Saturday, June 23.—Charabanc trip to Ely and its Cathedral, returning to Cambridge in the afternoon. The party should set out about 10 a.m., but the precise time of leaving will be intimated later. Lunch will be served at Ely.

The office of the Society during the Annual Meetings will be at the Arts School, Bene't Street. It has been decided on this occasion to charge an inclusive fee of £1 10s., in return for which a member will be supplied with a ticket for each of the functions, including the Dinner (inclusive of wines), the Dance, the trip to Ely and the lunch there. Tickets for ladies and members' guests are also £1 10s. each.

In addition to hotel accommodation, hospitality will be offered by several Cambridge hostesses to members accompanied by their wives or daughters, and to lady members, and single men accommodated in college rooms. The following Colleges have already agreed to offer accommodation : King's, Magdalene, Pembroke, Downing and Jesus, from Wednesday, June 20 ; Trinity College from Thursday, June 21. Members intending to be present at the Annual Meeting should arrange for their accommodation without delay. All communications regarding this should be sent either to the General Secretary in London (up to May 30), or to Mr. J. E. G. Harris, University Chemical Laboratory, Downing Street, Cambridge, stating whether the member desires : (1) hospitality ; (2) accommodation at one of the Colleges ; or (3) hotel accommodation. In each case information should be supplied as to whether or not the member will be accompanied by friends, and in the former case the names and addresses of these should be given.

A Ladies' Committee, of which Mrs. Weekes, wife of the Master of Sidney Sussex College, is Chairman, and of which Mrs. W. H. Mills and Mrs. Oliver Prior are Secretaries, has been formed to look after the interests of ladies attending the meetings. Mrs. C. T. Heycock is arranging for tennis in gardens and colleges, and for boating. Ladies are eligible to attend the meetings, including the Smoking Concert, the Dinner, the Dance, and the Excursion to Ely.

J. P. Longstaff,
General Secretary

Central House,
Finsbury Square,
London, E.C. 2

NEWS FROM THE SECTIONS

OTTAWA SECTION

Mr. F. J. Hambly occupied the chair at the meeting held on April 12 at the University Club, Elgin Street, Ottawa. After the minutes of the previous meeting had been read and approved, Dr. Tingle reported that suggested amendments to the Bill relating to Patents of Invention had been sent to the Minister of Trade and Commerce. The Secretary said that several more papers were nearly ready for publication, and that the committee felt that such papers should receive a far greater circulation. It was suggested that a Papers Committee of about ten members should be appointed next year.

Mr. R. J. Traill, research chemist of the Ore Dressing and Metallurgical Division of the Mines Branch, then read a paper on " Electrolytic Iron," in which he traced the development of the electrolytic production of iron from the beginning. Electrolytic refining of iron was at present an infant industry, but electrolytic refining was well established for the treatment of other metals such as zinc, copper, etc. The production of pure iron by electrolysis had been known for over 70 years, but not until the last ten or fifteen years, when the unusual physical and chemical properties of electrolytic iron were realised, was real interest taken in its production. The work of various investigators in this field was discussed and special attention was paid to the Eustis process, which is applicable to the direct treatment of ores, particularly pyrrhotite and iron pyrite ores, and for the recovery of sulphur as a by-product, as well as copper, lead, zinc, gold and silver, when these are present. Such a process was of particular importance for Canada, which had large resources in pyrrhotites and iron pyrites, many of these containing valuable metals, present, however, in insufficient quantities to make the deposits workable for these metals alone, but worthy of recovering as by-products in the production of electrolytic iron. The author then described some preliminary tests made to investigate the process from the point of view of utilising Canadian ores. In conclusion Mr. Traill outlined various uses of electrolytic iron, such as electrical machinery and appliances, liquid containers, pipes, wire, parts to be galvanised or nickel-plated, kitchen utensils, etc.

MANCHESTER SECTION

The eighth meeting of the Manchester Section was held on May 4, Dr. E. Ardern, F.I.C., being in the chair.

Mr. Howard Cheetham read a paper entitled "Reflections on Patents," in which he briefly discussed the history of English Patent Law, the effect of the conditions in which it began on judicial and public opinion regarding the protection of inventions and discoveries, and drew attention to the suggestions now being made in France for the better reward of scientific workers.

The second paper, by Messrs. F. S. Sinnatt, A. B. Owles and N. Simpkin, was entitled: "The Inorganic Constituents of Coal," Part 4, "The Melting Point of Coal Ash." Mr. Sinnatt, in reading the paper, explained that it was chiefly concerned with the description of a method of determining the melting point of ash, and an examination of the melting point of the various ingredients which could be separated from coal seams. The term melting point had been adopted to describe the complete melting of the ash, whilst the softening point was the temperature at which the first signs of softening occurred. The literature on the subject was reviewed, and an apparatus devised by the authors for the purpose of their experiments was exhibited. It was shown that there were wide variations in the melting point of ash from coal in different portions of the same seam.

A paper entitled "The Behaviour of the Principal Celluloses Towards Iodine and Dyestuffs," by Messrs. J. Huebner and J. H. Sinha, was read by Mr. Huebner. It was shown that different celluloses absorbed dyestuffs in very varying proportions, that the problem was one of considerable complexity, and that celluloses were not such simple bodies as they were frequently supposed to be. Although they had the same chemical formulæ they were entirely different, and differed very materially in their behaviour towards chemical reagents. It was not beyond possibility that the lengths and diameters of the fibres had something to do with the absorption of dyestuffs and of iodine.

LIVERPOOL SECTION

The annual meeting was held in the Muspratt Lecture Theatre of the University of Liverpool, on April 27, Professor E. C. C. Baly, F.R.S., in the chair. The following elections were made for the Session 1923-4:—Chairman, Mr. Edwin Thompson; Vice-Chairman, Dr. G. C. Clayton, M.P.; Hon. Treasurer, Dr. Alfred Holt; Hon. Secretary, Mr. E. Gabriel Jones. Four vacancies on the Committee were filled by the election of Dr. H. A. Auden, Captain F. W. Bain, Col. E. Briggs, and Dr. C. H. Clarke. The Secretary then submitted a report on the work of the past Session.

Mr. W. Ramsay, F.I.C., read a "Note on Petroleum." He had found a small quantity of nickel in crude Mexican oil, and this led him to examine specimens of petroleum from different parts of the world; in all cases except one—a refined ozokerite—the presence of nickel was demonstrated, the amounts varying from one part to over 200 parts per million. Sabatier and Senderens had produced artificial petroleum oils by hydrogenating acetylene at high temperatures and pressures and had suggested that natural petroleums were formed in the interior of the earth by some such hydrogenation process. Carbon, carbon monoxide, and carbon dioxide could be hydrogenated to form methane at comparatively low pressures and temperatures, and the author's results led to the conclusion that the theory of Sabatier and Senderens might possibly be the correct explanation of the origin of petroleum, the nickel found being the catalyst by the help of which the reactions have proceeded. An attempt was made to ascertain the condition in which the nickel was present in the oil, but this proved unsuccessful; the author, however, came to the conclusion that the metal was either in solution in the oil, or, more probably, in a colloidal form or fine suspension.

A paper on the "Determination of Sulphur" was read by Mr. J. M. Taylor, F.I.C., who said that, to determine sulphur, it was almost invariably converted into sulphuric acid or a sulphate and precipitated as barium sulphate. Variations in the conditions of acidity, method of addition of barium chloride, nature of other salts present and concentration of the solution, affected the purity of the barium sulphate. The best conditions for the determination of sulphur had been investigated by Lunge, Pattinson and others, but there appeared to be room for further work, as differences of over 1 per cent. in the sulphur content of pyrites, for example, were frequently found. Tables showing the variation of the barium sulphate obtained by employing different methods of adding barium chloride were shown. A higher degree of acidity during the precipitation of barium sulphate seemed to give more accurate results; in addition, the precipitate was obtained in a crystalline form, so that it settled and washed much more quickly than when precipitated in a slightly acid solution, as generally suggested. To obtain a still purer form of barium sulphate it was necessary to add the barium chloride and the sulphate simultaneously to boiling water acidified by hydrochloric acid, with constant stirring. This was equivalent to the precipitation of extremely dilute solutions of sulphuric acid by equally dilute solutions of barium chloride.

Precipitated in this manner, a heavy, distinctly crystalline barium sulphate was formed, which was practically pure, and could be washed readily and filtered perfectly through a single paper. The principle of adding two soluble salts simultaneously, so as to obtain a purer salt in larger crystals, was capable of a wide application. This principle was employed during the war to obtain explosives in a purer form, and by its use a crystalline form of calcium carbonate was obtained which could be treated on a mechanical filter, thus securing a larger output. In conclusion, methods of analysis formulated at the Central Laboratory, Widnes, for some of the new compounds now prepared in this country, including sulphur mono and di-chloride, thionyl chloride, chlorsulphonic acid and leucotrope were described.

CHEMICAL ENGINEERING GROUP

The Fourth Annual Meeting and Dinner was held at the Engineers' Club, London, on May 4, Mr. J. Arthur Reavell presiding. After the minutes of the third annual general meeting had been confirmed, the Hon. Secretary, Mr. H. Talbot, presented his report on the work of the year. The work of the committee of the Group during the past year consisted mainly in strengthening the organisation of the Group, particularly in reference to its relations with the parent Society, and in an endeavour to secure its continued well-being, rather than in active propaganda work by means of meetings, conferences and the like. This course was due largely to financial reasons, as the deficit on the previous year's working had persisted during the past year. The Data Sheet Committee had continued its labours, which had temporarily been suspended owing to lack of funds. Two data sheets, "The Properties of Tan Extract Liquors" and "Condensation Curves for Hydrochloric Acid," had been issued, owing to the receipt of a special grant of £100 from the Messel Memorial Fund of the Society. After expressing regret at the resignation from the Group Committee of Dr. H. J. Bush, who assisted in the inauguration of the Group and had done extremely valuable work on the Committee ever since, reference was made to the relations between the Group and the parent Society, which had continued to be the subject of much negotiation and discussion during the past year, following the preliminary agreement arrived at and reported to the last annual general meeting. The Hon. Secretary said it was impossible to overrate the services rendered to the Group by the Chairman, Mr. J. A. Reavell, and the Hon. Treasurer, Mr. F. H. Rogers, on the one hand, and by Dr. Armstrong, President of the Society, and Mr. E. V. Evans, Hon. Treasurer of the Society, on the other. As a result, the feeling between the two bodies had never been more cordial and, as evidence of this, the Group had been entrusted with the whole of the organisation of the Chemical Section of the World Power Conference to take place at the opening of the British Empire Exhibition during 1924. Similarly, the relations between the Group and the Institution of Chemical Engineers was naturally extremely close and joint offices were now shared in Abbey House, Westminster. The future position between the two bodies was still the subject of negotiations, and the Group Committee feels that in everybody's interests the two organisations cannot be too closely allied. Reference was then made to the various meetings held during the year, and regret expressed that the membership of the Group had declined from 401 to 315 at the end of the year, though the latter number had since considerably increased. As a result of the decrease in membership during the year, the revenue of the Group suffered, but the Society agreed to meet the deficiency on the past two years, amounting to £173, and special thanks were recorded to the Society for its generosity. At the beginning of 1922 an American Section of the Group was inaugurated, which continued in existence, although the organisation initially developed for its work might have to be revised, in view of the new relations between the Group and the Society. As one consequence of the formation of the American Section, the Committee nominated Dr. Ruttan, a past-president of the Society, as the first honorary member of the Group, a compliment which Dr. Ruttan had accepted. In conclusion, the past year had seen a very definite increase in the Group's stability, and it was anticipated that with the financial arrangements now made, the Group would be able to do much more useful work in the future than was possible in the past. The Hon. Secretary's report was adopted without discussion.

Mr. F. H. Rogers, Hon. Treasurer, in his report, said the falling off in membership during the year was due not to lack of interest in the work of the Group but to the trade slump. The arrangements by which the Society now collected the subscriptions of the members of the Group had brought in more members, so that the position now was more satisfactory, and the Group started the current year free of debt. There had been some discussion as to whether an appeal should be made to the members of the Group for donations, but it had been thought wise not to do that. Had such an appeal been made he was sure it would have met with a very good response, but after discussion with the parent Society it was arranged that the deficit should be borne by the Society. The Hon. Treasurer's report and the balance-sheet were adopted.

New rules for the Group were then adopted, consisting of certain modifications of the existing rules, based on those of the London Section, the working of which was slightly different from the working of the Group. The new rules were adopted, subject to confirmation by the Council of the Society.

With regard to members of Council for the coming year, the Hon. Secretary reported that there had been no nominations, and he therefore suggested that the existing members of Council should be re-elected. This was agreed to, and the present Chairman, Mr. J. A. Reavell, Hon. Treasurer, Mr. F. H. Rogers, and Hon. Secretary, Mr. H. Talbot, were also re-elected.

On the motion of Mr. Rogers, a hearty vote of thanks was accorded to the parent Society, special reference being made to Mr. E. V. Evans, the Hon. Treasurer of the parent Society, for the manner in which he had supported the Group in regard to financial assistance.

Prof. J. H. Hinchley, proposing a vote of thanks to the Chairman, Hon. Treasurer and Hon. Secretary, said that only those who were behind the scenes knew the amount of work actually done by these three gentlemen. He felt that the Group was now soundly established, and this was largely due to the work of these three gentlemen.

The only toast at the subsequent dinner was "The King," the rest of the evening being spent in listening to an interesting musical programme.

MEETINGS OF OTHER SOCIETIES

INSTITUTE OF METALS

The Thirteenth Annual May Lecture was delivered on May 2, by Dr. W. Rosenhain, F.R.S., of the National Physical Laboratory, the subject being the "Structure of Alloys." Referring to the great accumulation of facts relating to the properties and microstructure of alloys during recent years, the lecturer said that the time had arrived when it was most desirable that a key should be found to this maze of knowledge in the form of a general theory that would link together the mass of facts into a homogeneous whole. Such a theory he attempted to put forward, basing it upon the intimate knowledge of crystal structure which had recently been acquired by means of the application of X-rays to the study of the arrangement of atoms in crystals. The crystal structures found in pure metals became modified in the case of alloys, particularly in those called solid solutions, where a second kind of atom, the atom of the alloying element, entered into the structure of the crystal and produced in it certain minute changes. With regard to such changes, the lecturer put forward two simple principles, and was then able to show a striking series of inferences from his theory, which accorded closely with a large number of experimental facts. Connexions between various series of properties in metals and their alloys were established which had not formerly been recognised, such as the relation between hardness and alloying power. Especially important was the connexion between the minute distortion of crystal structure which occurred in alloys and their behaviour on melting and freezing, whilst such phenomena as plasticity, diffusion and others fell easily into line with the same type of explanation. Most important of all, perhaps, was the fact that this new theory of alloy structure afforded a ready explanation of the electrical properties of metals and alloys and the changes of those properties when the metal was heated or cooled. These explanations covered the mysterious phenomena of super-conductivity found in many metals when cooled nearly to the absolute zero of temperature.

THE ROYAL SOCIETY

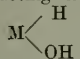
The following are abstracts of communications made to the Royal Society by Prof. H. E. Armstrong, F.R.S., on May 10 :—

I. The Origin of Osmotic Effects. IV. Hydrono-dynamic Change in Aqueous Solutions.—The conclusions arrived at are summarised in the following propositions :—

1. "Water" is a complex saturated with the gas *Hydrone*, OH_2. Primarily, hydrone is the sole potentially "active" constituent, but it becomes actually active only under conditions which suffice to determine electrolytic change.

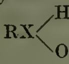
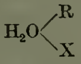
2. The vapour pressure either of water or of a solution is the measure of the proportion of free hydrone molecules present in the liquid.

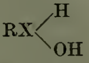
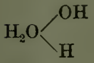
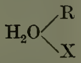
3. Although the vapour pressure is lowered in presence of any solute, the solution acquires attractive properties. The internal activity is increased whilst external activity is diminished.

4. The effect produced may be ascribed to an interaction of molecules of the solute and those of hydrone. From non-electrolytes (under the influence of conducting impurity) a simple hydrol is formed,  $M\begin{smallmatrix}/ H \\ \backslash OH\end{smallmatrix}$, only a single molecule of hydrone being "distributed" upon the molecule of the solute, whatever its magnitude.

5. In the case of potential electrolytes, a reciprocal interchange of radicles of salt and hydrone is to be postulated. Not only is the

solute hydrolated, but it is distributed upon hydrone, the salt X′R′ giving rise initially to the reciprocal systems

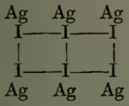

$RX{<}{}^{H}_{OH}$ and

$H_2O{<}{}^{R}_{X}$

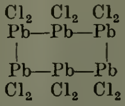
6. As the concentration is lowered, under the influence of hydrone, the complex  $RX{<}{}^{H}_{OH}$ is more and more converted into *hydronol*,  $H_2O{<}{}^{OH}_{H}$. Ultimately, the solution contains the solute only in the form  $H_2O{<}{}^{R}_{X}$ *together with an equal number of molecules of hydronol.*

7. The "distributed" reciprocal complexes, including hydronol, are the electro-chemical agents in a solution. The negative radicle in such complexes has greater residual affinity than it has in the original simple molecules.

8. The osmotic pressure manifest in an aqueous solution is the pressure exercised by the extra molecules of hydrone attracted into it by the "distributed" complexes, one by each complex, acting as though they were present in the gaseous state. In short, osmotic pressure developed within an aqueous solution, whatever the solute, has its origin in one and the same cause, and is properly spoken of as *hydrodynamic*—if the word be permissible: indeed, this term may be used as expressive of the general activity of water, *electro-chemical and osmotic.*

II. Electrolytic Conduction: Sequel to an Attempt (1886) *to Apply a Theory of Residual Affinity.*—Referring to the distinction which he drew in 1886 between simple and composite electrolytes—the former being electrolytes *per se*, the latter solutions of "salts"—the author calls attention to the diverse behaviour of the silver and lead haloids on electrolysis; the current being carried, as it were, by the metallic ion of the silver and by the halogen of the lead compound. The conclusion is drawn that the salts of the two metals differ in structure—perhaps thus





The assumption is made that the primarily active unit is the fundamental molecule, and that the circuit is formed by these molecules being coupled with (distributed at) the electrode face and with the complex molecules. A similar interpretation is applied to aqueous solutions.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

The Fuel Group of the Société met on April 25, under the presidency of Monsieur R. Etienne, professor at the National Higher School of Mines and vice-president of the Société, to discuss the terminology of liquid fuels. The necessity for defining the meaning attached in each country to the term "liquid fuel" had already been recognised by the International Union of Pure and Applied Chemistry, and by the congress on liquid fuels, held in October, 1922. Once this definition was established it was essential to prepare a list of the terms employed in each country to designate the various fuels and to complete this list by adding the chemical and physical characters of each fuel, and also the methods employed for determining these characters. It was therefore thought useful, in view of the approaching meeting at Cambridge of the International Union of Pure and Applied Chemistry to consult all those interested in the question, and it was decided to draw up, within three weeks, the list required, such list to be considered and discussed by an open commission. All the associations of producers and consumers have already undertaken to co-operate, so that the French delegation will have a very complete list to present. The question of the standardisation of terminology and analytical methods was also touched upon, but was referred for future discussion.

FEDERAL COUNCIL FOR PURE AND APPLIED CHEMISTRY

This Council consists of representatives from the Chemical Society, the Society of Chemical Industry, the Association of British Chemical Manufacturers, the Institute of Chemistry, the Society of Public Analysts, and nearly a score of other societies and associations. It has two main functions: 1, to act as the British organisation of the Union Internationale de la Chimie Pure et Appliquée; 2, to provide some sort of co-ordination between the various chemical societies of this country. Sir William Pope is the President. During the year 1922 the Federal Council assisted in the meeting of the Union Internationale held at Lyons, and was helpful in connexion with the effort to provide a weekly chemical journal to include both pure and applied chemistry. A number of other matters also came before the Council for consideration. Its income was £200, provided equally by the Chemical Society and the Society of Chemical Industry. Its only expense was the payment to the Union Internationale of 4500 francs for the year 1921, and 4500 francs for the year 1922. The Council incurred no office expenses during the year 1922, but will incur some expense this year in circulating the appeal for its fund, a note of which appears elsewhere in this issue.

CORRESPONDENCE

THE TITLE "CHEMIST"

Sir,—The Council of the British Association of Chemists wishes to endorse fully through your columns the proposals of Dr. E. F. Armstrong, set forth in his letter of April 9, for the calling of a round-table conference to discuss with the pharmacists the possibility of agreement over the future employment of the term "chemist."

The question of the education of the public mind in the correct signification of the terms "chemist" and "pharmacist" is one which has received the continuous attention of this Association, and it is felt that the calling together of such a conference as Dr. Armstrong proposes, representative of the interests concerned, would, with the active support of the press, tend in large measure to dissipate the confusion of thought at present existing in the mind of the general public.

If Dr. Armstrong will undertake further steps in the matter, we feel, that in addition to securing the immediate support of this Association, he will carry with him the whole of the other chemical societies.—We are, Sir, etc.,

for The British Association of Chemists
Herbert Levinstein, *President*
J. W. Hinchley, *Past President*
Wm. E. Kay, *Chairman of Council*
I. Boodson, *Hon. General Secretary*

108, Baker Street, W. 1
May 4, 1923

THE NITROGEN INDUSTRY

Sir,—My friend, Prof. Partington, in commenting on my review of the book by Dr. Parker and himself on "The Nitrogen Industry," appears to think that I have been a little unfair in my criticism, and that my words suggest that the volume is "written round the Report of the Nitrogen Products Committee." He considers that the parallel I gave of Mr. and Mrs. Sidney Webb's books in their relation to the Minority Report on the Poor Law is inapplicable.

But, Sir, I was careful to point out in my review, that although extensive use was made of the Committee's Report, in which the principal stress was laid on the *economics* of the various processes, the authors give "more detailed descriptions of the *processes themselves*," with illustrations of plant employed, and of a number of nitrogen factories. As in the one case there is no lack of the individuality of Mr. and Mrs. Webb, so in the other there is plenty of Partington and Parker unhesitatingly expressed. My remarks certainly did not imply want of originality in the volume in question.

I might mention that it seems unfortunate that although about 4000 copies in all of the Report of the Nitrogen Products Committee were issued, it has now been allowed to go out of print, although I know from the numerous inquiries which have reached me since I resigned from Government service, that there is still a demand for the Report, now very difficult to obtain.

I stated previously that I agree to a great extent with Prof. Partington in his criticisms as to the lack of a vigorous and definite Government policy in this country on nitrogen matters. In my view this was in large measure due to the constant changes taking place in the higher personnel of the Ministry of Munitions. As soon as a certain measure of educational work as to the aims of the Nitrogen Products Committee had been accomplished, and the interest had been aroused of officials dealing with the various branches, the officials were transferred to other duties, and the process had to be recommenced. The initial steps which led up to the formation of the Committee were taken by the Council of the Faraday Society in 1916, during the *régime* of the first Minister, Mr. Lloyd George, whilst the dissolution of the Committee and the sale of the Billingham factory took place under the fifth and last minister, Lord Inverforth.

If I wished, I might take a leaf out of the book of certain politicians, and set forth some of the inner history of what actually happened. I have, however, at present no intention of so doing, although some of the story might have to be even more startling than the statements of Prof. Partington.—I am, Sir, etc.,

J. A. Harker

16, Victoria Street, S.W. 1
May 5, 1923

BRITISH ASSOCIATION OF CHEMISTS

Dear Sir,—My attention has been called to the statement in the editorial of your issue of April 27, that the National Union of Scientific Workers has absorbed, or has been absorbed by the British Association of Chemists. In the interests of accuracy, I wish to inform your readers that neither version is correct, and that the National Union of Scientific Workers and the British Association of Chemists are still separate entities, working quite independently of each other.

During the past year negotiations have been in progress between the two Associations with a view to co-operation on matters of definitely common interest, and with the further object of avoiding overlapping of work. How far the proposals at present under consideration will lead to closer working between the two Associations it is not possible to state, but for the present no alteration in the constitution of the Association is contemplated by the Council of the British Association of Chemists.—I am, Sir, etc.,

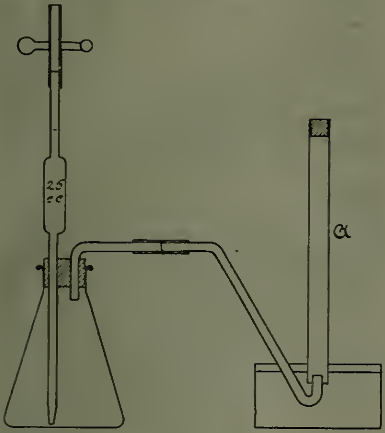
I. Boodson,
Hon. General Secretary

108, Baker Street, W.1.
May 3, 1923

DETERMINATION OF EQUIVALENTS

Sir,—The following may interest some of your readers, especially as I have not seen such an apparatus described in any of the elementary textbooks on chemistry.

A simple apparatus for carrying out this determination suitable for practical work in elementary classes is shown in the annexed sketch, which needs little explanation. The apparatus has the merit of being easily accessible in most schools, and the use of graduated measuring tubes is dispensed with. The tube A is a piece of combustion or other wide glass tubing of uniform bore, 2-3 cm. in diameter, and 45–50 cm. in length. In use, the length from the end to the bottom of the cork is measured (l cm.) and the volume (y c.c.) found by filling it with water from a graduated measure. It is then inverted over the end of the delivery tube and 25 c.c. of acid run into the flask from the pipette. When all the metal has dissolved, the level of the water inside the tube is adjusted to that of the water in the trough, and the length of the space occupied by the gas is measured (d cm.). The volume of hydrogen displaced by the weight of metal taken is therefore



$$\frac{d \times y}{l} - 25 \text{ c.c.}$$

The equivalent is calculated in the usual manner, after reducing this volume to N.T.P. Results very close to the correct figure can be obtained by careful students. The amount of metal taken should be such as will give about 100 c.c. of hydrogen (about 0·1 g. in the case of magnesium).—I am, Sir, etc.,

A. O. Jones

Technical College, Huddersfield
April 24, 1923

NEWS AND NOTES

FRANCE

The Title "Chemist"

The discussion on the correct use of the title "chemist" in Great Britain has attracted notice also in France, where a similar problem already exists. The wrongful use of the titles "chemical engineer" and "chemist" is strongly opposed by true chemists and pharmacists, who agree perfectly on the matter, but at present anybody in France can employ the titles, The word "engineer" designates a profession open to anyone and is not a title recognised and protected by the law. The use of the name "lawyer" (avocat) is legally restricted, but no penalties are imposed for improper use, and the titles of "médecin" and "pharmacien," which justly represent a certain status, can be freely used. It is true that persons who follow the profession of physician or pharmacist must be legally qualified, but the mere use of the title incurs no risk and the same is true of all diplomas and University degrees. Such a state of affairs is obviously very prejudicial to true chemical engineers and chemists, whose professional skill has been acquired through long years of study and practice, crowned by a diploma, and who yet have to meet the competition of persons without qualifications or assured technical and scientific knowledge. The only titles protected in France are those of "ingénieur agronome" and "ingénieur agricole." It is true that a certain selection of true chemists, chemical engineers and pharmacists is made by the regulations for admission into the various scientific societies, such as the French Chemical Society, the French Society of Industrial Chemistry, etc., and by professional societies comparable with the British Institute of Chemistry, but it has no legal force. In addition, a definition is badly wanted of the titles "chemical engineer" and "chemist," such definition to include the diploma-bearing students of the various schools and institutes of chemistry of the various Universities or technical schools, and also those who, by their long period of practice, though bearing no diplomas, belong to the profession. The position has, however, been the subject of numerous discussions, which have led to recommendations synthesised in two Bills which are to be presented to the Chamber of Deputies. One Bill proposes to complete the article 259 of the Penal Code by a clause providing imprisonment for from six days to two months and fines of from 100 to 200 francs for those who wrongfully utilise a professional title, a university degree, or a diploma of a public institution. The second Bill restricts the use of a professional title to those who have fulfilled certain conditions and provides penalties for those who use such titles without due authorisation. Thus the question of protecting the title of "chemical engineer" and consequently that of " chemist " (professor, industrial chemist research chemist, analyst) seems to be progressing favourably in France and is being enquired into by the Higher Council for Technical Education.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Electric Energy (Coal Consumption)

In a written answer to Mr. Hardie, Col. Ashley said that during the year ending March 31, 1922, the lowest consumption of coal per unit of electricity generated at public supply stations in Great Britain was 1·7 lb. The returns for the year ending March 31, 1923, were not yet complete.—(Apr. 30.)

Safeguarding of Industries Act, Part II

Viscount Wolmer, in answer to Mr. Tubbs, said that the number of industries affected by Orders made under Part II of the Act was seven. An exact figure of the number of employees in these industries could not be given.—(May 1.)

Home-Grown Sugar, Ltd.

In reply to Mr. Barnes, Major Barnston said that the value of the 250,000 £1 shares in Home-Grown Sugar Ltd. had been written down, in common with shares held by the public, to 5s., so that the nominal value of the Government shares was now £62,500.—(May 1.)

Industrial Diseases

Mr. Bridgeman informed Mr. Hancock that the number of industrial diseases notified under the Factory and Workshops Act was 514, including 38 fatal, in 1920; 350, including 32 fatal, in 1921, and 410, including 35 fatal, in 1922.—(May 2.)

Colonial Grown Sugar

In a written answer Mr. Ormsby-Gore informed Captain Terrell that the Colonial Secretary was anxious that as large a proportion as possible of this country's sugar requirements should be produced on British Territory, and hoped that the preference of British grown sugar would increase that proportion. The Colonial Office constantly placed the best scientific and technical advice at the disposal of sugar-growing colonies through the local departments of agriculture, but it would be beyond the functions of the Colonial Office or of the Colonial Governments to attempt to influence planters in choosing crops to be grown.—(May 2.)

HOUSE OF LORDS

Smoke Abatement

Answering Lord Newton, the Earl of Onslow stated that a Smoke Abatement Bill was to be introduced this session by the Government.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for May* 3)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Albania	Pharmaceutical and medicinal materials	569
Algeria	Earthenware, glassware, sugar	586
Argentina	Hardware, red lead, rubber tubing	589
,,	Perfumery,	590
Belgium, Netherlands & Northern France	Non-ferrous metals	570
British India	Electric cable (tender)	*
Bulgaria	Zinc chloride, creosote, caustic soda, copper sulphate, colza and mineral oils, tin, lead, pig iron and quinine	571
Canada	Stainless steel tubing	563
Denmark	Tin, zinc, lead, antimony moulders' requisites	572
France	Insulating materials, metallurgical products, sheet iron, sheet tin, steels, rustless steels	575
India, Burma and Ceylon	Brass and copper sheets and tubes	568
Italy	Electrical materials, iron, cement	577
Italy (Fiume)	Tinplate	578
Morocco	Holloware	853/6/F.G. E.C./A./2
Rumania	Drugs and chemicals	10543/F.E. (C.C./2)
Rumania (Transylvania)	Flake litharge, red lead	583
United States	Asbestos lumber	588

* The Director-General, India Store Dept., Branch No. 10, Belvedere Road, S.E.1.

TARIFF CUSTOMS EXCISE

Angola (*Portuguese West Africa*).—All disinfectants and insecticides can be imported duty free.

Austria.—Modifications have been made in the duty levied on imports of olive oil and potato starch.

Denmark.—Revised duties have been applied as follows :—Vanilla, vanillin and saffron, 20 kr. per kg., tyre covers, 40 öre per kg., plus 6 per cent. *ad valorem*, inner tubes, 12 öre per kg., plus 6 per cent. *ad valorem;* aluminium wares, 45 öre per kg. ; porcelain, 65 öre per kg.

French Togoland.—Restrictions have been placed on the sale and importation of drugs, chemical and medicinal products, pharmaceutical and druggists' specialities, and especially on opium, morphine, cocaine and other poisonous substances.

New Caledonia (*French*).—Import duties have been removed from molasses and ammonium sulphate.

St. Vincent.—A restriction has been placed on the importation of raw and medicinal opium, morphine, heroin, cocaine and similar drugs.

South Africa.—In the issue for May 3 a schedule is given, setting forth proposed dumping duties on various goods, including detonators, calcium carbide, motor spirit, paper, rubber, asbestos-cement manufactures, metal sheets, paint, etc. The Budget proposes to amend the excise tariffs on patent medicines and perfumery.

Tunis.—The prohibition on the export and re-export of molasses has been reimposed.

Uruguay.—Bicarbonate of soda of a strength exceeding 98 per cent. is to be classed as "medicinal," and of a strength less than 98 per cent., under "commercial." Bicarbonates in packets or cases labelled "pure" may be imported provided they are of a strength of more than 98 per cent.

Jugoslavia.—The export duty on tanned ox and calf leather, and edible oils has been reduced.

PERSONALIA

The following have passed the examination for the Associateship of the Institute of Chemistry :—P. J. Brady, H. J. Grayson, L. W. Gregory, G. Loasby, B.Sc., L. W. Marrison, H. W. V. Player, D. A. Smith, and G. J. C. Vineall, B.Sc.

Mr. A. J. Hoskins has been appointed professor of mining in the University of Illinois in succession to the late Dr. H. H. Stoek, and Prof. E. O'Neill has resigned from the chair of inorganic chemistry in the University of California.

Dr. M. Perard has been appointed Professor of Agriculture and Organic Chemistry at the Central School of Arts and Manufactures, Paris.

* * *

The death is announced of Monsieur Joseph Gillet, an industrialist of Lyon, whose name is well-known in various branches of the silk, chemical, textile and dyeing industries.

REVIEWS

Surface Tension and Surface Energy and Their Influence on Chemical Phenomena. *By* R. S. Willows *and* E. Hatschek. *Third edition. Pp.* 136. *London: J. and A. Churchill,* 1923. *Price* 6*s.* 6*d.*

This edition, prepared by Dr. Willows, is nearly twice the size of the first edition which appeared in 1915, and has been brought carefully up to date. The chief enlargements comprise an account of the important recent work of such investigators as Langmuir and Hardy on the properties of thin films, polarised molecules, and lubrication.

A clear and reasoned account is given of the main aspects of the subject, and its brief treatment is quite comprehensive. The book can be heartily recommended to those who wish to become acquainted with the essentials in this rapidly widening field, which interests biologists, physicists and chemists alike.

J. W. McBain

Dr. Aetherische Olien Leverende Planten van Nederlandsch Oost-Indië en de Bereiding van haar Oliën. *By* A. W. K. de Jong. *Pp. vii*+183. *Amsterdam: Koloniaal Institut,* 1922. *Price* 3·60 *florins.*

This publication, reprinted from the *Indische Mercuur* of 1922, and issued by the Dutch Colonial Institute, consists of a series of monographs edited by A. W. K. de Jong, on the methods of distillation in general use, in reference to their application to those oils distilled in the Dutch Colonies, and to the extraction of perfumes generally. In the description of distilling processes, with a number of photographic illustrations, there is nothing new ; it is merely a summary included for the sake of convenience to readers.

Useful summaries of the various commercial aspects of production of the oils of citronella, lemongrass, palmarosa, vetivert, patchouli, basil, chenopodium, cinnamon, clove, pimento, nutmeg, cubebs and a number of others are included.

The chemistry of the oils is but sparingly mentioned, and the brochure must be regarded as a useful catalogue of domestic rather than general interest, although it contains much useful information of a botanical and commercial nature, carefully summarised, and of value to the essential-oil specialist.

Ernest J. Parry

Mr. H. G. Byers has been elected president, and Mr. L. van Doren vice-president of the American Institute of Chemistry for 1923–24.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The general demand for chemicals is quite up to expectation and on the whole prices are fully maintained. Saltcake shows greater activity and available supplies in quantities for export in large parcels are getting scarce. Bleaching Powder is slightly better and Acetic Acid still in good demand and short supply. There is good inquiry for both home and export for Alkali and Caustic Soda.

Acetic Acid, 40% tech.	£24 per ton.
Acid Hydrochloric	4s.-5s. per carboy d/d.
Acid Nitric 80° Tw.	£24 10s. per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton.
Arsenic (White)	£70-£75 per ton.
Bleaching Powder	Spot £11 7s. 6d. d/d. Contract £10 7s. 6d. d/d.
Bisulphite of Lime	£7 per ton, packages extra.
Calcium Chloride	£5 17s. 6d. per ton d/d.
Copper Sulphate	£27 per ton
Potash Caustic	£35-£36 per ton
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d; Export £5 5s. per ton f.o.b.
Soda Caustic 76%	£20-£21 per ton.
Soda Crystals	£5 10s. per ton.
Sod. Acetate 97/98%	£26 per ton.
Sod. Bicarbonate	£10 10s. per ton.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	2⅞d.-3d. per lb.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, conc.	£16 per ton carr. paid.
Sod. Sulphite, Pea Cryst.	£17-£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£26-£28 per ton according to quantity.
Carbon Black	1s. 5½d. per lb. ex wharf. Still very scarce.
Chromium Oxide	1s. 5d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb. Firmer on advance in price of Rape Seed Oil.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

The market generally remains firm and there is a ready sale for all products. Particularly in the case of Brown Sugar of Lead there is a considerably increased demand. Wood Naphtha, both Miscible and Solvent, is scarce and also Charcoal of the higher grade retort quality.

Acetate of Lime—	
Brown	£10 15s. per ton d/d
Grey	£20 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 10s. per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d, ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 9d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 10s. per ton d/d.
Brown Sugar of Lead	£43 5s. per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 6d. per lb. Still fair inquiries but prices are slightly lower for delivery second half of year.
Crude 60's	3s. 6d.-3s. 9d. per gall. Market weaker.
Acid Cresylic—97/99	2s. 2d.-2s. 5d. per gall. Market quiet.
Pale 95%	2s.-2s. 4d. per gall. Not much demand.
Dark	1s. 10d.-2s. 0½d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	9½d.-10d. per gall. Not much demand.
Unstrained	9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8½d. per gall. Business slack, abundant supplies.
Pure	2s.-2s. 4d. per gall.
Toluole—90%	1s. 9d.-2s. per gall.
Pure	2s. 1d.-2s. 6d. per gall. Not much inquiry.
Xylol	3s.-4s. per gall. according to quality.
Creosote—	
Cresylic 20/24%	11½d.-1s. 0½d. per gall. Not much business.
Middle Oil	8½d.-9½d. per gall Market steady.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d.-9¼d. per gall.
Solvent 90/160	1s. 6d.-1s. 9d. per gall. Fewer inquiries.
Solvent 90/190	1s. 5d.-1s. 8d. per gall. Market steady.
Naphthalene Crude—	
Drained Creosote Salts	£7-£8 per ton. Market easier.
Whizzed or hot pressed	£11-£14 per ton.

Naphthalene—	
Crystals	£18 per ton.
Flaked	£16 per ton.
Pitch, medium soft	No business for this season. Prices for Autumn delivery 140s.-150s. per ton.
Pyridine—90/140	11s.-12s. per gall. More inquiries.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

The recent improvement in the business done in Aniline Dyes reported previously is still maintained. Business is coming through rather more freely. This is rather surprising in view of the fact that the Textile Trade is very quiet and we must anticipate that when the Textile Trade improves, the Aniline Dyes Trade will be still better. Prices are firm without advance, but there is no likelihood of any fall for some little time forward.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
p-Dichlorbenzol	£70 per ton.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	4s. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
p-Nitrobenzene	6½d.-7d. per lb. naked at works. Good demand.
Nitronaphthalene	1s. per lb. d/d.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid, Acetic 80%	£47 10s.-£52 10s. per ton.
Acid, Acetyl Salicylic	In a somewhat weaker position as some holders are now accepting 3s. 3d. per lb.
Acid, Benzoic	2s. 6d. per lb. In shorter supply.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton. Prices reduced by £5 per ton.
Acid, Citric	1s. 9d. per lb., less 5%. Dearer; demand active; higher prices expected.
Acid, Gallic	3s. per lb.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb.
Acid, Salicylic	2s. 3d. per lb. would be accepted for quantity, showing a slightly easier tone.
Acid, Tannic	3s. 3d. per lb. Unchanged.
Acid, Tartaric	1s. 4d.-1s. 4½d. Demand continues to increase, and a period of hot weather should see a further rise in price. There is much more inquiry from the Continent and the U.S.A. and good business has been done for export.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d. per lb. is now wanted.
Amidopyrin	13s. 6d. per lb. without inquiry.
Ammon. Carbonate B.P.	£37 10s. per ton.
Atropine Sulphate	12s. per oz. Firmer but demand very poor.
Barbitone	18s. per lb.
Benzonaphthol	4s. 6d. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Bromides	Firmer all round, but prices have not yet been advanced as much as anticipated.
Calcium Lactate	2s. 9d. per lb. is the value for best English makes free from odour. Lower qualities are offered down to 2s. per lb., these being mainly of Continental manufacture.
Chloral Hydrate	4s. per lb. in shorter supply.
Chloroform	2s. 3d. per lb. for cwt. lots, ton lots being quoted down to 2s. per lb.
Creosote Carbonate	10s. per lb., with little enquiry.
Formaldehyde 40%	£90 per ton.
Guiacol Carbonate	8s. 6d. per lb. is the present value without any orders.
Hexamine	4s. 6d. per lb. The position is somewhat weaker for holders owing to arrivals from America which have nullified the high prices being quoted by Continental manufacturers.
Homotropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. Market good with considerable inquiry.

Magnesium Carbonate—	
Light Commercial	£38 per ton nett.
Magnesium Oxide—	
Light Commercial	£85 per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Menthol	35s. per lb. spot. Advanced.
Methyl Salicylate	2s. 8d. per lb. still quoted for carboys.
Methyl Sulphonal	14s. 6d. per lb.
Mercurials	Unchanged. Market quiet.
Paraformaldehyde	4s. Neglected.
Paraldehyde	1s. 5d.-1s. 7d. per lb. Forward prices show a much firmer tendency.
Phenacetin	Up to 7s. per lb. now quoted on a better market.
Phenazone	7s. 6d. per lb.
Phenolphthalein	5s. 6d. per lb.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	98s. per cwt., less 2½%. Firmer.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. Demand still continues good.
Potass. Metabisulphite	8d. per lb., 1-cwt. kegs included.
Potass. Permanganate	11d. per lb. Still firm.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Salol	3s. per lb. is the higher value now quoted.
Sod. Benzoate	2s. 6d. per lb., with better demand.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality. Demand improving and considerable business being done.
Sod. Hyposulphite—	
Photographic	£15-£17 per ton, according to quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d. per cwt. Fairly good demand.
Sod. Salicylate	In good supply. Values unaltered, being 2s. 9d. per lb. for Powder, 2s. 11d. per lb. for Crystal.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. per ton, according to quantity for home trade, 1-cwt. packages included.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 4d. per lb.
Thymol	Manufacturers are inclined to accept lower prices in order to meet Continental competition. Present value 17s.-18s. per lb.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate	3s. ,, ,,
Cinnamic Aldehyde	14s. 9d. ,, ,,
Coumarin	15s. 6d. ,, ,,
Citronellol	22s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	18s. 6d. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. 6d. ,, ,,
Geraniol (Palmarosa)	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	16s. 6d. ,, ,,
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	25s. 6d. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Ketone	35s. ,, ,,
Musk Xylol	9s. 6d. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s, ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	23s.-24s. per lb.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	2s. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	31s. 6d. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4½d. per oz.
Cassia Oil 80/85%	8s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. ,, ,,
Ceylon	3s. 2d. ,, ,,
Clove Oil	8s.-8s. 6d. per lb.
Eucalyptus Oil 70/75%	1s. 9d. per lb.
Lavender Oil, Mont Blanc 38/40%	13s. ,, ,,
Lemon Oil	3s. 1d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	11s. 6d. per lb.
Otto of Rose Oil—	
Anatolian	24s. per oz.
Bulgarian	30s. per oz.
Palma Rosa Oil	17s. per lb.
Peppermint Oil—	
English	80s. ,, ,,
Wayne County	13s. ,, ,,
Japanese	5s. 3d. per lb.

PUBLICATIONS RECEIVED

Synthetic Inorganic Chemistry: A Course of Laboratory and Classroom Study for First-Year College Students. *By* A. A. Blanchard, Ph.D., *and* J. W. Phelan, S.B. *Third edition, entirely rewritten and greatly enlarged. Pp. xiv+321. New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.,* 1922. *Price* 15*s. net.*

Technical Methods of Ore Analysis for Chemists and Colleges. *By* A. H. Low, Sc.D. *Ninth edition, entirely rewritten and enlarged. Pp. xlix+348. New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.,* 1922. *Price* 17*s.* 6*d. net.*

The Bulletin of the British Association of Chemists. *Vol.* 1, *No.* 4. *Pp.* 12. *London: British Association of Chemists,* 1923.

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EDITORIAL

SOME two months ago we referred in an editorial note to the various articles we had received on the definition of a synthetic organic chemical. We had the temerity to remark, " Sir William has given a proof that calcium carbide is a synthetic organic compound, so closely reasoned, so well supported by evidence and so lucidly explained that it seems incontestable." Things are not always what they seem. Mr. Chas. H. Herty, in his capacity as President of the Synthetic Organic Chemical Manufacturers Association of the United States, informs us that the Board of Governors of that Association has adopted a set of definitions prepared by a committee of seven representatives of the industry assisted by six scientists eminent in the field of organic chemistry. The definition of the term " synthetic organic chemical " is as follows :—" *Chemical.*—A material containing a preponderating proportion of an individual substance of definite elementary composition. *Organic chemical.*—A chemical containing carbon in combination with other elements. *Synthetic organic chemical.*—An organic chemical which has been produced by a controlled process involving change in chemical identity. . . . The term *Organic Chemical* is not applicable to the following chemicals : carbon monoxide and carbon dioxide ; carbon silicides, carbides, carbonates, bicarbonates, cyanides, cyanates, thiocyanates, ferrocyanides, ferricyanides, and cyanamides of metals or inorganic radicles. The term *Controlled Process* is to be interpreted as including not only the interaction of chemicals, but also the carrying out under pre-determined conditions of destructive distillation and biochemical conversion of raw materials by the agency of biologically pure cultures of organisms with exclusion of other organisms which would interfere with the progress of the desired reaction." The following notes are appended : " The isolation of a chemical individual from a mixture by the simple processes of mechanical separation, extraction with selective solvents, fractional distillation, or crystallisation, does not constitute a process involving change in chemical identity. In the case of a substance which may be classified either as a natural or a synthetic product, it shall be considered to be synthetic whenever it can be shown that it is produced in substantial commercial quantity by synthetic methods. Natural dyes are to be classified as synthetic chemicals only when the method of their isolation involves change in chemical identity."

* * *

The definition of chemical seems to be fairly wide and might include limestone, sandstone, sand, brick and glass. For brick there is some authority. Did not Lemery prepare oil of brick ? Are golf-balls materials containing a preponderating proportion of an individual substance of definite elementary composition ? If so, they are chemicals. We hope we shall receive in due course the reasoning which shows that the term organic chemical is not applicable to the list of chemicals mentioned by the Association. We are sure that it is not a mere dictum or opinion of the seven champions of industry assisted by the six eminent scientists. The Notes require a little further elucidation in order to free them from the last traces of ambiguity. Acetic acid in common parlance may be either natural or synthetic. Is it now produced in substantial commercial quantity by synthetic methods ? Nor are we quite clear whether the method of isolating natural indigo involves change in chemical identity. Perhaps Professors Thorpe and Morgan or Mr. W. A. Davis can enlighten us. We understand that Mr. Davis and Dr. Eyre have recently conducted a series of important experiments on evaporation and absorption in some underground cellar designed for the storage of a material containing a preponderating (but not the most exhilarating) proportion of an individual substance of definite elementary composition. But as their researches are very shortly to be published we will not seek to proticipate, as the lady said.

* * *

It is now well over one hundred years since Sir Humphry Davy, lecturing before the Royal Institution, described the safety lamp that bears his name, and the perennial fascination which the investigation of the mechanism of combustion has for chemists was once more revealed in the Friday Evening Discourse delivered by Prof. W. A. Bone last week in the theatre where Davy once spoke. Prof. Bone's subject was "Gaseous Explosions at High Pressures," and we wish to supplement the account published elsewhere in this issue by calling especial attention to certain very important aspects of his work. To put it briefly, Prof. Bone has found that, on exploding a mixture of carbon monoxide, oxygen and nitrogen in a steel bomb under a pressure of fifty atmospheres, the nitrogen absorbs energy from the rapidly vibrating molecules of carbon monoxide at the moment of explosion, becomes active or "activated," and is then capable of combining with oxygen to form oxides of nitrogen. Here then it would seem—disregarding the Häusser process, in which high pressures are not used—we have a potential method of nitrogen fixation for which a suitable raw material is available in abundance in blast-furnace gases. The lesson of the war is still too keenly felt for us to have forgotten the intimate connexion between nitrogen-fixation and national safety, and apparently all Prof. Bone has to do is to develop his process to large-scale application. Unfortunately, however, whereas the bomb now in use will withstand pressures of the order of 1000 atmospheres, further prosecution of the investigation requires a bomb that can resist very much higher pressures, pressures at which, so Prof. Bone anticipates, nitrogen can be made to burn as easily as carbon monoxide at atmospheric pressure. Until the new bomb is provided—and this seems too heavy a task for the funds of Prof. Bone's department—the work must be suspended. The discourse ended with the grave warning that if the work were not soon developed in this country, it would not be long before its significance was appreciated abroad. We can only hope that the imagination of those able to supply the deficiency in this country will be quickly stimulated and that we shall shortly have the pleasure of recording further advances in Prof. Bone's most important researches. Money can be found to build vast stadia, to finance Armenians, to construct huge men-of-war, and we refuse to believe that it will not be forthcoming to aid in solving the problem of nitrogen-fixation, for every ton of nitrogen fixed in this country makes war more remote and frees vast sums for works of peace.

THE LLANDARCY REFINERY OF THE ANGLO-PERSIAN OIL COMPANY

British chemical industries have gained an important addition through the establishment by the Anglo-Persian Oil Company at Llandarcy, South Wales, of their great refinery for the complete treatment of the crude oil brought from the Company's wells in South-Western Persia. This enterprise, which already has been in operation for nearly two years, producing petrol, kerosene, and fuel oils, will shortly be supplying a complete range of petroleum products, including all classes of lubricants, and various other oils for special purposes, as well as paraffin wax. When completely working this will be the only large-scale refinery operating in the British Isles for the treatment of imported crude petroleum and the manufacture from it of the whole series of products, of which the bulk heretofore used in this country has been imported from America, either fully refined or in partly manufactured form.

The establishment of this plant in South Wales has marked an important departure from the common practice of oil refiners, which had been to build their refineries at the nearest point to production of the crude oil that would permit of ready shipment to the consuming markets. It was thus something of an experiment to build the large plant at Llandarcy, though the arguments in its favour far outweighed the objections. The refinery has now been in operation sufficiently long to have proved the complete wisdom of the step taken by the company. Whilst the geological formation of Persia makes highly improbable any failure of oil from this source, the situation of this refinery in the British Isles safeguards supplies for the British Petroleum Company—the subsidiary organisation which distributes "B.P." motor spirit and other products refined at Llandarcy—as in case of any temporary interruption in supplies from the main field, crude oil to keep the refinery in operation could be drawn from other sources, and adequate storage at Llandarcy, both for crude oil and refined products, exists to cover any emergency.

To the chemical industry an obvious advantage of the establishment of this great refinery is the opportunity it affords to British chemists and chemical workers of doing in this country a large amount of refining work that hitherto has been done abroad. Since a very large part of the work in an oil refinery—even apart from that of the trained chemists—is of a character requiring skilled workers, the establishment of the Llandarcy plant has provided an opening for the more intelligent, and therefore valuable, class of worker in the district. At Llandarcy there is now a skilled refinery staff, the majority of whom have been trained by the nucleus of experienced chemists and engineers brought from the refineries of the Anglo-Persian and Burmah Oil Companies, in Persia and Burmah, respectively. As this and the other refineries which the company is now building through its associated or subsidiary enterprises in Scotland, Australia, and on the Continent further develop, the opportunities for skilled workers in this new home industry will expand.

An advantage derived from the employment of British labour is the production of more dependable and uniform products from the refinery established in Wales, than is usual with products brought from abroad. To this advantage the equable temperature at home, as compared with that in the tropical or subtropical countries where many refineries operate, adds still further to the uniformity of the various petroleum derivatives marketed in Great Britain under the "B.P." brand name. In planning the great refinery at Llandarcy the chemist and engineer worked in close co-operation, the experience gained by the Company's technical staff at the main refinery at Abadan on the Persian Gulf, forming a basis upon which to build, and to this was added the best results of refinery practice elsewhere throughout the world. Extensive research work under the direction of the Company's Chief Chemist and Chemical Adviser was a further preliminary, since the character of the crude oil to be treated is a most important factor in deciding the details of a refinery layout. In this particular instance, the paraffin content of Persian crude oil—permitting the extraction of wax and the production of all classes of lubricants—required the construction of important plant for these special processes.

The land on which the Llandarcy Refinery now stands was acquired as part of the comprehensive policy decided upon by the Company prior to the war. It was not, however, until February, 1919, that actual operations could be commenced. The area now occupied by the extensive plant, tank farm, and model village for housing the chief process workers—some 660 acres in all—was at that time waste land, the hilly portion a rabbit warren, and the lower levels bogland. When it is stated that the plant was put into operation in June, 1921, some idea can be gained of the enormous amount of work carried out during the period from 1919 to that date, the undulating slopes having been covered by an oil refinery equipped with the most modern plant capable of producing nearly 600 tons of petrol alone per day, as well as great quantities of lamp oil and other products. Incidentally, the capital expenditure involved in the enterprise was approximately £3,000,000.

Crude Bench with Pre-heating Apparatus

The crude oil (a thin, dark-coloured liquid of sp. gr. 0·837) is conveyed from Persia by the Company's tankers, of which the fleet, if placed end to end, would make a line nearly six miles in length, whilst their equivalent capacity is that of a 10 inch pipe-line extending for 22,000 miles. These tankers berth at the Queen's Dock, Swansea, where a special installation, embracing a subsidiary tank farm, pump house and pipelines, has been provided for rapid unloading, and for ready shipment of the refined products. From the dock area the crude oil is pumped through pipe-lines about 3½ miles long to the main tank farm, where there are 33 large tanks, all but eight of which are each of 10,000 tons capacity, giving a total storage capacity of upwards of 75,000,000 gallons. From the tank farm the crude oil is pumped to the service tanks on the hillside overlooking the refinery, ready for treatment.

Crude petroleum is essentially a complex mixture of hydrocarbons, but contains also, as impurities, varying percentages of oxygen, nitrogen, and sulphur compounds. These bodies are found in most petroleums and constitute the main portion of the impurities which the oil refiner endeavours to remove in order to obtain marketable products, or, in other words, products which will satisfy the market demands in the particular territory which he supplies. Crude petroleum is roughly classified as of :—(1) Paraffin base, (2) asphalt base, (3) mixed base, according to the predominating characteristics of the oil. It is to the last named class that Persian oil belongs.

The first operation of refining petroleum is that of distillation in order to separate the hydrocarbons present as completely as possible into the various grades of products required. At Llandarcy the continuous method of distillation is employed for the first treatment of the crude oil, the oil passing through the various units in a constant stream. Crude oil from the tanks on the hillside passes through pre-heaters into the crude-oil distillation units, the contents of the stills being brought to distillation temperature by means of oil fires. Preheating of the crude oil is effected by means of the residual oil from the distillation, which passes out at a temperature of about 230° C., imparting its heat to the incoming oil. This system of preheating at Llandarcy effects an economy of 50 per cent. in fuel costs. The vapours passing from the stills ascend dephlegmators or fractionating columns, and after passing through the distillate preheaters, are carried through the condenser tanks, which contain radiator-type fittings.

After condensation, the products pass into the tail house, where "look boxes" are arranged to enable the refiner to keep a close watch at all times upon the output of the stills.

The first distillation splits the crude oil into two parts :—Once-run distillate ; and fuel oil. This latter fraction is then ready to be pumped back to the docks at Swansea or to the railway siding on the works for the market ; or to be passed through the works for further treatment in order to produce lubricating oils, wax, and other by-products.

The once-run distillate flows from the crude oil stills by gravity to the benzine refinery, where it is washed by agitation in upright vessels with a solution of caustic soda, being partially decolorised in the process. The distillate so treated is then passed to the benzine rectification stills where further distillation takes place in order to produce the special fractions the market requires, which at the moment are petrol, and kerosene or paraffin oil. Heat for this latter distillation process is supplied solely by means of steam, the oil which passes into the receivers being first heated by means of closed coils and the temperature being further raised by the introduction of open steam.

For the final treatment, the petrol fraction is returned to the benzine refinery, where the petrol is washed with a slightly alkaline solution of sodium hypochlorite. The effect of this treatment is to remove by oxidation substantially all the reactive sulphur content. The finished petrol, now free of all impurities, is ready for market and furnishes motorists with the clear spirit known as "B.P."

The special process for eliminating impurities from the crude petrol by means of sodium hypochlorite referred to is a patented process evolved by the Company's Chief Chemist, and the refineries of the company have the monopoly of the patent outside America. At Llandarcy a special electrolytic plant is in operation, electricity to supply this being provided from the main power station at the refinery, and converted by means of rotary converters from a 3300 volt alternating current to a 200–220 volt direct current. With this plant it is possible to convert 10 tons of salt solution into sodium hypochlorite within two hours.

The kerosene fraction receives its final treatment by means of filtration through granulated bauxite, a reddish-brown aluminium ore. The bauxite, previously roasted, removes sulphur and colour, the oil coming from this process sweet in odour and perfectly colourless, being in fact the highest grade of lamp oil or kerosene. After a certain period of use the bauxite is re-roasted to burn out the impurities taken from the oil, after which it can be used again.

Both the kerosene and petrol, now ready for market, are transferred to their respective storage, large quantities being delivered to the dock area, whence they are shipped in special tank vessels to bulk-storage installations of the British Petroleum Co. at the main ports of the United Kingdom, or to subsidiary organisations on the Continent. Shipment of these products is also made by means of tank cars on rail to various points inland.

Part of the residue from the crude bench of stills, as previously stated, is sold as fuel oil, whilst the remainder goes to the pitch bench for further distillation. Here three cuts are made, namely, (1) heavy kerosene, (2) gas oil, (3) heavy oil and paraffin, the residue being a soft pitch. The third fraction becomes solid on cooling, due to the separation of crystalline wax, and its temperature is therefore kept above its setting point until it arrives at the paraffin sheds.

For the extraction of the wax an elaborate section of plant is provided, including a large refrigerating plant. The heavy oil and paraffin is pumped through long columns known as "Thompson's coolers," which contain coils in which cold brine is circulating. The oil is thus chilled, but is prevented from solidifying by a stirring gear, which keeps it constantly in motion. It then passes into the presses in the cooling rooms, these latter being kept at a temperature of 15° F. The oil is pumped through these filter presses, leaving behind a residue of scale or crude wax; whilst the liquid filtrate—technically known as "blue oil"—forms the base for lubricating oil and is passed on for further treatment through the sulphur dioxide plant.

The wax is sent through the hydraulic press house, melted, and then pumped to the sweating stoves, which contain cylindrical vessels having an annular space, which is filled with the scale. This scale is gradually heated by hot water, with the result that the oil sweats out and drains away from the wax. After this treatment the wax is run off and pumped to the refinery in a molten state, undergoing a final treatment of filtration though bauxite to remove the colour. Cooling sheds arranged with tiers of shallow pans facilitate the solidification of the wax, which is then ready for market.

Steam plays so important a part in modern refinery practice that the boiler house is literally the heart of the refinery plant. At Llandarcy the two most modern methods of steam raising are seen in operation side by side in the great boiler-house, where certain boilers are oil-fired and the remainder are heated by coal. For the latter the coal is received and conveyed into the furnaces automatically, the ashes being removed from under the boilers by means of a small runway, which conveys them to an ash elevator, and they are subsequently used for making paths and roads on the site.

Adjoining the boiler-house is the power-house, in which three steam turbines running at 3000 revolutions per minute are connected to A.C. generators of 2500 kw. at a pressure of 3300 volts. The switchboard (one of the finest in the country) is foolproof, each cubicle being under lock and key with interlocking and isolating links. Steam is generated at 180 pounds pressure, and after doing active work in the turbines, exhaust steam is drawn off at a reduced pressure of 40 lb. per square inch and is used for the distillation plant. The air-cooling plant under the power-house, commonly known as a wet-air filter, has a fan on the shaft of the generator, which draws air through the filter. A small pump is constantly circulating water in the form of a spray. The air passes through the spray, all dust is collected and the air passing through the windings of the generator is both cool and clean.

Lubricating-Oil Bench and Fireless Locomotive

During every stage of the refining process chemical tests of the oil are made as a matter of routine, a special laboratory for the purpose, with a staff under the direction of the Works Chemist, being part of the plant. These routine tests number nearly 1000 per day, and as a result of the care taken Llandarcy is turning out "B.P." motor spirit and other products which are achieving a reputation for uniform quality.

At Llandarcy an interesting detail of the laboratory equipment is a self-contained unit, in which experiments that promise success, when carried out on a miniature scale, with glass and test tube, are repeated with small working models. Another important development of the company is the establishment of a very complete laboratory at Sunbury in Middlesex, where a number of eminent research chemists are continually engaged in the study of the numerous problems connected with the commercial utilisation and the improvement in quality of the many products of petroleum.

The immense supply of water required for the steam plant and for cooling and other purposes, is provided by means of a reservoir containing some 15 million gallons and covering an area of 3½ acres. Centrifugal pumps force the water from this reservoir to an immense tank holding 250,000 gallons situated at the highest point of the refinery area. Some eight or ten million gallons of water are pumped round the circuit of the plant each day.

Constant precautions are taken at all times against fire—the oil refiner's bugbear—special refinery police and watchmen being constantly on guard, whilst efficient fire-fighting arrangements have been made to deal with any outbreak. An interesting detail of the refinery equipment designed to reduce fire risk is the "fireless locomotive," popularly known as a "Thermos Flask," several of which are used within the danger areas. These locomotives operate on high-pressure steam supplied from the central boiler plant, a twenty-minute charge keeping a locomotive going for four hours.

For housing the chief process workers, a model village has been laid out by the Company adjoining the refinery area. This village, known as "Llandarcy," to commemorate the name of the late Mr. Knox D'Arcy—the original concessionaire of the Persian oilfields—comprises over 100 houses picturesquely situated amid gardens in the style of a garden city. A second area, situated a mile or two from the refinery and known as "Cefn Park," has been set aside for the senior staff, for whom the Company has provided commodious houses. In addition there is a home farm of seventy acres, from which produce can be procured by the refinery staff.

With its immense concessions in Persia, its fleet of oil tankers, its refineries at Llandarcy, Abadan, and elsewhere, and its efficient distributing organisations, of which the British Petroleum Co. is the chief, the Anglo-Persian Oil Co. has a complete and effective organisation for carrying out its task as the only purely British oil enterprise in the field; and its activities to date justify the belief that this comparatively young company will become more and more a factor in the oil trade of the world, and recover for this country much of the business which in the past has been allowed to fall into outside hands.

THE EXPLOSIVES INDUSTRY

According to the report of H.M. Inspectors of Explosives for 1922 (Cmd. 1862. 6d.), for the first time in the history of the industry in Great Britain, no fatal accidents occurred during the year in factories registered under the Explosives Act, and only 11 persons were injured by the 51 accidents that did occur.

THE PREPARATION OF METOL*

By W. F. A. ERMEN

Although Metol (monomethylpara-amidophenol sulphate) was introduced as long ago as 1891 as a photographic developer by the firm of Hauff, very little has hitherto been published as to the method of manufacture. Paul in 1897 (*Z. angew. Chem.*, 1897, 171) stated that this body was most probably prepared by the action of heat on oxyphenyl glycin:

$$OHC_6H_4NH{\cdot}CH_2COOH = OHC_6H_4NH(CH_3) + CO_2,$$

but omits to state that this reaction only takes place when the glycin is first dissolved in an appropriate solvent.

Metol prepared in this way is quite innocuous to the skin. Direct methylation of para-amidophenol, by means of alkyl halides, calcium methyl sulphate or dimethyl sulphate, leads to an undesirable mixture, containing unaltered amidophenol, metol and very soluble higher methylated bodies, from which it is impracticable to isolate pure metol. Lapworth has recently overcome this difficulty by acting on benzalamidophenol (or cresol) with dimethyl sulphate. Benzalamidophenol can be prepared in good yield by stirring a solution of amidophenol or amidocresol hydrochloride with benzaldehyde in presence of sodium acetate. The benzalamidophenol is filtered off, washed, dried, and treated with a little more than an equivalent of dimethyl sulphate. The condensation product is then steam-distilled, the benzaldehyde being regenerated, and a solution of metol in sulphuric acid obtained. Some amidophenol is always regenerated, and some dimethylamidophenol is also formed; but the main product of the reaction is metol, containing about 7 per cent. of amidophenol sulphate. The metol prepared in this way also appears to be quite innocuous.

Merck's patent 260,234 describes a third method of producing metol, by acting at a high temperature on hydroquinone with an aqueous or alcoholic solution of methylamine. The metol produced by this method is found as the free base, partly dissolved in the reaction liquor, and partly as a dark brown oil. On adding sulphuric acid to the mixture the whole solidifies to a crystalline paste of metol. It is found that the alkaline reaction liquor is extremely irritating to the skin, rapidly raising blisters which break into sores that heal with difficulty. Very slight contact with the material may not even redden the skin, but causes severe pain, which is intensified on placing the hands in warm water, or holding them near a fire.

After filtering off the crystals of metol and carefully recrystallising them several times, this poisonous property appears to be removed.

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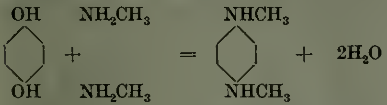
* A communication from the Photographic Research Department of The British Dyestuffs Corporation, Ltd.

Even the base separated from the purified metol exhibits very little toxicity. The crude mother liquor, however, retains all the irritant qualities of the original reaction mixture. It appears to contain, besides unaltered methylamine and hydroquinone, mainly the very soluble sulphate of a base which is thrown out on addition of an excess of caustic soda as a dark oil. This oil, reconverted into the sulphate and recrystallised from alcohol, is obtained in the form of white, stable crystals, very soluble in water, and in dilute alcohol. In contact with the skin, intense irritation is caused in a very short time, so that one may affirm with some degree of certainty, that the poisonous action of metol is due to the presence of small traces of this substance.

From the fact that the base of this body is insoluble in caustic soda, one is led to the conclusion that it has been formed by the condensation of two molecules of methylamine with one of hydroquinone :—



sym. dimethylparaphenylenediamine.

That this is the constitution of the body is borne out by a determination of the proportion of sulphuric acid in the sulphate, and by titration with nitrous acid, with which it forms a double nitrosamine.

Further confirmation of this supposition was obtained by treating the benzylidine compound of paraphenylenediamine with dimethyl sulphate. As in the preparation of metol by the Lapworth process, a methylated phenylenediamine is obtained after steam distilling the reaction product, which appears to be identical, both chemically and in its toxic properties, with the body obtained by the interaction of hydroquinone and methylamine.

[We are glad to be able to publish the above account of Mr. Ermen's important investigation on the preparation of pure metol. Amongst photographic developers, metol is probably the one most widely employed, but hitherto it has suffered from the serious disadvantage of producing severe lesions on the skin of those using it. Mr. Ermen, however, has shown that this action is due to a substance usually present in small quantity in ordinary commercial metols and that by adopting a different method of manufacture, metol free from irritant action can be produced. Since metol was introduced in Germany some thirty years ago, the cause of its poisonous action has been the subject of much controversy among Continental chemists. It is therefore highly gratifying that the problem has been solved by a British chemist, and the work may be taken as evidence of the vitality of our fine-chemical industry, as exemplified by the British Dyestuffs Corporation.]

THE ALKALI CENTENARY

In the early manufacturing processes alluded to in the previous article on this topic the methods were comparatively simple. Liquids, or liquids and solids, were mixed together in a tub or vat, or solids were calcined in a furnace of simple construction ; the finished products were separated and purified and such of the by-products as could be conveniently utilised were treated by other processes, but as the number of chemical compounds rapidly increased and as electricity became an important factor in manufacturing operations, much more complicated methods were practised. The electric furnace, liquid gases, high pressure vessels and catalytic methods involving ingenious and complicated mechanical devices became necessary.

The processes of fermentation worked out by Pasteur in the middle of the last century have been largely developed and the early makers of alkalis undertook the manufacture of a great variety of compounds quite unconnected with the alkali industry, including, in many cases, the manufacture of explosives. Indeed, during the war, the manufacture of explosives by the alkali manufacturers formed a very notable addition to the fighting strength of this country. This is not the place to discuss these in detail, but the discovery of guncotton by Schöbein in 1845, of nitroglycerin by Sobrero in 1847, of dynamite by Nobel in 1867, the use of ammonium nitrate as an explosive, first worked out by Ohlsson and Norrbin in 1867, the manufacture of smokeless powder by W. F. Reid in 1882 and the discovery of cordite in 1889 and 1890, are important incidents in the progress of this industry. At first sight, it may seem singular that so simple a process as the ammonia-soda process should not have been successful on a commercial scale when it was first put into operation, but, like a good many other chemical processes, in practice the reaction is by no means so simple as is represented by the theoretical equation. It was found that a considerable excess of salt was required, and probably the process could only be economically conducted where salt was cheap and no heavy freight payable on it. The absorption of gases by the salt solution required a great deal of investigation before it could be successfully carried out on a large scale, and in addition there is always the loss of a small proportion of ammonia. Great care, complicated machinery, and the experience of many years are necessary to keep this loss of ammonia down to small limits, and although Solvay patented his new process on the lines of the original one of Dyar and Hemming in 1861, it took him some years before he was able to make it profitable. It was in 1873 that Dr. Ludwig Mond and Mr. Brunner commenced the manufacture of alkali by the Solvay process at Winnington, and, as is well known,

The Muspratt Works of the United Alkali Co. at Widnes they encountered very considerable difficulties during the first few years of their work. The technical difficulties were finally overcome by Dr. Mond, who worked day and night when some portion of the plant did not perform its allotted task. Dr. Mond combined great scientific knowledge with a determination rarely met with. He never despaired of success or spared any trouble or the expenditure of time or money to solve a problem which stood in his way, and his qualities, combined with the good business methods of his partner, finally overcame all the difficulties and enabled the works to enlarge until it became the greatest and most important in the country. The carbonic acid required for the ammonia soda process was obtained by roasting limestone, and the lime so produced was used to convert the ammonium chloride into ammonia and calcium chloride. The calcium chloride when treated with zinc oxide and carbonic acid, or with zinc carbonate, formed zinc chloride and calcium carbonate which could be used again. The zinc chloride was electrolized and so produced electrolytic zinc and chlorine, forming important materials for use in many industries. In 1887 the Castner process for the electrolysis of caustic soda was worked out, and in 1890 the large number of firms engaged in the Leblanc process for making soda combined to form the United Alkali Company, and doubtless effected many improvements in manufacture and many economies, and so enabled the United Alkali Company to become the powerful organisation which it is to-day. They have just celebrated the 100th anniversary of the Leblanc process in this country, and in a few weeks Messrs. Brunner, Mond and Co. celebrate the 50th anniversary of the Solvay process in this country.

Among the various developments associated with the alkali industry, the fixation of atmospheric nitrogen is one of the most interesting. The experiments of Kuhlmann on the oxidation of ammonia in 1839, the work of Regnault on making ammonia by sparking mixtures of nitrogen and hydrogen in 1840, and the attempts to make cyanogen compounds from atmospheric nitrogen by Bramwell in Newcastle at about that period were interesting but of no commercial importance. It was not until the Haber process was worked out in the years 1906, 1907 and 1908 that the fixation of nitrogen from the air, on a commercial basis, became possible. This process has led to interesting developments, both in this country and abroad, and we hope that Dr. Harker, whose letter appeared in last week's issue, will be persuaded some time to disclose the history which he has hitherto been not sufficiently indiscreet to set out in detail. Further developments, of course, will be forthcoming, and the latest is the work by Prof. W. A. Bone on exploding together mixtures of carbon monoxide, oxygen, nitrogen and other gases. By this method he seems to have converted nitrogen into an active variety, and the publication of his papers before the Royal Society and the Royal Institution is eagerly awaited.

THE STREAM-LINE FILTER

By PROF. J. W. HINCHLEY

A remarkable filter has been invented by Prof. Hele Shaw, F.R.S., whose work on stream-line motion of fluids is so well known and whose ingenious clutch, steering gear, hydraulic transmission, pipe joints and taps have made his name familiar all over the world. The filter consists of several thousand similar sheets of paper or fabric, impervious to the liquid to be treated, and pierced accurately with a large number of equidistant holes. The sheets are placed in a pack so that the holes coincide, and are secured between endplates. By means of channels formed in these endplates alternate rows of holes may be connected together as the inlet for the liquid to be filtered, whilst the other holes connect with other channels in a similar way, forming the exit for the filtrate. It will be realised that true filtration may take place between the sheets through the interspaces formed by the roughness of the paper or fabric.

By squeezing the pack the finest materials, bacteria, colloid particles, etc., may be retained by the filter, and on releasing the pressure it may be readily cleansed by driving a washing liquid in either direction. The formation of a hard cake is not allowed to take place, but the precipitate or residue is removed by allowing the contents of the inlet holes to discharge either intermittently or continuously through a suitable orifice. It will be realised that the filter possesses all the useful properties of a sand or porous pottery filter with the wonderful addition of a means of adjustment of porosity and of cleansing which puts it in a separate class.

Such a filter appears to be a great need of the time. Workers with the colloid mill know that a colloidal suspension with about 10 per cent. of solids is its usual product, and that such a product needs concentration before a real commercial benefit can usually be achieved. The stream-line filter will concentrate such solutions continuously to the point required by industry or to the point where drying by vacuum or other plant becomes a commercial proposition. Experimental work is being conducted which will demonstrate the usefulness of the filter in different industries and settle some of those questions which have arisen through the remarkable facility by which it removes discoloration and produces bright solutions.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

The Evening Meeting

of the London Section of the Society held last week somehow seemed to just miss the mark. It is difficult to say why. The subject was "The Action of Bacteria on Cellulosic Materials." It was introduced by Sir Frederic Nathan, who, realising the wide scope of the subject, contented himself by indicating the various heads under which the discussion might with advantage be carried on. He threw out a number of suggestions for the guidance of those who were to follow, but the subsequent speeches never seemed to follow the sequence suggested. Each was very interesting in itself; it was the correlation of them which bothered me. Mr. Lymm led off with carefully prepared details of work done by Mr. Laugwell and himself on the production of light motor fuel by the fermentation of cellulosic waste materials. Dr. Tyson dealt with the biochemical side of the subject. Dr. Page told us of the Rothamsted experiments for the production of artificial farmyard manure. So the discussion went on, with Dr. Ormandy in a pessimistic mood and Mr. Cross asking for definite information as to the price of alcohol and acetic acid. What everybody in chemical industry wants to know is how we are to obtain plentiful supplies of cheap alcohol. This we were not told.

In His Baeyer Memorial Lecture

Professor Perkin gave to those of us who never knew Baeyer a very convincing portrait of one whom we should all like to know, if not at first, then at secondhand. For an hour and a quarter Professor Perkin held us entranced while in an even placid voice he dealt with some of the outstanding characteristics of the great man. When he was describing his method of lecturing it so absolutely corresponded with his own that I felt that Professor Perkin had unconsciously modelled his style on that of Baeyer. From the age of nine, when Baeyer literally "brought chemistry into the home," till far on in life we can think of him only with a test-tube in his hand—a test-tube cleaned, as we were told, in his own way, first with dilute caustic soda, then with water, then with alcohol, then with distilled water. We can think of him peering at it, not anxiously to see if some pet theory is vindicated, but keenly to be sure that he missed nothing of the answer nature gave to the question he had put to her. He cared little for the theatre, for music or for what can only be described as "political chemistry"; but if he ever began to regret his keen concentration on his chosen subject, he would be the first to declare that it was this concentration which brought him his well-merited reputation. In proposing a vote of thanks to the lecturer Professor Armstrong spoke of Baeyer as the "Father of Condensation Chemistry," and it is to be hoped that this apt title will always be associated with the name of Baeyer.

The Chemical Engineering Group

have completed and duly celebrated another year's work. There have been times—a spirit of sweet reasonableness now prevails, brought about very largely, I believe, by the President and Treasurer of the Society on the one side, and the Chairman and Treasurer of the Group on the other. A deficit of £173 on the working of the past two years is wiped out by the Society, the Group presents its thanks, and everyone is happy. There might have been trouble between the Group and the new Institution of Chemical Engineers, but there has not been, and I do not think there is likely to be any. They are now sharing the same office and the same assistant secretary. Such exemplary conduct demands a reward, and this will be found in the steadily growing influence and sense of responsibility of the Group. The Group has recently been entrusted with the whole of the organisation of the Chemical Section of the World Power Conference which is to be held at the British Empire Exhibition at Wembley next year. *Vires acquirit eundo.*

The Meeting

of the Union Internationale at Cambridge is rapidly approaching. The delegates—and I hope every chemist of distinction in the country will be a delegate, for all such are invited—will be received by Sir Charles and Lady Walston on Sunday afternoon, June 17. On the following day there will be council and committee meetings and a discussion of Professor McBain's paper on "The Nature of Soap Solutions" and a reception by the Master of Sidney Sussex College and Mrs. Weekes. On Tuesday there will be other meetings and the annual dinner in Trinity College, and on Wednesday the presentation of honorary degrees at the Senate House and a reception by the Vice-Chancellor at the Fitzwilliam Museum. It is time the whole programme was published and the list of delegates, too.

The Royal Institution

provides scientific feasts in its Friday Evening Discourses and the discourse delivered by Professor Bone last week was no exception to the rule. But I was disappointed that he did not say more of the possibilities of his process for nitrogen-fixation. However, the conversion of laboratory into industrial work is nothing new to Professor Bone and his hint of possibilities may be only scientific caution.

SOCIETY OF CHEMICAL INDUSTRY

THE ANNUAL MEETING

CAMBRIDGE. JUNE 20 TO 23, 1923

Accommodation of Members in Colleges. Accommodation will be available for men in various colleges from the afternoon of Wednesday, June 20, to the afternoon of Saturday, June 23. Members who arrive on Wednesday will be charged an inclusive fee of £3, those arriving on Thursday an inclusive fee of £2. These fees include the use of a set of rooms (bedroom and sitting-room), attendance, gratuities to college servants and the following meals: *Wednesday, June* 20.—Tea (if required) and dinner. *Thursday, June* 21.—Breakfast, lunch and dinner. *Friday, June* 22.—Breakfast, lunch and dinner (if required). *Saturday, June* 23.—Breakfast, and lunch (if required). Members will usually take their breakfasts in their rooms. Luncheon and dinner will be served in the halls of colleges. On Thursday and Friday tea will be served at the Vice-Chancellor's reception, and at the Garden Party at Sidney Sussex College respectively. Members who arrive before five o'clock on Wednesday, and who will require tea, are requested to give notice to that effect on a form to be supplied. There will be no extra charge. Members unable to attend the Annual Dinner of the Society on Friday, and desirous of dining in college that evening, may do so without extra charge by giving notice to that effect on the form above referred to. Members who do not make the trip to Ely, and who require luncheon before leaving Cambridge on Saturday, may obtain it in college on that day without extra charge.

It is important to note that alcoholic drinks are not included in the charges specified above, and members requiring such drinks with their meals must sign a chit presented by the waiter at the time of ordering. Payment for such must be made by members at the office of the Society at the Arts School, Bene't Street, on Saturday, before departure. It is the wish of the college authorities that no money shall change hands at table, and it is hoped that members will kindly co-operate in order that this scheme of payment may be a success.

To the list of colleges offering accommodation given on page 469 of the last issue of *Chemistry and Industry*, Selwyn College is to be added. As previously stated, men requiring accommodation should communicate with Mr. J. E. G. Harris, the University Chemical Laboratory, Downing Street, Cambridge, who will supply any further information and forward a form to be filled up by the member.

The Smoking Concert on June 20 will be held in the dining room of the University Arms Hotel.

Group Photograph. A photograph of the members will be taken at the close of the Annual General Meeting on Thursday.

Guide to Cambridge. A copy of the illustrated Guide to Cambridge will be forwarded to each member who has purchased his ticket as soon as supplies are received from the publishers.

News. Further information will be published from week to week in this *Journal.*

J. P. Longstaff,
General Secretary

NEWS FROM THE SECTIONS

LONDON SECTION

The Annual Meeting was held at the Engineers' Club, London, on May 7, Mr. E. V. Evans presiding. The chairman announced that Dr. Bernard Dyer had accepted office as Chairman of the Section, and that Dr. Monier-Williams had agreed to continue as Hon. Treasurer and Secretary. Commenting on the change of place of meeting during the present session from Burlington House to the Engineers' Club, the chairman mentioned that there was not an absolutely unanimous agreement on the change, although he believed it had been generally appreciated. The Committee of the Section felt that more papers should be offered to the Section. The Section had 1400 members, and he had been surprised during his term of office at the difficulty which the Secretary often had in getting papers. The following were elected to fill vacancies on the Committee: Dr. J. P. Longstaff, Dr. E. H. Tripp, Dr. L. A. Jordan, and Mr. R. A. Punter.

Sir Frederic Nathan, K.B.E., in opening a discussion on "The Action of Bacteria on Cellulosic Material," said the discussion should be mainly directed to the industrial side. The action of bacteria on cellulosic materials, using both terms in their widest sense, might be considered for the purpose of the discussion as proceeding either naturally or artificially. The effects of natural action might be either harmful or beneficial, and as an example of beneficial action, first place must be given to coal. An example of harmful action was the deterioration, observed in 1906, of cotton waste in India; the cause was attributed to the climate. In 1917, supplies of cotton waste and cotton linters stored under adverse conditions were found to have undergone similar disintegration. It was found that under certain conditions of temperature and moisture, bacterial action was set up, and further, that cottons grown in different parts of the world were decomposed at different rates. Investigations were still proceeding, and it was hoped that means would be found for preventing or restricting this serious loss. Reference was next made to work at Rothamsted on the production of artificial farmyard manure, and to recent patents covering the production of acetic acid and alcohol from waste vegetable materials by direct bacterial fermentation. Again, experiments were being carried out at Nobel's explosives factory in Ayrshire upon the fermentation of cotton waste into practically nothing but methane and carbonic acid; the work was in its initial stage, but it offered possibilities for the production of formaldehyde and methyl alcohol. The conversion of waste vegetable materials into power gas had been examined at the Indian Institute of Science, Bangalore, and bacterial action on flax and other fibres was being studied. So far no micro-organisms had been found that would attack cellulose materials to produce alcohol directly and in such a way as to point to a successful commercial application. The method of subjecting grasses to acid hydrolysis gave good results and a process for treating sawdust and wood waste had reached application on a technical scale, both in France and Germany, the material being subjected to the action of strong hydrochloric acid, both liquid and gaseous, in plant of special material and construction. The yield of alcohol from the fermentation of the resulting carbohydrates was stated to be at least three times as great as that obtained by the older processes of Clason and others.

Mr. A. H. Lymm gave an account of researches by Mr. H. Langwell and himself upon the fermentation of cellulosic materials for the production of light motor fuel, the aim being to use waste materials that had no food or fodder value, such as maize waste and the various straws and grasses found abundantly in the tropics. Hitherto no process had been developed for transforming cellulose directly into useful organic products—the most important of which were alcohol and fatty acids—without the intervention of considerable quantities of relatively expensive chemicals. Most of the early work consisted of laboratory experiments, but the work of Mr. Langwell and himself, however, was on a large scale, utilising cultures up to 8000 litres in volume, and was partly embodied in British Patents 134,265 of 1918, and 161,294 of 1920, and four further patent applications on file. At first the investigations were concerned chiefly with the organisms to be employed, and as a result a bacillus was found which would rapidly attack almost every form of cellulose under either anærobic or ærobic conditions. It was found, however, that lignocelluloses (wood and jute) and cuto-cellulose (cork) were only attacked extremely slowly, if at all, unless the cellulose was first freed from combination. With these exceptions almost every form of carbohydrate (including starches and sugars) yielded to the attack of the bacillus. The work showed that a certain bacillus was the chief if not the only organism concerned in the general anærobic fermentation of cellulose according to the process worked out by Mr. Langwell and himself. It was found that two distinct types of colony were almost invariably obtained, but experiments showed that these were only forms of the same organism. A large variety of carbohydrates was tested, and they appeared to behave similarly, yielding products similar to those from the typical cellulose adopted as standards, filter paper in the laboratory tests and sulphite pulp in the large cultures. The rate of fermentation was also satisfactory, and varied from 24 hours for the sugars to about 5 days for the resistant celluloses. The products obtained could be varied, on the small scale, by varying the conditions of fermentation, without any change of organism. In practice, fermentation was carried on at 68° C., a temperature which automatically purified the culture and kept it free from contamination. It was only necessary to know the amount of fermentable carbohydrate in any substance to obtain a good idea of the possible yield of products from such a raw material by the process which had been described. The conclusion from these investigations was that a single organism was responsible for anærobic fermentation of cellulose, and it did not appear that this organism was similar in its behaviour on standard media to any species known to the authors. The organism might satisfactorily be cultivated at any temperatures from 37° to 65° C., the former being most suitable for pure culture work, whilst the latter appeared to be the optimum temperature.

Dr. Tyson, of the Royal Naval Cordite Factory, said that until quite recently the biochemistry of the cellulose fermentation was but little understood. Pringsheim showed that the bacterial breakdown of cellulose appeared to follow lines parallel to those already known from the chemical hydrolysis of cellulose and a further study of the bacterial decomposition of pure cellulose would materially assist in the elucidation of the cellulose molecule. Mr. Page (Rothamsted) referred to the experiments which have been carried out upon the production of artificial farmyard manure at Rothamsted. Dr. Harland (Cotton Research Association) said the work which was being carried out at the Shirley Institute upon the various types of mould which caused cotton fabrics to deteriorate indicated that cottons in which the nitrogenous material was reduced to a minimum, were very much less susceptible to attack by mould.

Mr. C. F. Cross expressed the view that the discussion had ranged over too large a field, and with the exception of Mr. Lymm, the speakers had failed to concentrate upon the most important aspect, viz., the industrial applications. In such a discussion it was most useful to keep to the practical industrial side. We wished to know whether alcohol could be made at £10 per ton or acetic acid at £15 a ton and he wished Mr. Lymm had said more of the industrial results achieved.

Dr. Hutchinson, speaking of work carried out in 1917 in an endeavour to dispose of the surplus straw produced as the result of the food production campaign, said it was found necessary to have an adequate supply of air, and also a supply of nitrogen preferably in an inorganic mineral form. Given these conditions, straw was rapidly broken down. Mr. H. E. Thornton (Head of the Bacteriological Department, Rothamsted) described experiments carried out on the application of unrotted straw to the land.

Dr. W. R. Ormandy agreed with Mr. Cross that the discussion had tended to the theoretical rather than the practical and spoke of a coming shortage in petrol supplies, to meet which alcohol would have to be produced. He did not agree that only so-called waste materials should be used for this purpose, as there were processes in Switzerland and Germany for the production of fermentable sugars from wood whereby it was possible to obtain 300 litres of 100 per cent. alcohol from one ton of dried wood substance. It was not a question of obtaining alcohol to compete with petrol at its present price, but at the price it might easily attain in the course of a year or two.

Mr. Langwell referred to the large scale upon which the experiments described by Mr. Lymm had been carried out and to the ease with which the products obtained could be changed over within a few hours from, say, acetic acid and methane at one end to lactic acid at the other end. On the technical side, the process was very far advanced. Dr. Lessing discussed the formation of coal, which was briefly touched upon by Sir Frederic Nathan, and said, with all respect to Dr. Ormandy, that our supplies of coal were far more important than the question of oil both in quantity and economic importance.

In replying to a hearty vote of thanks for opening the discussion, Sir Frederic Nathan agreed with what Mr. Cross and Dr. Ormandy had said as to the discussion not following the lines which he had sketched out. He had wanted more on the practical side and was disappointed that Mr. Langwell had not said something about the production of alcohol on a considerable commercial scale by his process. But he was not so pessimistic on the subject of oil supplies as Dr. Ormandy. He would like to know what proportion of alcohol would be obtained with that process from a given weight of straw, because that was the most likely source of alcohol in the future. Although the process to which Dr. Ormandy referred in which wood was treated with strong hydrochloric acid required large quantities of wood which were not available in this country, such a process might be possible in the United States, or Canada, as well as on the Continent. Hitherto, however, the production of alcohol from wood in the United States had not been successful commercially.

YORKSHIRE SECTION

The chairman, Dr. L. L. Lloyd, presided at the annual meeting held on May 7 in the Queen's Hotel, Leeds, and the following officers were elected for the ensuing session: Chairman, Dr. L. L. Lloyd; Vice-Chairman, John Evans; Hon. Local Secretary and Treasurer, B. A. Burrell. Messrs. F. W. Branson and W. J. Read were elected to fill the two vacancies on the committee. Subsequently, Mr. F. W. Richardson read a paper on "The Adulteration of Olive Oil."

Methods of testing olive oil for its suitability for oiling tops, as well as for detecting adulteration, are of great importance in the woollen industry, as an oil possessing drying properties may damage goods during storage. The question of adulteration should be approached with care as the various methods of extracting olive oil give a range of oils which have different constants, but yet are genuine olive oils. Years ago the author devised a test consisting in oxidising the oil in thin layers in a specially designed oven, hot air being drawn over the oil. Under this test, a good olive oil remains liquid, whereas rape oil becomes very viscous and linseed oil a hard varnish; the test is one of the best methods of detecting nut oil. If, after four hours' heating, an oil does not show any marked increase in viscosity, it will not oxidise markedly on oil tops in store. Some of the usual tests are unreliable, as genuine oils may be unsuitable, whereas an adulterated oil may be quite suitable; again, the tests may be of small assistance. It is not sufficient to rely on one fact, or even on a combination of data, in deciding whether an oil is adulterated or not, and when abnormalities are found the oil should be investigated further.

An olive oil was found to have an iodine value of 85·5, a potash number of 185, and a content of 2·8 per cent. unsaponifiable matter. Although the iodine value was rather higher than usual and the potash figure lower, these figures do not indicate adulteration. On further examination, however, suspicion was aroused when the result of a turbidity test did not agree with that of olive oil, and diazotised *p*-nitraniline gave an indication of rape oil. To ascertain if rape oil was present in quantities of 10 or 15 per cent., the Tortelli and Fortini test was used. The procedure adopted was the test as modified by Fryer and Weston, the "solid acids" being examined for iodine value and melting point. The mean values for olive oil were 7·8 and m.p. 58·5° and for rape oil 62 and 41·5°, but the suspected oil gave values of 20·8 and 53·5°. As there is no erucic acid in cottonseed, nut or sesamum oils, and as the figures agree with those given by a mixture of 15 per cent. rape oil with olive oil, it is almost certain that the oil was abnormal.

In the discussion, the Chairman said that all tests required further elucidation before oils could be definitely said to be adulterated

Colour reactions could not be depended on. Mr. W. McD. Mackey asked whether free oleic acid was not liable to oxidise, and also why Mr. Richardson suspected the presence of rape oil; the cloth tester definitely indicated the presence of oxidisable oils and he asked if it had been tried. Mr. B. A. Burrell stated he had found the Tortelli and Fortini test to be reliable for edible olive oil, but was it equally reliable for the ordinary commercial olive oils used in the woollen trade? Mr. Richardson, in reply, amplified some of the data which, to him, suggested adulteration. He had tried the cloth test and the temperature reached 320° F., a further abnormality, but he could not confirm that an oil containing free oleic acid was to be condemned; in fact he had found some eminently suitable. Naturally the oil had to be free from iron and copper catalysts. The Tortelli and Fortini test was very reliable for commercial oil and the figures given in the paper were for such oils.

MONTREAL SECTION

The Annual Meeting was held in the Queen's Hotel on April 16, and was preceded by dinner as usual. Dr. MacLean, the chairman, presided. The chairmen of the various committees reported on their activities during the session, the Reception Committee being particularly commended for their good work in bringing about greater friendliness among the members. The Nomination Committee made its recommendations for the Executive, and on the ballot being taken the following were elected:—*Chairman*, F. W. Horner; *Secretary-Treasurer*, C. F. Bardorf; *Committee*, Dr. A. R. M. MacLean (*ex officio*), Mr. J. B. Bell, Prof. LeCointe, Mr. N. Holland, Mr. C. C. Coll McFee, Mr. J. R. Macaulay, Mr. W. B. Woodland. Representatives of the guests from McGill and the University of Montreal expressed their appreciation of the hospitality extended to them by many Montreal business houses.

Mr. Munro then gave a summary of his prize-winning essay on the Manufacture of Newsprint Paper, an account of which will be given in a subsequent issue of *Chemistry and Industry*. The thoroughness with which Mr. Munro had studied his subject, during his vacations, was exemplified by the fact that he had joined a Trade Union in order to enable him to work with the men in overalls, thus acquiring the most intimate acquaintance, from the lumber camp to the sales office.

Professor LeCointe followed with a short discourse in lighter vein, on "Safety First," illustrated by humorous transparencies. The business of the evening being concluded, the members were entertained by musical selections by the McGill Quartet, Prof. Evans, F. J. Toole, H. Blackburn, C. W. Reynolds, D. Gillespie and J. Gillespie, the retiring chairman and the newly-elected chairman being accorded musical honours.

MEETINGS OF OTHER SOCIETIES

SOCIETY OF PUBLIC ANALYSTS

A meeting was held under the presidency of Mr. P. A. Ellis Richards on May 2 in the Chemical Society's Rooms. Five papers were read.

(1) "The Quantitative Determination of Hemp and Wood in Papers containing these two Fibres," by W. Dickson, F.I.C. The author considers that in the microscopical determination of hemp fibres in the presence of wood, examination alternately by ordinary and polarized light makes it possible readily to distinguish the microstructure of the different fibres. He has devised a method for quantitative work, utilising the counting method of Spence and Krauss. The paper is disintegrated by boiling with caustic soda and the pulp churned up with an egg switch. The fibre is then stained by the double Malachite Green and Congo Red method, and mounted in the usual way. The counting is done by Spence and Krauss's method, but no correction factor is required to convert proportions by diameter counting into proportions by dry weight of furnish.

(2) "The Estimation of Fat, Lactose and Moisture in Dried Milks," by H. Jephcott, M.Sc., F.I.C. As a result of examining over 25,000 samples of dried milk it is contended that: (1) Moisture is best determined by drying at 102-103° C. for 1 to 2 hours. (2) Fat can best be determined by a careful use of the Werner-Schmidt method; a modified Gerber method gives less accurate but concordant results for rough routine purposes. (3) The polarimetric determination of lactose in milk powders, whilst offering certain advantages, should not be used where great accuracy is desired. In such cases a gravimetric process, based upon the modified Fehling's method of Quisumbing and Thomas, is recommended.

(3) "The Determination of Lactose by the Polarimetric and Gravimetric Method," by A. L. Bacharach, B.A., A.I.C. Pure α-lactose monohydrate was prepared by careful recrystallisation and drying. It was shown to have the value for $[\alpha]_{D}^{20}$ of 52·42, agreeing with the most trustworthy recorded figure. The specific rotation of pure α-lactose monohydrate for the green line of the mercury-vapour arc was represented by the equation

$$\Big[\alpha\Big]^{t\;c=5}_{\lambda=546}=61{\cdot}94+(20-t)0{\cdot}085.$$

The reducing power of pure α-lactose monohydrate was also determined by the modification of the Fehling method due to Quisumbing and Thomas. The accuracy of this method claimed by these authors was confirmed, but the reducing power obtained was somewhat higher, 0·1000 g. of lactose hydrate giving 0·1565 g. of cupric oxide.

(4) "The Presence of Barium and Strontium in Natural Brines," by A. G. Francis, B.Sc., F.I.C. The results of the analysis of 7 samples

of brines from deep boreholes in Derbyshire, Staffordshire and Scotland are recorded, together with a brief account of the method of analysis adopted. The maximum quantities of barium and strontium chlorides found were 178·2 and 169·4 parts per 100,000, respectively. An explanation based upon the "permutit" reaction is put forward to account for the presence of the chlorides of barium and strontium in natural brines and it is shown that there is a gradation in the strengths of sodium chloride solutions necessary completely to remove calcium, strontium and barium from a "permutit" filter charged with these elements.

(5) "The Melting Point and Iodine Value of Refined Natural *d*-Camphor." by M. S. Salamon, B.Sc. The iodine value and melting point of specially purified *d*-camphor have been re-determined, and it is shown that the usually accepted iodine value is too high, and that the usually published melting point is too low. The iodine value of the specially refined *d*-camphor is found to be 0·1 and the melting point 179° C. It is concluded that the majority of previous determinations must have been made on *d*-camphor that was slightly impure. The iodine value of oil of camphor has also been re-determined, and examples are given of how this value, together with the melting point and iodine value of *d*-camphor, can be used to indicate the percentage of camphor present in a sample of refined *d*-camphor; this, for pharmaceutical purposes, should have a melting point not lower than 176° C. and an iodine value of not more than 0·7.

SOCIETY OF DYERS AND COLOURISTS

A meeting of the London Section was held on April 26, when a paper on "Fur Dyeing" was given by Mr. L. G. Lawrie.

Although the art of dyeing furs has been practised since the earliest of historical times, it is only recently that any notable progress by the use of fur bases has been made. In 1888 E. Erdman patented the use of paraphenylenediamine and similar compounds for the dyeing of hair, and it was soon realised that these substances could also be used for fur dyeing, and about 1895 the Berlin Aniline Co. introduced the first of its range of Ursol colours. These fur bases were principally diamines, amidophenols, diphenylamine derivatives, etc., which form coloured insoluble compounds in the presence of oxidising agents.

Before dyeing, the skins must be dressed and tanned. Various methods of tanning, such as alum and salt, or chrome tannages are used but the oldest and most important method consists in working seal oil into the skins, which are then allowed to "heat," 30° C. being the maximum safe temperature. After tanning the skins are wetted out in warm water, treated with an alkaline solution (*e.g.*, ammonia, soda lime, caustic soda) to ensure even dyeing, then mordanted with metallic salts, which produce deeper, more varied and faster shades, copper sulphate, sodium bichromate, ferrous sulphate and alum being the salts usually employed. The furs are then washed and dyed.

The furs are dyed by impregnating them with a solution of the fur base, together with hydrogen peroxide, and usually a little ammonia or a little acetic acid. There are two main methods of dyeing :—"Dip" dyeing, in which the skins are completely immersed in the dyebath ; and "brush" dyeing, in which the dye solution is brushed on the hair. In dip dyeing the necessary weight of fur base is dissolved in boiling water and the solution added to the dyebath, which is made slightly alkaline, acid or neutral, according to the base used and the shade desired. An amount of hydrogen peroxide (12 vol.) 12-15 times that of the fur base is then added to the bath and the mordanted furs entered cold or lukewarm. The furs are left in this solution for anything from 6-12 hours according to the depth of shade required. After dyeing they are thoroughly washed to remove any unaltered fur base. The "brush" method of dyeing is sometimes necessary owing to the fragility of some furs, but more often it is used in order to colour the tips of the hair only or to colour them differently after the whole skin has been dyed a ground shade. Several applications of the brush may be required, the fur being allowed to dry between each application. After dyeing, the furs are subjected to a finishing process to improve the leather and to bring out the full beauty of the furs.

ROYAL MICROSCOPICAL SOCIETY

At a meeting of the Industrial Applications Section held on April 25, Prof. Frederic J. Cheshire, C.B.E., in the chair, Mr. W. N. Edwards read a paper on "The Microscopic Structure of Coal."

With improved technique the microscopic study of coal has advanced considerably in recent years, illuminating not only questions of its origin and formation, but also more strictly economic problems. The necessity for minute investigation of the structure and properties of coal has not always been felt so strongly in a country like England, where high-grade coal is so abundant and so easily obtainable, as in places where much research has been necessary before coal resources could be utilised economically. Thus in Sweden it has proved possible to use a coal with 50 per cent. of ash in certain smelting processes. The study of microscopic structure has been of value in considering problems such as spontaneous combustion and inflammability of coal dust, and the collaboration of the chemist with the microscopist should go far to solve these and other problems and to ensure the best possible use of different coals industrially.

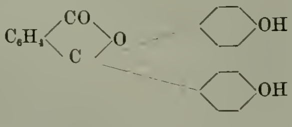
THE CHEMICAL SOCIETY

At the meeting held on May 3, the President, Prof. Wynne, recorded the death of Prof. E. H. Morley, an honorary Fellow of the Chemical Society, and said the Council might arrange for a Morley memorial lecture.

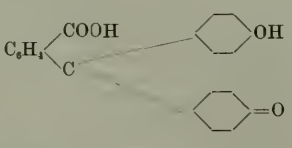
The first paper read was by Prof. H. B. Baker, on "Change of Properties of Substances on Drying. Part II." This work is a continuation of that published previously by Prof. Baker. It was shown that in taking the boiling point of the various liquids the high temperature was only observed when the thermometer bulb was immersed in the liquid itself. If the thermometer was suspended in the vapour above the liquid the rise above the usual normal boiling point was only 1°–2° C. at the most. The temperature of ebullition was taken to be that at which bubbles appeared freely in the liquid. In further experiments, several samples of the carefully dried liquids were sacrificed by boiling off the whole. With benzene the temperature of the vapour rose from 81° at the beginning to 88° C. at the end of the distillation. Evidence of change of melting point was also given. Dry benzene had m.p. 6·0° instead of 5·4°. Sulphur trioxide dried one month over phosphorus pentoxide had m.p. 50°, but that dried for several years had m.p. 61°. Two instances of abnormal vapour density were given :—

Ether, dry	B.p. 83°	V.D. 81·7
,, normal	B.p. 35°	V.D. 37
Methyl alcohol, dry ..	B.p. 120°	V.D. 45
,, ,, normal ..	B.p. 65°	V.D. 16

The second paper, entitled "The Sodium Salts of Phenolphthalein," by H. Bassett and P. Halton, was read by the latter author. Both colourless and coloured alkyl derivatives of phenolphthalein are known, a benzenoid structure being assigned to the former and a quinoid to the latter. The colour changes with phenolphthalein itself in aqueous solution are supposed to be due to a tautomeric equilibrium between the colourless



and the coloured



the former representing free phenolphthalein and the latter the red alkali salts. As little is known about the salts, especially when in the solid state, an examination was made of the three-component system phenolphthalein, sodium hydroxide and water. At 25° mono-, di- and tri-sodium salts were obtained as crystals each in the form of several different hydrates, and the di-sodium salt was also obtained in an anhydrous state. All these salts are colourless. Therefore in the deep red solutions from which these crystals separate there is probably a complex equilibrium between colourless mono-, di- and tri-salts and coloured mono- and di-salts.

"The Action of Thiosulphates on Cupric Salts" was the title of a paper by H. Bassett and R. G. Durrant. Prof. Bassett stated that the reaction between sodium thiosulphate and acid solutions of cupric salts leading ultimately to the precipitation of cuprous sulphide and sulphur consists in the first place in the reduction of the cupric to the cuprous with simultaneous oxidation of thiosulphate to tetrathionate. This occurs at once at ordinary temperature on mixing neutral solutions, the reduction being possible because excess of thiosulphate at once converts the cuprous copper into comparatively stable complex sodium cuprous thiosulphates. By change of concentrations several of these compounds can be isolated in the solid state, *e.g.*, $2Na_2S_2O_3$, $3Cu_2S_2O_3$, $6H_2O$; $Na_2S_2O_3$, $Cu_2S_2O_3$, $3H_2O$; and $Na_2S_2O_3$, $Cu_2S_2O_3$, H_2O. From a solution of cupric nitrate, $2Na_2S_2O_3,3Cu_2S_2O_3,6H_2O$ is obtained in a pure state, but when prepared from a sulphate solution it always contains some of the corresponding double sulphate $2Na_2SO_4,3Cu_2SO_4,6H_2O$ in isomorphous admixture. From the chloride, $Na_2S_2O_3,Cu_2S_2O_3.H_2O$ is obtained with some of the isomorphous Na_2Cl_2,Cu_2Cl_2,H_2O. All these double thiosulphates are hydrolysed on boiling, the action being rapid with acids. Cuprous sulphide and sulphur are precipitated, and when this occurs in contact with tetrathionate a portion of the latter is converted into pentathionate by the nascent sulphur. The filtrate consequently gives a precipitate of sulphur when made alkaline ; a characteristic reaction of pentathionates.

"The Conditions of Reaction of Hydrogen with Sulphur. Part II. The Catalytic Effect of Oxygen. Part III. On the Mechanism of the Reaction of Hydrogen with Sulphur and its Catalysis by Oxygen." In this paper, by R. G. W. Norrish and E. K. Rideal, Mr. Norrish drew a distinction between volume reaction, surface reaction and gaseous reaction, and the effect of oxygen in catalysing the reaction between sulphur and hydrogen and *vice versa.*

The last paper, read by Prof. T. M. Lowry, was entitled "Studies of Electrovalency. Part II. Co-ordinated Hydrogen." It started with the evidence of the ice crystal that hydrogen attracts two oxygen atoms and could thus itself act as a co-ordinator. He then applied his theory to special cases, which before had been difficult of explanation.

ROYAL SOCIETY OF ARTS

On May 9 Professor W. A. Bone read a paper entitled "Surface Combustion with special reference to recent Developments in Radiophragm Heating." The lecturer gave a brief summary of his experimental results and then showed that: (1) According to their chemical nature and physical texture all hot surfaces, at temperatures below ignition point, have the power of accelerating gaseous combustion in different degrees; (2) at high temperatures this difference in power of acceleration practically disappears; (3) during combustion the chemical action occurs mainly in, and is usually confined to, the boundary layers between the gaseous and solid phases; (4) the accelerating influence rapidly increases with rise in temperature; and (5) all surface combustion depends upon the absorption of the combustible gas, and probably the oxygen by the surface, thereby becoming activated through association with the surface. The work done in collaboration with the late Mr D. C. McCourt, which resulted in the installation at Skinningrove Iron Works of two boilers fired on this principle with coke-oven gas, was next reviewed. Unfortunately the "Radiophragm," developed during this period, proved difficult to manufacture, and possessed the disadvantage of pre-ignition if working at a temperature above 900° C. Recently the work has been resumed in conjunction with Mr. F. J. Cox, and both flat and circular radiophragms have been made, which are capable of working at much higher temperatures without danger of pre-ignition. At the conclusion of the lecture a demonstration was given on various types of these new radiophragms. which have found a wide variety of industrial applications.

ROYAL INSTITUTION

The Friday Evening Discourse on May 11 was delivered by Prof. W. A. Bone, on the subject of "Gaseous Combustion at High Pressures." In his discourse, Professor Bone described the steel bomb, the Petavel gauge for measuring the pressures generated in the bomb and the method by which these pressures taken over intervals of time of 1-100 of a second were recorded, and then proceeded to give an account of the work carried out with the assistance of the late Mr. W. A. Hayward. In this work it was found that when a mixture of carbon monoxide, oxygen, and nitrogen, capable of liberating the same total amount of energy as a hydrogen-air mixture was exploded, the time taken to reach the maximum pressure was much longer in the former than in the latter case, also that the cooling in the case of the hydrogen-air mixture took place immediately, whilst in the former case the cooling was delayed for quite an appreciable interval, thus showing that heat energy was being liberated long after the maximum pressure had been reached. To elucidate these differences and to determine the part played by nitrogen, mixtures consisting of carbon monoxide and oxygen, to which were added either nitrogen, oxygen, argon, or hydrogen in definite and varied amounts, were exploded in the bomb. It was found that the times taken to reach the maximum pressures in the case of the oxygen, hydrogen, and small amounts of argon diluents, did not differ greatly from those obtained with hydrogen-air mixtures, whereas the nitrogen mixtures were much slower, the length of time required to reach the maximum pressure being appreciably affected by the amount of nitrogen present. It was also found that with nitrogen mixtures the ratio of the final to the initial pressure was much less than with either the oxygen, argon or hydrogen mixtures and that the washings of the bomb after an explosion of a nitrogen mixture showed distinctly the presence of nitric acid.

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held on May 10, Sir William Pearce presiding in the absence of the chairman, Sir Max Muspratt.

An interim report was received in connexion with the quantity of fuel consumed by members of the Association during 1922, and when the final report is available the information will be passed to the Mines Department.

In connexion with the Sixth International Mining Exhibition the Association has arranged for two lectures to be given on Thursday, June 12, 1923, one by Mr. E. I. Lewis, of Messrs. Albright and Wilson, Ltd., on the subject of "Fine Chemicals," and the other by Mr. Edmund White dealing with "Rare Earths." Sir William Pearce will occupy the chair.

The arrangements for the Chemical Section of the British Empire Exhibition are moving very satisfactorily. With the exception of about 3000 sq. ft. the whole of the space allocated to the chemical industry has been taken, and it is anticipated that by the end of the month all the space will be booked. Nearly £2000 has already been subscribed towards the expenses of the scientific exhibit.

Dr. Clayton, M.P., reported that the Salmon and Freshwater Fisheries Bill has passed the Committee stage of the House of Commons in such a form as would not be inimical to the interests of chemical manufacturers.

The General Manager presented a report dealing with the proposed compulsory marking clause in the Merchandise Marks Bill, and said that certain suggestions have been laid before the Board of Trade as to the best methods to adopt in dealing with this vexed question.

A report from the Transport Manager disclosed that the new conditions of carriage of merchandise by goods train at company's risk had been settled by the Railway Rates Tribunal, and many valuable concessions obtained.

NITRATES FROM THE AIR

In the first of the series of Cantor lectures delivered before the Royal Society of Arts on "Nitrates from the Air," Mr. A. Kilburn Scott mentioned the reasons which led the Ministry of Munitions to instal a small cyanamide factory at Dagenham Dock and ultimately to erect a large factory for the manufacture of ammonia by the Haber process at Billingham-on-Tees. Dealing with the fixation of nitrogen by the arc process he pointed out that this method entailed the least possible amount of labour and the minimum cost for raw materials. In the manufacture of nitrates by the arc process, the furnaces may utilise single- or three-phase alternating current. Belonging to the single-phase type in which the furnaces have to be used in sets of three are the Bradley and Lovejoy, and the Island furnaces, in which the formation of the arc is accomplished by mechanically moving parts, the Birkeland-Eyde and Moscicki furnaces using a magnetic field to direct the arcs, the Schönherr and Wiegolofsky furnaces having a fixed arc, and the Pauling and Heckenbleckner varieties in which air currents are employed to direct the arcs. The Kilburn Scott furnace having air blown arc flames and pilot arcs and the Nitrum furnace in which air currents are employed to rotate horizontally a disc-like arc, are furnaces in which three-phase alternating current is used in each reaction chamber.

It was stated that the usual production from the single-phase type of furnace, employed in Norway, amounted to 62 g. of nitric acid per kw.-hr., whilst tests on the three-phase type of furnace had given between 90 and 100 g. of nitric acid per kw.-hr. The commercial importance of the arc process was illustrated by figures of the output of the Norsk Hydro-Elektrisk Kvaelstofaktieselskab, which, using furnaces of the original Birkeland-Eyde type and a more recent type, supplied to the specification of the Badische Anilin und Sodafabrik, manufactured during 1919, 67,419 tons of nitrate of lime and exported 50,000 tons of nitric acid, sodium nitrite, sodium nitrate and ammonium nitrate. The lecturer described the Pierrefitte plant, in which there are four Birkeland-Eyde furnaces, each 10 ft. in diameter, fitted with water-cooled electrodes and consuming 4000 kw., and it was stated that with this plant nitric acid could be manufactured at a cost of £6 per ton; power costing 20s. per kw. year. As illustrating the three-phase system the furnaces used by the Nitrum Co. of Zurich were taken. These furnaces, varying in size from 700 to 8500 kw. consist of three adjustable, water-cooled electrodes operating in a firebrick-lined cylinder into which the gases are introduced tangentially, thus keeping the walls of the cylinder cool, and at the same time producing a horizontal disc-like arc. The oxidised gases leave the chamber at the centre of the arc at high velocity through a water-cooled pipe, which rapidly cools the gas and gives a concentration of from 2·5 to 3 per cent. of oxides of nitrogen. When oxygen is used the yield of nitric acid is from 75 to 80 g. per kw.-hr. The lecturer accounted for the inability of the 300 kw. Scott three-phase furnace installed at Messrs. Kynoch's works, to realise the figures obtained from the experimental plant, by stating that after the issue of the report of the Nitrogen Products Committee, it was found that the electric meter used was reading 100 per cent. high.

The first part of the second lecture dealt with the capital cost of the alkali and acid absorption towers, which account for nearly half the total cost of the plant. It was pointed out that the problem of reducing this great capital outlay could be solved by increasing the percentage of nitric acid, as in the Nitrum furnace, for an increase of from 1½ to 2½ per cent. concentration would result in a reduction of those towers to one quarter of their original size. Another method would be to pass the gases through the towers under pressure as adopted in the latest type of Häusser plant, in which metal towers are used into which the gas passes at a pressure of about 45 lb. per sq. in. In this case the towers can be reduced to one-fiftieth of the size required when working under atmospheric pressure. Mr. Scott suggested that future improvements in the arc process would be obtained by passing equal quantities of nitrogen and oxygen into the furnace, and, as recent researches of C. P. Steinmetz seemed to indicate, by maintaining the pressure inside the furnace between 50 and 100 lb. per sq. in. The second part of this lecture was devoted to recent developments in the Häusser plant and a detailed description of the Muscle Shoals plant in America was also given. The improvements in the Häusser plant consist in increasing the capacities of the bombs used, forming the absorption towers of acid-resisting steel alloys, and passing the gases through those towers under pressure. With improved plants of this type it is possible to obtain a yield of 200 g. of nitric acid per cb. metre. The Muscle Shoals plant was intended to produce 40,000 tons of fixed nitrogen per annum. Twelve rectangular furnaces, formed of steel and lined with fire-brick, each 12 ft. by 22 ft. by 16 ft., were installed, each furnace being capable of producing 50 tons of carbide per 24 hours. After cooling the carbide is crushed in an atmosphere of nitrogen until 85 per cent. will pass through a 200-mesh sieve; 1536 electric ovens, each containing a charge of 1600 lb. of pulverised carbide, are used to convert the carbide into cyanamide, the carbide being heated in an atmosphere of nitrogen to 2000° F. for 40 hours. After cooling, the cyanamide is again crushed and ground until 95 per cent. will pass through a 200-mesh sieve and is then treated with water to remove any free carbide. This finely ground cyanamide is then treated with superheated steam at 150 lb. pressure, when pure ammonia gas is evolved, the sludge, containing carbonate of lime, caustic soda and free carbon, passing to a set of Oliver filters, where the weak caustic soda is recovered. To produce oxides of nitrogen the ammonia mixed with air in the proportion of 1 to 10 is passed over a catalyser, consisting of platinum gauze heated to 750° C. The gas enters at the top of the catalysers, 696 in number, and the oxides leave at the bottom and after passing under boilers enter the towers and coolers. Special precautions are taken to obtain pure air for the liquid-air plant and every effort has been made to recover the heat from the gases leaving the catalytic chambers. Although it has never been used commercially this plant has already cost 107 million dollars, and if Mr. Ford acquires it he will spend a further 100 million dollars to complete it. Of this sum 15 million dollars will be spent on a plant for the manufacture of phosphoric acid from Florida phosphate rock.

At the beginning of the third lecture Mr. Scott referred to the Humphrey pump and discussed its application to the Häusser process, and then described the Haber process in which ammonia is formed by passing hydrogen and nitrogen over a pure iron catalyst. The nitrogen for this process is obtained from Linde liquid-air plants and the hydrogen may be obtained, either electrolytically or from producer gas. If the first method is employed 75 per cent. of the power required would be utilised to produce hydrogen. When hydrogen is obtained from producer gas it is necessary to remove by freezing the carbon dioxide, which poisons the catalyst. The gases before entering the catalyser are compressed to 200 atmospheres and the catalyst is maintained at a temperature of 550° C. The Claude process also passes hydrogen and nitrogen over a catalyst, but in this case the gases are previously compressed to 900 atmospheres. Under this pressure it is found that the heat of reaction is sufficient to raise the temperature of the incoming gases to 500° C. Claude's latest type of catalyser consists of two concentric tubes, the inner containing the catalyst. Cold gas enters at the bottom of the annulus formed by these tubes and passing upwards, is heated by the heat generated within the catalyst. The walls are so designed that the heat absorbed by the incoming gas will be just sufficient to raise its temperature to 500° C. as it enters the catalyser material.

In the discussion which followed Dr. Harker pointed out that the enriched air arc-process, which had been adopted in three plants in Switzerland and Germany, had ended in disaster, the plants being wrecked by explosions. He also touched on the developments which were going on at Billingham-on-Tees.

PERSONALIA

Sir J. J. Thomson has been elected honorary professor of natural philosophy and Sir E. Rutherford professor of natural philosophy in the Royal Institution.

The Department of Scientific and Industrial Research has constituted a special committee of the Building Research Board to report on the best methods by which the decay of building stones may be prevented or arrested. The chairman will be Sir Aston Webb, and the members of the committee include Prof. C. H. Desch, F.R.S., Sir Herbert Jackson, K.B.E., F.R.S., Dr. A. Scott, F.R.S., and Mr. H. M. Weller, M.I.C.E.

Dr. G. K. Burgess has been appointed director of the United States Bureau of Standards in place of Dr. Stratton, who resigned to become president of the Massachusetts Institute of Technology.

E. P. Mathewson has been elected President and T. T. Brewster and F. M. Smith have been elected Vice-presidents of the American Institute of Mining and Metallurgical Engineers for 1923.

Prof. Brodhun has been appointed director of the Physikalisch-Technische Reichsanstalt, Berlin.

* * *

Landrat M. Rotger, formerly chairman of the firm of Krupp and president of the Office for German Industry during the War, has died at the age of sixty-three. The deaths are also announced of A. Wellenkamp, well known in the potash industry; of Prof. G. Barkhauens, Rector of the Technical *Hochschule*, Hanover; and of Dr. E. Reiss, who had worked on blood serum, on uræmia and on the electrical degeneration of the muscles.

FORTHCOMING EVENTS

May 24. Society of Chemical Industry, *Birmingham and Midland Section.* A visit has been arranged to the works of Messrs. Cadbury Bros., at Bournville. The number is limited, and members should notify the Hon. Secretary at an early date.

May 24. The Royal Institution of Great Britain, 21, Albemarle Street, W., at 9 p.m. "Engineering Problems solved by Photo-elastic Methods," by E. G. Coker, D.Sc., F.R.S. (Lecture 2.)

May 28. The Faraday Society, at the Institution of Electrical Engineers, Victoria Embankment, W.C. 2, at 3 p.m. Discussion on "The Physical Chemistry of the Photographic Process."

May 31. The Royal Institution of Great Britain, at 3 p.m. "The Nature of Enzyme Action," by Sir W. M. Bayliss, LL.D., D.Sc. Also on June 7.

CORRESPONDENCE

TURPENTINE AND WHITE LEAD POISONING

Sir,—In confirmation of the conclusion arrived at by the Norman Committee respecting the alleged poisonous nature of turpentine vapour, viz., that it is not the cause of the symptoms attributed to acute or chronic lead poisoning, and that there is no evidence that the inhalation of turpentine fumes induces chronic "Bright's disease," I can furnish very pertinent evidence.

In one part of the Sanitas Company's factory over a period of many years a considerable number of men, boys, women and girls was engaged in regular and continuous work, the atmosphere of the building being all the time fully impregnated with turpentine vapour arising from operations with thousands of gallons of the liquid in a heated condition, and during the whole of that time there was never a complaint of any kind; neither acute abdominal pain, headache or any other disorder; indeed, it would be difficult to find a healthier lot of people.

I brought this information to the knowledge of Sir Kenneth Goadby in June, 1921.

As to the assumption of poisonous plumbiferous vapours emanating from white lead paint, I quite agree with Professor H. E. Armstrong that it is without any foundation, and that white-lead poisoning is to be attributed to the dust produced in rubbing down dry.—I am Sir, etc.,

C. T. Kingzett

"Newlands," Weybridge
April 20, 1923

THE TITLE "CHEMIST"

Sir,—The Institute of Chemistry, through its President, Mr. Chapman, raises the question of "title" to the designation of Chemist in an appeal to the public through the Press, or rather, in an appeal to the pharmacist usurpers, with the public cited as witness or more correctly *qua judex*. We English chemists have long accepted our anomalous position, looking to the Institute to bring the pharmacist to the status corresponding with that of the French *Pharmacien* and the German *Apotheker*. And we still look! Chemists would agree that it would waste our time and energies to engage in a controversy which would merely emphasise the fundamental unrealities of the position. In regard to the realities, which we all recognise, I suggest for consideration a terminology of classification subject to revision as regards etymology.

The discussion of this, or alternatives to be suggested, may contribute to a clear understanding on some matters of moment. Thus we appear as a body to have generally accepted the terms "Pure and Applied Chemistry" as an antithesis of Apostolic sanction. The use of these terms has had a polarising influence leading to fixed ideas. I suggest we may with advantage revise these terms, with others, to express what we really mean. Thus, the science of chemistry is a holothetic discipline. Applied chemistry may be fitly described as heterothetic. With the professional practice of the science as such, there enter a number of values, both technical and industrial, which require to be treated by exact method and are in fact factors of problems truly scientific. That this is a more correct terminology would appear from one illustration. Physiology is really applied chemistry, and on the old terminology the physiologist is denied any claim to follow the cult of the "pure" science, so called. This excommunication is not intended. These terms, current for so long, are inexact and lead to confusion of idea. Should we adopt such terms as suggested, we should have to consider whether the equivalent terms holo-chemist and hetero-chemist are acceptable, and whether they are etymologically sound. Outside the two groups of chemists connoted by the above division there is the group of "chemists" who associate with the practice of a section of the science, the trading, as wholesale or retail vendor, in chemical products alone or in association with miscellaneous goods. This group would include the shop-keeping pharmacist, the drysalter or wholesale druggist, laboratory furnishers, dealers in nostrum articles and perhaps the *dilettante* patrons of our science. If we had to find collateral terms for such as these, it is suggested that the words "amphithetic" and "amphichemist" should be considered.

Incidentally to a discussion amongst ourselves on these lines, we might succeed in enlightening the public and, indeed, educating it to the point of seeing the humorous side of those extraordinary products of our insular civilisation, the "chemist's" shop and the blue-bottle "chemist." Where the Pundits have failed to establish the "Pucka" chemist, the appeal to Puck may avail something.—I am, Sir, etc.,

C. F. Cross

Lincoln's Inn, London, W.C. 2
April 23, 1923

THE NITROGEN INDUSTRY

Sir,—Prof. Partington's letter of April 27 on the subject of Dr. Harker's review of our book on "The Nitrogen Industry," raises again a question the importance of which cannot be over emphasised.

Of recent years it has become a chemical platitude that the prosperity of a nation is measured by its consumption of sulphuric acid. I venture to express the opinion that the time is not far distant when this criterion will be the national production of combined nitrogen, in whatever form, and from whatever source. Prof. Partington refers playfully to the jousting between the "technical experts" and the "pure chemists." Such bickerings are inevitable among the professors of an inexact science and do no real harm to either side—fraternal strife judiciously controlled makes for a healthy family. But the choler expended thus wise is but as the bun flung from brother to brother across the family tea-table as compared with the greater *political* campaign which will be necessary before our national house is put in order. The chemists (both "pure" and "technical") are alive to the importance of the nitrogen problem, and progress has undoubtedly been made, even since the writing of our book.

The bureaucrats and the "administrative experts" have now to be convinced. One does not despair, but is given to wondering whether a threat of national extinction will again be necessary in order to supply the necessary stimulus in Olympic circles.—I am, Sir, etc.,

L. H. Parker

Experimental Station, Porton, Wilts

THE ORIGIN OF TWADDELL'S HYDROMETER

Sir,—In the event of any of your readers having knowledge of the inventor and origin of Twaddell's Hydrometer it would be of interest to put it on record. I believe that he was a workman at a Tyneside chemical works, but this piece of biography, or even the correct spelling of his name, does not seem to be known with certainty. Only those familiar with his hydrometer can really appreciate the many practical advantages of that instrument in chemical works.—I am, Sir, etc.,

H. A. Auden

Whitehedge Road, Garston
May 6, 1923

NATURAL TANNINS

Sir,—In the "Reports of the Progress of Applied Chemistry" for 1922, Mr. D. Woodroffe (p. 355) makes the statement: "The work of E. Fischer is being consolidated and supported by fresh investigations on natural tannins." In support of this statement Mr. Woodroffe gives the following two references: *Trans. Chem. Soc.*, 1922, **121**, 23; *Helv. Chim. Acta*, 1922, 5, 108. The first reference is to my paper on "Paullinia Tannin." This paper does not confirm Fischer's ester formula, but it shows conclusively that Paullinia tannin is a *normal glucoside* and not an acyl derivative of glucose. The second reference is to a paper by Karrer and Solomon, which deals with the syntheses of different galloyl-lævoglucosanes, none of which have so far been found in nature. I have tested Professor Karrer's trigalloyllævoglucosane by the gold-beater skin test for tannins which has been worked out in this laboratory by Miss E. Atkinson and Miss E. O. Hazleton (*Biochem. Journ.*, 1922, **16**, 516) and I have convinced myself that Karrer's substance has no tanning properties. Mr. Woodroffe's optimism is obviously unfounded.—I am, Sir, etc.,

M. Nierenstein

The University, Bristol
May 14, 1923

NEWS AND NOTES

FRANCE

The Nitrogen Industry

Since the article on the position of the nitrogen industry in France was published in these columns (Mar. 9, p. 228), further information has come to hand on the operation of the Claude processes at the Mines de Béthune. The coke-oven gas is tapped at the exit of the benzol scrubbers, compressed at 25 atm. and passed into a pressure column where the last traces of benzol are removed by a current of heavy oil, subsequently passing into a second column in which carbon dioxide is removed by lime water. The gas is then led to the separation apparatus, in which water and other condensible products, including ethylene, are removed. The hydrogen is then stored in a gasometer, but the remaining gases, which are rich in methane and yield 6000 cals., are utilised. From the gasometer the hydrogen is drawn by the hypercompressor at the same time as a suitable volume of air which is burnt before compression, and the mixture of nitrogen and hydrogen obtained is hypercompressed, passed through the purifying tube in which carbon monoxide is transformed into water and methane, and finally into the five catalyst tubes. The residual gases are returned to the hydrogen apparatus. From actual working the following figures have been obtained:—On treating 850 cb.m. of coke-oven gas per hour containing 49 per cent. hydrogen, a yield was obtained per hour of 425 cb.m. of gas containing 90 per cent. of hydrogen and 1·6 per cent. CO, the remainder consisting of nitrogen; 150 kg. of ammonia, of which 140 kg. was liquid, was produced per hour, and the total power consumption for heating, benzol removal, etc., was 460 kw.—*i.e.*, 3·06 kw.-hrs. per kg. of ammonia, 1·5 kw.-hrs. being required for the synthesis itself. The advantage of this procedure lies in more perfect recovery of the benzol, and the recovery of ethylene for the production of synthetic alcohol, of which 150 to 200 kg. is obtained per ton of ammonia. Recovery of these two products considerably reduces the cost per unit of nitrogen fixed. It is reported that a plant for treating 5000 cb.m. of gas per hour is under consideration for the manufacture of 20 metric tons of ammonia per day or 25,000 m.t. of ammonium sulphate annually. According to recent information on the Casale process, catalysis plant for producing 3 to 5 and 7 m.t. of ammonia per day has been established at the factory at Terni, in Italy. The hydrogen is produced by the electrolysis of water, a procedure which is economic under certain conditions, and a mixture of nitrogen and hydrogen is obtained by burning excess of hydrogen in air, water being eliminated as liquid. The pressure of the gas in the catalysis circuit is from 500 to 700 kg. per sq. cm., as compared with 200 kg. in the Haber and 1000 kg. in the Claude processes. The ammonia gas is liquefied by cooling, water not being used. An interesting point is that the gas is circulated by a pump through a single closed circuit and a single catalysis apparatus until transformation is complete. The French Cie. des Produits Chimique d'Alais, Troyes et Camargue, is installing plant to exploit this process, and further factories are said to be under consideration in Spain, Switzerland and Spain.

UNITED STATES

The Patent Office in 1922

During the year ended December 31, 1922, more than $3,000,000 was paid into the U.S. Patent Office by inventors and others, an increase of $237,000 over previous years. This increase was caused by a slight increase in fees charged and by the receipt of over 108,000 patent and trade-mark applications during the year; 88,930 applications for patents, reissue of patents and designs, and 173,932 amendments in pending applications having been filed. Inventors and attorneys were furnished with 72,626 photographic copies of drawings, and 186,129 photostat copies, for which $11,392.30 and $36,606.35 were received. Printed copies of specifications and drawings of patents to the number of 2,417,284 were sold at 10 cents each. The total number of printed copies of patents distributed during the year was 4,809,887.

GENERAL

Jâbir and Geber

In a recent number of *Nature* (Feb. 17, 1923), Prof. J. R. Partington discussed the identity of Geber, the reputed early Arabic chemical writer (whose identity with Jâbir was suggested by Mr. E. J. Holmyard in *Nature* of Oct. 28, 1922), and strongly criticised the attitude of Prof. E. O. von Lippmann in his *Entstehung etc. der Alchemie* with regard to the authenticity of the Latin works attributed to Geber. Prof. von Lippmann has now replied (*Chem.-Z.*, April 14, 1923), and claims that, so far from his method of argument being arbitrary and "untrustworthy," his conclusions have been arrived at inevitably, step by step, and have been favoured by eminent Orientalists. Prof. Partington's evidence for the authenticity of Geber's (pseudo-Geber's) works, based on Boerhaave's *Elementa Chemiae*, is considered unconvincing, and the comparison between the *De Anima* and *Canon* of Avicenna and Newton's *Daniel* and *Principia* quite unjustifiable. The facts remain that there is no Arabic MS. of Geber extant, that no Arab of that or a later period possessed a comprehensive chemical knowledge, and that the form of the Latin "translations" bears the stamp of the schoolmen of 1250–1300, Latin MSS. of a prior date not being extant. Concluding with a reference to the latest treatise of Darmstaedter, Prof. von Lippmann invites his critic to prove the existence of the spectre which he claims to see.

LEGAL INTELLIGENCE

The Carriage of Zinc Ash. A. Brandt and Co., and F. W. Vogel and Co. *v.* The River Plate Steam Navigation Co.

An action was heard by Mr. Justice Greer on April 25, in the King's Bench Division in which A. Brandt and Co., London, and F. W. Vogel and Co., Buenos Ayres, sued the River Plate Steam Navigation Co. for damages for breach of contract to carry a cargo of zinc ash from Buenos Ayres. After loading the zinc ash showed signs of heating; it was therefore unloaded and afterwards re-dried and reconditioned, the allegation being that it was wet when shipped. The defence was that there was justification in removing the cargo as it was dangerous as the heat generated was 160° F.

Mr. Knight, F.I.C., of Liverpool, said that he did not think there was any danger of spontaneous combustion; had he found zinc ash in the hold heating to the extent indicated, he would have advised its removal. Zinc ash might become dangerous and produce an explosion.

Mr. F. W. Harbord said that heat would be evolved when moisture and finely-divided zinc came in contact. The bags were rotted by chemical action, and not charred; if the ash contained much very finely-divided metallic zinc it might generate sufficient heat to damage or be a source of danger to any organic material. If the bags burst, as they would if they were rotten, there would be danger that the bales of cotton in the cargo might be ruined, as the ash contained zinc chloride, which would char cotton. Assuming that large quantities of hydrogen gas had been produced, there would be danger from the introduction of a naked light, but no danger of spontaneous combustion from the heat developed.

In delivering judgment, Mr. Justice Greer said he was satisfied that the zinc ash was dry at the time it left Messrs. Vogel's warehouse, and that some of the bags, which were the cause of the subsequent trouble, were wet through delivery on a wet day, but none of the bags afterwards found to be damaged became wet after delivery to the ship. The temperature might, through oxidation, have been raised so greatly as to cause the bags to be so damaged, that the zinc might have escaped during the voyage and damaged the surrounding cargo, but in no case was there any danger of spontaneous combustion. There would, however, have been grave risk of the contents escaping on the voyage and causing damage to cotton and cottonseed in the hold. More bags than was necessary were removed from the ship, and there was unreasonable delay in reconditioning and reshipping the unshipped bags. Judgment was given for Messrs. Brandt for £748, money paid by them under protest, damages for the breach to be assessed by the referee. The claim by Messrs. Vogel was dismissed without costs.

REVIEWS

Weyls Methoden der Organischen Chemie. *By* Prof. J. Houben. *Vol. II. Pp. xxviii*+1115. *Second edition, revised and enlarged. Georg Thieme,* 1923. *Price: paper,* 33*s.*; *bound,* 36*s.*

The second edition of the first volume has already been reviewed in these pages (1922, 141 R), and it is only necessary, therefore, to explain the scope and character of the second volume.

Briefly, it deals with the reagents and reactions of organic chemistry and is divided into sections. Each section is compiled by an author of established reputation, generally, though not invariably, with characteristic precision and thoroughness. Thus oxidation and reduction are very fully treated by Dr. Stoermer, esterification and hydrolysis by Dr. Hess, condensation by Dr. Kempf, and so forth. Not only are the individual processes described and examples quoted *in extenso,* but the preparation of the necessary reagents, both organic and inorganic, is also given—all with full references to the literature.

Each new section is introduced with a general outline of the process, its application and, where necessary, an account of any special apparatus, and it is rounded off at the end with a tabular statement of a list of the reagents described. Thus the volume forms a compendium of practical information to which every organic chemist may turn for an account of many of the chief laboratory processes. It should be pointed out, however, that the sections are by no means of equal merit. The first two or three chapters and the last on the action of light are brought well up to date. The last-named contains a very full and interesting account of much recent work, especially by Ciamician and Silber and other Italian chemists, and by Stoermer and Stobbe in Germany, and is introduced by a description of the various forms of lamps and apparatus used in this branch of research which the writer has not seen elsewhere. Perhaps the least satisfactory sections are those on electrochemical processes, enzyme action and the resolution of optical isomerides, which are not only incomplete in point of matter, but which ignore important work derived from non-German sources. For example, we are informed in a footnote to the section on fermentation enzymes that the most important work on the subject has appeared in the German "Berichte," whilst the work of Harden and his collaborators is dismissed in five lines. Again, in the table giving a list of the resolution of asymmetric amines, no mention is made of the exhaustive researches of H. O. Jones, whose name does not even appear in the index, and only one example is given of Kipping's resolution of the asymmetric silicane compounds. The omission of the names of Crum Brown and Walker under the electrolysis of the salts of organic acids is another curious instance of the same kind, whilst the persistence in attributing the discovery of the aluminium mercury couple to H. Wislicenus, though described by him many years after its description and use in this country, is another example of either ignorance of the facts or their intentional omission.

J. B. Cohen

Crystallisation of Metals. *By* Col. N. T. Belaiew, C.B. *Pp.* 143. *London: University of London Press,* 1923. *Price* 7*s.* 6*d. net.*

Col. Belaiew, whose name is well known in this country as an investigator who has continued the work of Prof. Tschernoff in the study of the structure of metals, has now printed the substance of a course of lectures delivered by him at the Imperial College last year, Prof. Carpenter contributing a preface. The subject is divided into the study of crystallisation from the molten state, crystallisation from the solid state, the formation of eutectics and eutectoids, and structural equilibrium in solids, most of the examples being drawn from the steels. The author's earlier memoir, which contains the results of most patient investigations into the crystallisation of slowly cooled masses of high carbon steels, was only published in the Russian language, and has therefore been inaccessible to most metallurgists except in the form of abstracts. The principal facts and illustrations are now reproduced, with a lucid explanation of the main features of the process. The author is particularly interested in the geometrical relations of the constituents of metallic masses, and therefore treats of the growth of crystallites, the relation of macro- and micro-structure, Widmanstätten figures, and the shape of crystal grains, subjects which are ordinarily omitted from the orthodox treatises on crystallography, whilst he uses the principles established by the crystallographers to co-ordinate his facts. The result is a fresh and highly interesting volume, which can be read and understood by every metallurgist and by most physical chemists. The constitution of the pearlite grain, a subject recently discussed by Col. Belaiew in a paper read before the Iron and Steel Institute, is shown by geometrical diagrams and by some beautiful photographs at high magnifications. The damascened steels afford other striking examples of crystallisation and segregation or coalescence. Throughout the book, indeed, the beauty of the illustrations is remarkable, and evidences the skill of the author and of his colleague, Capt. Brandt, in the manipulation of the microscope. The importance of crystallisation in metallurgy is great, and it will be of assistance to many to have so clear a presentation of the main facts placed before them.

C. H. Desch

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for May* 10)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Belgium ..	Pharmaceutical specialities	601
Canada ..	Drug specialities ..	597
Italy	Aluminium, nickel, tin, zinc, copper, brass, antimony, lead	605
,, ...	Shellac, gum arabic, medicinal herbs and plants ..	606
,, ...	Electrical cables ..	19365/F.W./C.C.
Netherlands ..	Iron tubes and fittings	852/3/F.G./E.C./2
New Zealand ..	Drugs, photographic materials	596
Rumania ..	Emery wheels (tender)	10578/F.E./E.C./2
South Africa ..	Copper tubing (tender)	11196/E.D./E.C.
Sweden ..	Chemical products and dyestuffs for the wood pulp, paper and glass industries	613, 614
United States	Asbestos and asbestos products	18655/F.W./M.C./2

TARIFF CUSTOMS EXCISE

Australia.—The operation of the duty on writing and typewriting paper has been deferred until January 1, 1924.

Czechoslovakia.—The Commercial Convention with the Netherlands is now in force.

Costa Rica.—The issue of May 10 gives a list of duties on various lighting materials.

Eucador.—The export of sugar had been prohibited.

Italy.—A general stamp tax has been levied on the transfer of the ownership of certain goods, including scrap metal, chalk, lime, cement, chemicals, fertilisers, resins and medicinal specialities. The duty on petroleum imported for agricultural machinery has been reduced to 10 lire (gold) per 100 kg.

Kedah.—Manufactured rubber goods are exempted from export duty.

South-West Africa.—Sugar may not be imported except under permit.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Mines (Working Facilities and Support Bill)

In moving the second reading of this Bill Lt.-Col. Lane-Fox said that the Bill was to secure the most effective development of the national mineral resources. It represented a valuable agreement between conflicting interests and should have enabled large properties of minerals to be worked. The second reading was carried by 214 votes to 76.—(May 7.)

Applications for Patents

Viscount Wolmer, answering Mr. Ede, said that 6000 applications for patents were awaiting examination in the Patent Office. This congestion was due chiefly to arrears caused by the war and to the revival of foreign applications after the war. He hoped that the return to normal conditions would be soon accomplished. —(May 8.)

Anglo-Persian Oil Co.

In answer to Mr. Potts, Mr. Baldwin said that of the share capital of 20,000,000 £1 shares in this company, the Government held 5,000,000 in addition to 1000 £1 8 per cent. cumulative first preference shares, and £199,000 in 5 per cent. debentures. The net profit during 1922 was £2,730,381, compared with £4,028,022 in 1921.—(May 8.)

International Labour Conference

In moving approval of the Government's policy respecting the Draft Convention's recommendations adopted by the International Labour Conference held at Geneva in 1921-22, Sir Montague Barlow referred to the Draft Convention relating to the use of white lead in painting. The Convention was passed owing to the influence of the British delegates, but the vote was given solely on the basis that the Convention should prove satisfactory and acceptable to all. In its wide outlines the Convention prohibited the use of white lead or lead sulphate in the internal painting of buildings, and the employment of males under 18 years of age, and of all females in any painting work of an industrial character involving the use of white lead. These provisions, however, were not to come into force until November 20, 1927. Further regulations controlled the conditions under which white lead could be used. Since then, difficulty had been found in interpreting the phrase "work of an industrial character" and the report of the Norman Committee (*cf. Chem. & Ind. p.* 377, 1923) indicated that in view of recent discoveries, some of the restrictions embodied in the Draft Convention, were no longer so important as they were. The matter therefore, called for further consideration, and it was proposed to communicate with the Authorities at Geneva whilst the Home Secretary would confer on the matter with the interests affected.—(May 9.)

REPORT

REPORT ON THE ECONOMIC CONDITIONS IN CUBA, DATED SEPTEMBER, 1922. *By* G. HAGGARD, *H.M. Consul-General, Havana, and* D. GAINER, *H.M. Vice-Consul, Havana. Pp.* 20. *Department of Overseas Trade. H.M. Stationery Office,* 1922. *Price 9d.*

The economic, political and geographical ties of Cuba are mainly with the United States, a dependency which is well illustrated by the trade statistics. Following the slump in sugar in 1920 the 1921 crop of 3,922,267 tons was thrown on to the market, causing worse confusion. The Government took control of sales till December, 1921, after which the demand improved, and the price obtaining at the time of issue of the report (3¾ cents per lb.) gave rise to general optimism. Up to the end of July, 1922, there had been shipped 4,099,305 tons, of which the United States took 74 per cent. The tobacco industry also suffered greatly during the year; between January 1 and August 31, 1921, 172,683 bales of tobacco were exported, whereas in the same period of 1922 the amount was 235,333 bales. Industrial alcohol has been exciting much attention in Cuba recently (*cf* J., 1922, 570 R), the raw material being molasses, a cheap by-product of the sugar industry. Much denatured spirit is used in motor vehicles, and it is hoped eventually to render Cuba independent of imported supplies of petrol. According to recent statistics the output of local distilleries other than those attached to sugar factories is 6½ million gallons, which is mainly exported. There are several soap works on the island. Brewing is carried on, though Canadian and British beers are also imported. There are large henequen (Mexican agave) plantations, and in the fiscal year ending June 30, 1920, apart from local requirements, cordage manufactured from this product was exported to the United States to the value of $200,604.

Mineral exploitation is not extensive; there is an output of about 1,000,000 tons of iron ore per annum, and the latest figures show an export of 42,000 tons of copper ore. Manganese and chromium ores are worked on a small scale and gold is also found. There are British controlled asphalt deposits near Mariel which are capable of important development. The total exports for the year ending June 30, 1920, were valued at $855,138,341 and for the corresponding period of 1920–21 at $395,914,577. Of the latter figure the United States took 85·2 per cent., and the United Kingdom 5·9 per cent. The imports in 1919–20 amounted to $356,435,099 and in 1920–21 to $278,130,740, of which the United States supplied 78·0 per cent. and the United Kingdom 9·8 per cent. It is anticipated that projected tariff revisions will affect British trade adversely in a number of articles, including soap, alcoholic beverages, textiles, etc.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

With the exception of a reduction in the price of Sodium Sulphite (pea crystals) there are no changes to report in this section.

Acetic Acid, 40% tech. ..	£24 per ton.
Acid Hydrochloric ..	4s.-5s. per carboy d/d.
Acid Nitric 80° Tw. ..	£24 10s. per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d.-£8 per ton.
Arsenic (White) ..	£70-£75 per ton.
Bleaching Powder ..	Spot £11 7s. 6d. d/d. Contract £10 7s. 6d. d/d.
Bisulphite of Lime ..	£7 per ton, packages extra.
Calcium Chloride ..	£5 17s. 6d. per ton d/d.
Copper Sulphate ..	£27 per ton
Potash Caustic	£35-£36 per ton
Potass. Bichromate ..	5¾d.-6d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b.
Soda Caustic 76% ..	£20-£21 per ton.
Soda Crystals	£5 10s. per ton.
Sod. Acetate 97/98% ..	£26 per ton.
Sod. Bicarbonate ..	£10 10s. per ton.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	2⅞d.-3d. per lb.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, conc. ..	£16 per ton carr. paid.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide ..	5s. 9d. per lb.
Carbon Bisulphide ..	£26-£28 per ton according to quantity.
Carbon Black	1s. 5½d. per lb. ex wharf. Still very scarce.
Chromium Oxide ..	1s. 5d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb. Firmer on advance in price of Rape Seed Oil.
Lead Hyposulphite ..	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood-distillation products. Grey Acetate of Lime has advanced in price.

Acetate of Lime—	
Brown	£10 15s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 10s. per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 9d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£5 10s. per ton d/d.
Brown Sugar of Lead	£43 5s. per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 5d. per lb. Little movement in the market.
Crude 60's	3s. 6d.-3s. 9d. per gall. Market weaker.
Acid Cresylic—97/99	2s. 2d.-2s. 5d. per gall. Market quiet.
Pale 95%	2s.-2s. 4d. per gall. Not much demand.
Dark	1s. 10d.-2s. 0½d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	9½d.-10d. per gall. Not much demand.
Unstrained	9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8½d. per gall. Business slack, abundant supplies.
Pure	2s.-2s. 2d. per gall.
Toluole—90%	1s. 9d.-2s. per gall.
Pure	2s.-2s. 6d. per gall. Not much inquiry.
Xylol	3s.-4s. per gall. according to quality.
Creosote—	
Cresylic 20/24%	11½d.-1s. per gall. Not much business.
Middle Oil	8½d.-9½d. per gall Market steady.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d.-9¼d. per gall.
Solvent 90/160	1s. 7d.-1s. 9d. per gall. Fewer inquiries.
Solvent 90/190	1s. 5d.-1s. 8d. per gall. Market steady.
Naphthalene Crude—	
Drained Creosote Salts	£7-£8 per ton.
Whizzed or hot pressed	£11-£14 per ton.
Naphthalene—	
Crystals	£18 per ton.
Flaked	£16 per ton.
Pitch, medium soft	No business for this season. Prices for Autumn delivery 140s.-150s. per ton.
Pyridine—90/140	11s.-12s. per gall.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

The recent improvement in the business done in Aniline Dyes reported previously is still maintained. Business is coming through rather more freely. This is rather surprising in view of the fact that the Textile Trade is very quiet and we must anticipate that when the Textile Trade improves, the Aniline Dyes Trade will be still better. Prices are firm without advance, but there is no likelihood of any fall for some little time forward.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
p-Dichlorbenzol	£70 per ton.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	4s. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works. Good demand.
Nitronaphthalene	1s. per lb. d/d.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid, Acetic 80%	£50 per ton.
Acid, Acetyl Salicylic	3s. 2d.-3s. 3d. per lb. Steady.
Acid, Benzoic	2s. 6d. per lb. Still very scarce at this figure.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton. Prices reduced by £5 per ton.

Acid, Citric	1s. 9d. per lb., less 5%. Dearer; demand active; higher prices expected.
Acid, Gallic	3s. per lb.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb.
Acid, Salicylic	2s. 3d. per lb. still quoted.
Acid, Tannic	3s. 3d. per lb. Unchanged.
Acid, Tartaric	1s. 4d.-1s. 4½d. Demand continues to increase, and a period of hot weather should see a further rise in price. There is much more inquiry from the Continent and the U.S.A. and good business has been done for export.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d. per lb., without much movement.
Amidopyrin	13s. 6d. per lb. Unchanged.
Ammon. Carbonate B.P.	£37 10s. per ton.
Atropine Sulphate	12s. per oz.
Barbitone	Quoted up to 20s. per lb. Much firmer.
Benzonaphthol	4s. 6d. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Bromides	In steady demand without alteration in price.
Chloral Hydrate	4s. per lb. Price well maintained.
Chloroform	2s. 3d. per lb. for cwt. lots, ton lots being quoted down to 2s. per lb.
Creosote Carbonate	10s. per lb., with little enquiry.
Formaldehyde 40%	£90 per ton.
Guiacol Carbonate	8s. 6d. per lb. is the present value without any orders.
Hexamine	4s. 3d. per lb. Lower prices now quoted.
Homotropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. Market good with considerable inquiry.
Magnesium Carbonate—Light Commercial	£38 per ton nett.
Magnesium Oxide—Light Commercial	£85 per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Menthol	35s. per lb. spot. Advanced.
Methyl Salicylate	In a weaker position at 2s. 6d. per lb. for carboys.
Methyl Sulphonal	14s. 6d. per lb.
Mercurials	Unchanged. Market quiet.
Paraformaldehyde	4s. Neglected.
Paraldehyde	1s. 7d. per lb.
Phenacetin	6s. 6d. per lb. spot value. In good demand at this figure.
Phenazone	7s. 6d. per lb.
Phenolphthalein	5s. 6d. per lb. Much firmer.
Potass. Bitartrate—99/100% (Cream of Tartar)	98s. per cwt., less 2½%. Firmer.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. Demand still continues good.
Potass. Permanganate	10½d. per lb. Market less firm.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Salol	3s. per lb. still asked.
Sod. Benzoate	2s. 6d. per lb. Very firmly held.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality. Demand improving and considerable business being done.
Sod. Hyposulphite—Photographic	£15-£17 per ton, according to quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d. per cwt. Fairly good demand.
Sod. Salicylate	In good supply. Values unaltered, being 2s. 9d. per lb. for Powder, 2s. 11d. per lb. for Crystal.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. per ton, according to quantity for home trade, 1-cwt. packages included.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.
Thymol	Present value of good white from agowan seed is 17s. per lb.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	8s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate	3s. ,, ,,
Cinnamic Aldehyde	14s. 9d. ,, ,,
Coumarin	16s. 3d. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	15s. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. 6d. ,, ,,
Geraniol (Palmarosa)	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	16s. 6d. ,, ,,
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	25s. 6d. ,, ,,
Methyl Anthranilate	6s. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Xylol	9s. 6d. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	3s. 3d. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	23s.-24s. per lb.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	2s. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	31s. 6d. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4½d. per oz.
Cassia Oil 80/85%	8s. 6d. per lb.

Citronella Oil—	
Java 85/90% ..	4s. 2d. ,, ,,
Ceylon..	3s. 3d. ,, ,,
Clove Oil..	8s.-8s. 6d. per lb.
Eucalyptus Oil 70/75%	1s. 9d. per lb.
Lavender Oil, Mont Blanc 38/40% ..	13s. ,, ,,
Lemon Oil	3s. 1d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet ..	11s. 6d. per lb.
Otto of Rose Oil—	
Anatolian	24s. per oz.
Bulgarian	30s. per oz.
Palma Rosa Oil ..	17s. 6d. per lb.
Peppermint Oil—	
English	80s. ,, ,,
Wayne County ..	13s. ,, ,,
Japanese	6s. 4½d. per lb.
Petitgrain Oil	8s. 3d. ,, ,,

TRADE NOTES

Dyestuffs (Import Regulation) Act

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during April has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 512, of which 430 were from merchants and dealers. To these should be added 22 cases outstanding on April 1, making a total of 534 for the month. These were dealt with as follows:—Granted: 331 (of which 318 were dealt with within 7 days of receipt). Referred to British makers of similar products: 130 (of which 121 were dealt with within 7 days of receipt). Referred to Reparation Supplies available: 56 (all dealt with within 2 days of receipt). Outstanding on April 30: 17. Of the total number, 534, of applications received, 479, or 90 per cent., were dealt with within 4 days of receipt.

British Chemical and Dyestuffs Traders' Association

It is announced that the British Chemical Trade Association has amalgamated with the Chemical and Dyestuffs Traders' Association to form the above Association. Mr. Victor Blagden (Victor Blagden and Co., Ltd., London) is the Chairman of the new organisation, and the remainder of the executive are as follows:—Vice-chairman, Mr. F. T. T. Reynolds (Millwards Merchandise, Ltd., Manchester); Hon. Treasurer, Mr. W. Waugh (Walter Waugh and Co., London). *Executive Committee*: Mr. H. A. Berens (Old Strand Chemical and Trading Co., Ltd., London); Mr. A. F. Butler (R. W. Greeff and Co., Ltd., London); Mr. A. Connell (A. Connell and Co., London); Mr. H. Gilliat (E. G. Jepson and Co., Leeds); Mr. G. A. Hamilton (A. and M. Zimmermann, Ltd., London); Mr. T. Henderson (T. Henderson and Co., Ltd., Glasgow); Mr. S. J. C. Mason (Bush, Beach and Gent, Ltd., London); Mr. C. Page (Chas. Page and Co., Ltd., London); Mr. H. S. Willcocks (H. S. Willcocks and Co. (Chemicals), Ltd., Manchester). The offices of the Association will be at 80, Fenchurch Street, E.C. 3 (Telephone: Avenue 7347), and the Secretary will be Mr. O. F. C. Bromfield, Secretary to the late British Chemical Trade Association.

PUBLICATIONS RECEIVED

THE CHEMISTRY OF UREA. THE THEORY OF ITS CONSTITUTION, AND OF THE ORIGIN AND MODE OF ITS FORMATION IN LIVING ORGANISMS. *By* EMIL A. WERNER, M.A., Sc.D. *Pp.* *x*+212. *London: Longmans, Green & Co.*, 1923. *Price* 14*s*.

THIRD ANNUAL REPORT OF THE INDUSTRIAL FATIGUE RESEARCH BOARD, TO DECEMBER 31, INCLUDING PERSONAL CONTRIBUTIONS FROM INVESTIGATORS. *Medical Research Council. Pp.* 83. *H.M. Stationery Office*, 1923. *Price* 2*s*.

SPECIAL STEELS: A CONCISE TREATISE ON THE CONSTITUTION, MANUFACTURE, WORKING, HEAT TREATMENT, AND APPLICATIONS OF ALLOY STEELS. *By* T. H. BURNHAM, B.Sc. *Pp.* *xxi*+185. *London: Sir Isaac Pitman and Sons, Ltd.*, 1923. *Price* 5*s. net.*

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. *Department of the Interior*, 1923. *Washington: Government Printing Office*:—

GOLD, SILVER, COPPER, LEAD AND ZINC IN NEW MEXICO AND TEXAS IN 1921. *Mines Report* I:27. *By* C. W. HENDERSON. *Pp.* 467—477.

GOLD, SILVER, COPPER, LEAD AND ZINC IN COLORADO IN 1921. *Mines Report* I:28. *By* C. W. HENDERSON. *Pp.* 479—511.

MINERAL WATERS IN 1921. *By* W. D. COLLINS. II:29. *Pp.* 229—236.

NATURAL-GAS GASOLINE IN 1921. *By* E. G. SIEVERS. II:30. *Pp.* 237—252.

STONE IN 1921. *By* G. F. LOUGHLIN *and* A. T. COONS. II:27. *Pp.* 175—213.

GOLD, SILVER, COPPER, LEAD AND ZINC IN IDAHO AND WASHINGTON IN 1921. *Mines Report. By* C. N. GERRY. I:25. *Pp.* 399—428.

SILICA IN 1921. *By* L. M. BEACH. II:5. *Pp.* 19—20.

MINERAL RESOURCES OF THE UNITED STATES, 1919. PART I., METALS. *By* G. F. LOUGHLIN. *Pp.* 157 A+807. PART II., NONMETALS. *By* R. W. STONE. *Pp.* *iv*+565.

CONGRÈS DE LA PRODUCTION COLONIALE, EXPOSITION COLONIALE NATIONALE, MARSEILLE, 1922. *Compte-Rendus et Rapports. Marseille: Institut Colonial*, 1922:—

CONGRÈS DES CÉRÉALES (SEPTEMBER 27—30, 1922). *Pp.* 254.

CONGRÈS DES BOIS (JUNE 26—28 ET NOVEMBER 8—10, 1922). *Pp.* 153.

TEXTILES—CAOUTCHOUCS ET GOMMES SUCRES—ALCOOLS, PLANTES STIMULANTES, MÉDICINALES, À PARFUMS ELEVAGE. *Pp.* 286.

THE THEORY OF SPECTRA AND ATOMIC CONSTITUTION. THREE ESSAYS. *By* NIELS BOHR. *Pp.* *x*+126. *Cambridge: The University Press*, 1922. *Price* 7*s*. 6*d*.

SYNTHETIC RESINS AND THEIR PLASTICS. *By* CARLETON ELLIS. *Pp.* 514. *New York: The Chemical Catalog Co., Inc.*, 1923. *Price* $6·0.

THERMODYNAMICS AND THE FREE ENERGY OF CHEMICAL SUBSTANCES. *By* PROF. G. N. LEWIS AND PROF. M. RANDALL. *Pp.* *xxiii*+653. *London: McGraw-Hill Publishing Co., Ltd.*, 1923. *Price* 25*s*.

JOURNAL of THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

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EDITORIAL

THE meeting of the Union Internationale at Cambridge seems likely to be well attended. Among the French delegates are included Professors Moureu, Béhal, Boudouard, Haller, Lindet, Etienne, Le Chatelier and Blaise, and Messrs. Kestner, Kling, Marie, Gérard, Nicolardot, Matignon, Bordas and Grignard. America is sending among others Professors Bancroft, Lewis, Noyes and Hibbert, and Messrs. Washburn, Zanetti and Howe. The Italian delegation includes Dr. Conti Ginori, Prof. Nasini, Senator Paternò, Signori Delfino and Pomilio; the Czecho-Slovakian includes Prof. Vesely, the Polish Profs. Marchlewski, Bielecki, Swietoslawski and Trepka. Spain is sending Profs. Fernandez, Giral, Moles and Mourelo, Denmark is sending Profs. Bjerrum, Bronsted, Jacobsen and Biilmann and Mr. Kai Warming. Prof. Minovici is coming from Rumania, Prof. Bodtker from Norway, and Prof. Read from Australia. Altogether at least a hundred delegates are expected, and as a number of controversial topics are to be discussed, we may expect to find distinguished chemists in every street, maintaining with no little heat, their various opinions. The beauty of Cambridge, its interesting historic associations and its mediæval air make it singularly suitable for such a Congress.

* * *

The delegates will be received by Sir Charles and Lady Walston on Sunday, June 17th, at 4 p.m., at Newton Hall, and in the evening by the President and the British Federal Council. On Monday, June 18th, there will be Council and Committee Meetings, and at 4.30 p.m. the discussion of Prof. McBain's report on "The Nature of Soap Solutions"; in the evening a reception by the Master of Sidney Sussex College and Mrs. Weekes. On Tuesday, Council and Committee meetings, at noon the discussion of Dr. Rideal's report on "Recent Developments in Contact Catalysis," at 5.30 p.m., the discussion of Prof. J. F. Thorpe's report on "New Aspects of Tautomerism," then tea in the charming gardens of Sidney Sussex College, and at 8 o'clock the Annual Dinner in the Hall of Trinity College. On Wednesday, after the Council Meeting, there will be a discussion of Prof. Gowland Hopkins' report on "Chemical Mechanisms involved in the Oxidations which Occur in Living Tissues." This will be followed by the presentation of a very few Honorary Degrees to some distinguished foreign visitors and a reception by the Vice-Chancellor of the University at the Fitzwilliam Museum, and as the delegates leave and the Conference breaks up—which is what the Greeks meant by catalysis—the members of the Society of Chemical Industry will assemble for their own meeting. Cambridge will be full of interest for chemists during that week, and how many valuable discussions will take place during the short journeys between the Arts School, the Senate House, Trinity, King's, and the other colleges. *Plurimi transibunt et augebitur scientia* says the Vulgate, unless our memory is at fault, which signifies, "Many shall walk to and fro, and knowledge shall be increased."

* * *

Chemical Engineering appears to have made rapid strides in the United States. Here we announce with some self-satisfaction the foundation of a chair of chemical engineering at University College, London. The University of Michigan has recently sent us a note of the department of chemical engineering at Ann Arbour, from which it seems that the department includes three professors of chemical engineering, one of metallurgical engineering and a large number of assistant professors and instructors in these two subjects. The chemical engineering laboratories, which are to be opened next September, will occupy an area exceeding 40,000 square feet, with special facilities for studying evaporation, distillation, gas absorption, filtration, drying and crystallising; in addition there are special metallurgical, cement, ceramics, pulp and paper laboratories and other laboratories specially devised for investigating petroleums, motor fuels, gas and fuel. This appears to be the finest laboratory of the kind in any country, and we shall expect to receive much valuable information from the researches to be undertaken in it.

* * *

We are informed by the American Chemical News Service that catalysis is now to be applied to internal combustion engines. Dr. Edward Sokal, of New York, claims that greatly improved combustion is obtained by painting the interior of the cylinder head or firing chamber with a refractory paint containing a catalyst whose composition is not yet disclosed. This catalyst will accelerate the explosion and, according to the news circulated by the American Chemical Society, tests made on various types of automobiles show that an increase in power is obtained and an examination of the exhaust gases shows that the combustion is more complete. The progress of the internal combustion engine is a remarkable instance of the manner in which scientific discoveries can bring about new industries. Motor cars and aeroplanes will, no doubt, in the future, show yet further evidence of the practical utility of every branch of science and among these chemistry will be of supreme importance. The whole question of combustion is being studied by new methods; the nature of the chemical reaction of mixed gases may at any moment receive some explanation which will lead to surprising developments, and any new discovery which will effect economies in the production of power will be followed with great interest.

* * *

The University of London announces a course of three lectures on "The Structure and Behaviour of the Molecule," to be delivered by Prof. Gilbert N. Lewis, of the University of California. The lectures will be given at University College, London, at 5 o'clock on Wednesday, June 6th, Friday, June 8th, and Tuesday, June 12th, and are addressed to advanced students and others who may be interested. No ticket is required for admission. Professor Lewis's work is well known in this country, although perhaps full justice has not been done to him by many casual readers of the new theories of the structure of the atom. He it was who first worked out a really clear conception of an octet to explain the chemical activities of an electronic atom, and but for his work the more recent hypotheses of Langmuir, Bohr, Dauvillier and others would have been less easily understood and less widely known. Of the three lectures mentioned above the first is on "The Structure of the Molecule," the second on "The Colour of Substances," and the last on "The Sources of Chemical Affinity."

CHEMISTRY—THE KEY TO INTERNATIONAL RELATIONS

By H. E. HOWE

For the most part international relations grow out of efforts to improve the status of a country either as regards the physical or financial well-being of the people. These two considerations are basic, although they are to be found in many forms all along the path of history. The enforced territorial expansion of a country, while primarily to permit peoples to go out from centres of great concentration of population, in the end means that a greater quantity of natural resources must be found. Whereas the craving for power may sometimes appear to be at the base of international relations, even this may be translated into such terms as the exploitation of conquered peoples or other forms of gain which may be described in terms of physical or financial well-being.

Only in comparatively recent times has the physical well-being of a people become a prime consideration. Assistance in overcoming a plague or epidemic, relief in times of famine, and the defence of weaker peoples against oppression have become more common phases of international relations since the days of republics. Indeed, republics themselves are the result of the effort to further the interests of the people as a whole as opposed to a ruling class.

The control of natural resources, which is desirable in peace and vital in war, may be said after all to be the basis of most international dealings. A nation seeking power in commerce or an impregnable position in war directs attention to natural resources of present value and future application. Natural resources and their development always involve chemistry, since chemistry is the science which concerns itself with the characteristics and properties of materials under all varieties of conditions. The resources themselves may be expressed in terms of chemical compounds, and before they can be economically utilised chemical research and technology is invariably called in. It is but a step to those processes through which raw materials for particular commercial uses are changed to meet new sets of specifications and materials are synthesised in the laboratory to make available in commercial quantities compounds nowhere to be found in Nature.

That nation, therefore, which pays the greatest attention to the development of chemistry and its application to the arts may well be said to occupy a commanding position in international affairs. A knowledge of substances and how best to use them for given purposes may be even more important than the ownership of the resources themselves. To prove this may be cited the refining of tungsten from its ores and the separation of radium from carnotite. In both these instances countries without the raw materials gained a commanding position through research and development, so that ores were sent to them to be refined instead of the knowledge of how this was done being transmitted to the sources of supply. Let us examine history and see what examples of international relations to which chemistry has been the key may be found to support this premise, and to show how the advantage has shifted, now to this nation and now to that, depending upon scientific work and principally work in chemistry.

One of the earliest severe strains upon international relations came about through the loss by storm at sea of three cargoes of those chemical substances known as spices and perfumes. A world-wide panic ensued, and while, to be sure, it was a financial panic, it must not be forgotten that finance is, after all, closely related to and at times dependent upon chemical development. In this instance a bank at Athens had loaned great sums to those engaged in the importation of these small cargoes. Then, as to-day, banking was conducted co-operatively by the banks all over the known world. The total loss represented by the sinking of the ships made it necessary for the bank at Athens to call upon its correspondents, and they in turn upon their correspondents, until Rome itself felt the pressure. It so happened that at this time a decree by the Roman Emperor had directed the financiers of the day to invest a certain large percentage of their funds in agricultural development, and much money had been withdrawn from the banks for this purpose. It was not a simple matter to have this money immediately deposited again, and the emperor was off on a hunting trip. Things became very acute before the end of the ten days necessary to secure his return, and only when the edict was rescinded and much of the emperor's wealth made available, did the financial world get on its feet again. People are prone to forget that the absolute destruction of a great mass of wealth at any place or at any time is a serious thing, and can be replaced only by an amount of labour usually in excess of that required to create the wealth destroyed.

The wealth and power of those ancient cities, Carthage and Tyre, which were comparable to at least the smaller countries of our day, were based upon a chemical compound found in minute quantities in the dorsal vein of a snail-like shellfish called *Murex*. One may easily imagine the hazards involved in collecting a quantity of molluscs from each of which no more than a few drops of a mucilaginous fluid could be obtained. When this fluid was put upon fabric or leather and exposed to air and sunlight the famous Tyrian purple was formed. In fastness to light and washing, in brilliancy and uniformity, its colour did not compare with modern indigoes, yet its value may be realised from the fact that the Emperor Hadrian is reported to have refused his wife a purple gown because of its extreme costliness. It is interesting to note that to this day isolated villages about the Mediterranean use this same fluid from the shellfish in dyeing fabric.

Feats of old, like the use of Greek fire and numerous devices employed in the defence of Constantinople, gave temporary advantages to those who had this special knowledge. The conquerors of old employed engineering at every turn, and those who developed the blades of Toledo and Damascus by processes now known to have been chemical, though not so recognised then, had an advantage over adversaries comparable with that gained by the first man who found out how to make metal into a weapon for use against the clubs of his adversary. In those days, when there was no such thing as systematic research and investigation, even the most observing men were dependent upon chance for such valuable discoveries. To this day people believe that the art of hardening copper has been lost for ever, and scarcely a week goes by without some clever man offering to sell to our great metal concerns the secret which he has rediscovered. Science has not answered all the questions of the ages, but the scientific method has nearly always been able to find causes, break problems into component parts, and solve them so that conditions for production may be satisfactorily duplicated.

The balance of power was at once disturbed when the chemical compound gunpowder was invented. Gunpowder thus became a new factor in international relations. Subsequently that nation which controlled the raw materials for explosives could dictate to a large degree how things were to be. A fundamental material in the manufacture of all explosives is nitric acid, and a source of nitrates became the thing greatly to be desired. From the time of the invention of gunpowder until the middle of the nineteenth century, Indian saltpetre was the only known available source of the element nitrogen, in a form which could be used for nitric acid. These Indian resources were in the form of potassium nitrate, and had been deposited in the soil or rocks through the action of nitrifying bacteria. When potassium salts are present, potassium nitrate is produced, but the native nitre usually consists of calcium nitrate and some magnesium nitrate. Where there is no excess of rain, the soil moisture brings the solution of these soluble nitrates to the surface, where they are deposited as an efflorescence as the water evaporates. Obviously the amount of nitre procurable from natural deposits and formed under natural conditions is very limited, and as the demand for saltpetre increased other sources of supply were sought. Following the principles that had been observed from the formation of natural deposits, nitrate plantations were established in many countries where nitrates were slowly formed and protected from the weather. The plantations of Hungary, Switzerland, France, and Sweden have been described in detail in the literature. Resort to the same methods was had by the Confederacy during the Civil War. In emergencies, as in Sweden in 1520, even the earth of cemeteries was lixiviated to obtain nitre, and at one time Sweden imposed a tax which had to be paid not in money but in saltpeter. About 1821 the immense deposits of sodium nitrate in South America were discovered. The deposits extend for some 450 miles north and south in the arid plains between the Andes Mountains and the coastal range on the Pacific, at distances of from 15 to 93 miles from the sea, and at altitudes of from 3600 to 13,000 feet; and exploitation has proceeded rapidly. Some years ago the exhaustion of the Chilean nitrate was forecast, and when Sir William Crookes predicted the possible starvation of the earth, he pointed out that the yield of wheat could be increased from an average of 12·7 bushels per acre to 20 bushels or more by the use of 150 pounds of nitrate of soda on each acre annually. He then went on to say that if this practice should be widely adopted and the whole area under cultivation be treated at the proposed rate, the Chilean deposits would be exhausted in four years. It now appears that these estimates were based upon then known deposits which were only a fraction of the actual deposits in Chile. In addition to this, there have been perfected processes for recovering nitrates from low grade ores that had not previously been worked. It is now estimated that at a rate of consumption of five million tons annually, the Chilean nitrate should last some three hundred years.

However, Chile is at a considerable distance from many nations which have found nitrate an essential in their world progress. Lines of supply in war time always present a difficult problem, and if such an essential material must always be brought overseas, the problem becomes further complicated. While great navies have been maintained for the protection of merchant shipping and of nationals at great distances from home, the nitrate situation has doubtless played a commanding part in the formation of an extended naval programme. It therefore became a scientific problem of world importance—how to make available the tremendous quantity of nitrogen present in the atmosphere. It has been estimated that the air over each acre of earth contains 33,880 tons of nitrogen, but to all intents and purposes this nitrogen is inert, since plants and animals can utilise it only when formed into nitrogen compounds.

For many years experiments have been conducted in an effort to find a way to fix this nitrogen. The early researches were of a purely scientific nature, and Priestley more than a hundred years ago found that by passing an electric spark through an atmosphere of nitrogen he could obtain traces of the oxides of nitrogen. Without giving all the historical details, it may be pointed out that the cheap water power of Norway enabled that nation to obtain something of an advantage when it was found that the nitrogen of the air could be oxidised by great electric arcs and recovered as nitric acid, although usually sold as calcium nitrate. The efficiency of the process was low, but hydroelectric power was extremely cheap, and the advantages gained were well worth the energy expended. Nations of Europe with military tendencies at once became interested in Norway, and took pains to acquire large financial interests in the Norwegian companies. Other scientists took up experiments in this field in the hope that they might find still more efficient methods. Great plants for the fixation of nitrogen by the cyanamide method sprang up in Norway and on other parts of the Continent, and became factors of no mean importance in international relations.

It was only a little more than ten years ago, when the Eighth International Congress of Applied Chemistry met in the United States, that we were given our first information of the success of experiments carried on by Haber at the expense of the Badische Anilin und Soda Fabrik. It was demonstrated that, in the presence of a catalyst, nitrogen and hydrogen could be caused to unite to form ammonia. We have since been told that the world war would have been begun earlier but for the fact that the Haber plants were not quite ready to meet the demand of Germany for military nitrates. It is interesting to note that to-day a smaller Germany is capable of producing 500,000 tons yearly, which is more than twice the nitrates which the old empire consumed annually for all purposes. English experts have not hesitated to sound a warning based upon this over-development of nitrogen fixation plants. The importation of Chilean nitrate by Germany is looked upon as a wholly commercial move designed to retain the good will of Chile and to take in return for German products the raw materials which Chile is in position to export.

The early methods for the fixation of nitrogen required great blocks of electric power, but much less power is needed to-day. The Haber process is operated at a pressure of 100 atmospheres and a high temperature. However, the recent work of Claude in France indicates that at still greater pressures, indeed up to 1000 atmospheres per square inch, the fixation is not only more rapid but the yield greater, and deterioration of the catalyst much retarded. The capital investment in large apparatus is reduced, for at this pressure much smaller vessels may be used and the larger units are a disadvantage rather than otherwise. The possibility, under present methods, of operating small plants may again shift to other lands the advantages derived from the fixation of atmospheric nitrogen. There are several industries where hydrogen is a waste product, and where it is purer than that prepared solely for the fixation of nitrogen by the synthesis of ammonia. In a Haber type plant nearly 70 per cent. of the operating cost is charged to the purification of gases. Obviously, if nitrogen fixation can be carried on in small units located where relatively pure hydrogen is available as a waste product, it will be a great step forward in the nitrogen problem. Nitrates are essential in food production, and while it is doubtful whether, under present conditions, nitrogen from the air can be fixed at a price to compete with Chilean nitrate, it is well to remember that in times of war, when costs are not considered, fixed nitrogen plants might be the salvation of a nation.

An advantage in world position has many times been lost because of the diligence of another nation in chemical research. We are indebted to necessities growing out of the Napoleonic wars for at least two important chemical developments. One of these is the production of sugar from beets. At a time when France was thoroughly blockaded and importation became next to an impossibility, the only source of sugar known was the cane of the tropical countries. The beets available did not contain more than five or six per cent. of sugar, and this was accompanied by so many foreign materials as greatly to reduce its purity. No doubt the first sugar from beets was far from satisfactory, but it was very much better than no sugar. The English sugar traders became alarmed and offered the French scientists sums large for those days to suspend their research, but all propositions were refused.

From that time the beet sugar industry has been developed not only in Europe but in the United States and Canada, and constitutes one of the best examples of what can be achieved through scientific selection. To-day whole crops of beets run well above 14 per cent. of sugar, with a purity that is quite satisfactory. Concurrently the scientific methods for extracting the sugar from the beet, purifying the sugar, and using the beet pulp and other waste products have gone forward. Whereas it once required beets from an acre to produce 300 pounds of commercial sugar, we now obtain 3600 pounds from the same area. Before the world war the production of beet sugar in the world had come to exceed that of cane sugar by several per cent., and from an importer of sugar France had become an exporter. A few years ago France exported as much as 250,000 tons annually.

Another invention resulting from the Napoleonic wars was Leblanc soda. Previously the important source of sodium carbonate was the native sesqui-carbonate of Egypt, Africa, and South America. Since the blockade prevented France from importing with any degree of certainty, Leblanc developed a process which is operating almost unchanged to this day, although it could not have persisted but for the market developed for hydrochloric acid, an important by-product of the process. This process has since been displaced to a large extent by the Solvay or ammonia soda process, which is based upon the fact that bicarbonate of ammonia is decomposed by a strong solution of sodium chloride or salt.

The siege of Paris gave us oleomargarine, which no doubt was a poor substitute for butter at the time, though none the less welcome. Since then margarine has become an important item of commerce. Dairy countries such as Holland and Denmark, and agricultural states like those of our Middle West, consume margarine in quantity. With the introduction of nutritious coconut oil into occidental diets, margarine is now made of wholesome vegetable oil churned in milk and often mixed with high grade butter in plants which are models of cleanliness. The one point of weakness has been the absence of that unidentified, unisolated, accessory food substance called fat-soluble vitamin A.

From the research now in progress we may expect the perfection of methods for preparing concentrated vitamins on a commercial scale which will make it possible to add them to otherwise satisfactory foods. This type of research is of utmost importance, not simply because of its relation to this one type of food but to others which, thanks to chemistry, can be prepared from staple raw materials. As a result of research, milk can be dried without affecting its physiological characteristics. This dry milk is soluble and may be stored for months without change. If the fat is first removed, the dry skim milk will keep indefinitely in tins. Neutral refined coconut fat can also be kept without developing rancidity for a long time. Since these two basic materials can be made into milk or cream, with practically any desired percentage of fat, where and when needed, they offer great advantages in transportation and storage, with a guarantee of quality and cleanliness difficult to obtain in many quarters of the earth, particularly the tropics. This type of food is wholesome and nutritious and satisfactory for adults. When chemical and biological research make it possible to add the fat-soluble vitamin, a food in every way equal to ordinary milk will be made available.

Nations also lose a world advantage when their scientists are compelled to go elsewhere for support in developing their discoveries to the commercial production stage. It was due to such causes that Germany had the opportunity to develop the dyestuff industry, and that the great Brunner-Mond establishment grew up in England. An effort to ruin England's West Indian trade by granting sugar bounties in France, Belgium, Germany and Russia forced England into industries using the cheap sugar of the Continent. Sugar-containing foods remained an item of English trade even after she again took up refining following the abolishment of the bounties in 1899.

(*To be continued*)

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

I OBSERVE

that all the best paragraphists occasionally take a holiday, and that although compelled by an unfeeling editor to supply their "copy" they are allowed somewhat more latitude while in the country doing their holiday task. In the intervals of sleeping, eating and a little golf I have been studying a bundle of papers which have accumulated on a subject which I have been wanting to look into for some time. At the present time it seems to me we are on the eve of big changes in the World's business and it behoves us to study every bit of information we can obtain. International Commerce is finding the old channels blocked and new outlets have to be made.

TWO FOREIGN COLLEAGUES

called upon me the other day from the *Neue Freie Presse*, which, as everybody knows has the position of *The Times* in Austria. I was most interested in what they had to tell me and perhaps even more in what was left unsaid. They had come over to make arrangements for various special articles and advertisements for their paper. They were particularly anxious to secure information with regard to British Chemical Industry. Their paper has a wide circulation in the new States which have been constituted as a result of the war, and it seemed very indicative to me that with Germany such a near neighbour there should be such a demand for British chemicals as they anticipated. The whole question of trade with Europe becomes more and more acute as time goes on. The superior persons who are set over us in authority, seem to think that the British Empire ought to be not only self-contained but self-sufficient. We are to look to the Colonies and forget all about Europe. Only last week I heard of a business project in Russia which demands for its furtherance tranquillity; now tranquillity is a timid article and easily scared away, and I fully expect that as the result of recent events the deal will be off.

GERMANY'S ECONOMIC POSITION

is discussed in the Annual Report of Mr. J. W. F. Threlwall and Mr. C. J. Kavanagh, Commercial Secretaries respectively at Berlin and Cologne. There are even fewer references to German Chemical Industry than in the last Report, but on the general economic financial conditions in Germany it is most illuminating. The authors warn their readers that "extreme caution must be exercised in expressing any opinion as to Germany's real position at the end of 1922. Inflation dominated every phase of public and private life, and inflation means constant fluctuation." An old point which is constantly raised in discussions in this country is dealt with. We frequently hear of enormous sums of money deposited by Germans in our own or other foreign banks. In Germany the figure usually mentioned is £50,000,000 only, while others outside Germany place it at ten times as much. In the opinion of the writers of the Report it cannot exceed £200,000,000. This does not seem very much to Germany's creditors.

FURTHER TROUBLE IN THE RUHR

has led to the closing of more German dyeworks last week. The Hochst dyeworks and the chemical factory at Weiler-ter-Mer were occupied, but of more importance still at Ludwigshafen the works of the Badische Anilin und Soda Fabrik were seized by the French troops. This move is no doubt made in order to secure reparation dyes due to France and Belgium, but if the precedent of coal is to be followed it does not follow that much in the way of dyestuffs will be very speedily obtained. What effect this will have on dyestuffs due to Britain on reparations account is difficult to see, but fortunately it will not place colour users in this country in any great difficulty.

IN THE MIDST OF SUCH TROUBLE

it is pleasant to record the fusion of the British Chemical Trade Association and the Chemical and Dyestuffs Traders' Association. The new association will take the name of "The British Chemical and Dyestuffs Traders' Association," and the offices in it have been judiciously filled by good men from each of the old bodies. From the inclusion of the word British in the title I take it that some attempt will be made to see that only British firms are admitted to the Association. There will be plenty of work for the Association to do. The business in foreign chemicals and dyestuffs has not been too good lately, and I should not be surprised to find a number of traders resolving very publicly to support British manufacturers, and deal only in British products. Meanwhile the Association's programme for the repeal of the Dyestuffs Act and the Safeguarding of Industries Act hangs fire. If you want to sell British goods it hardly seems worth while to do away with Acts of Parliament which enable the manufacturer to make the goods you want to sell.

ANNUAL REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY

Volume VII (price 7s. 6d. to members) is now ready and an order form with full particulars has been sent to every member of the Society.

SOCIETY OF CHEMICAL INDUSTRY

THE ANNUAL MEETING

CAMBRIDGE. JUNE 20 TO 23, 1923

Accommodation of Members in Colleges. Accommodation will be available for men in various colleges from the afternoon of Wednesday, June 20, to the afternoon of Saturday, June 23. Members who arrive on Wednesday will be charged an inclusive fee of £3, those arriving on Thursday an inclusive fee of £2. These fees include the use of a set of rooms (bedroom and sitting-room), attendance, gratuities to college servants and the following meals: *Wednesday, June* 20.—Tea (if required) and dinner. *Thursday, June* 21.—Breakfast, lunch and dinner. *Friday, June* 22.—Breakfast, lunch and dinner (if required). *Saturday, June* 23.—Breakfast, and lunch (if required). Members will usually take their breakfasts in their rooms. Luncheon and dinner will be served in the halls of colleges. On Thursday and Friday tea will be served at the Vice-Chancellor's reception, and at the Garden Party at Sidney Sussex College respectively. Members who arrive before five o'clock on Wednesday, and who will require tea, are requested to give notice to that effect on a form to be supplied. There will be no extra charge. Members unable to attend the Annual Dinner of the Society on Friday, and desirous of dining in college that evening, may do so without extra charge by giving notice to that effect on the form above referred to. Members who do not make the trip to Ely, and who require luncheon before leaving Cambridge on Saturday, may obtain it in college on that day without extra charge.

It is important to note that alcoholic drinks are not included in the charges specified above, and members requiring such drinks with their meals must sign a chit presented by the waiter at the time of ordering. Payment for such must be made by members at the office of the Society at the Arts School, Bene't Street, on Saturday, before departure. It is the wish of the college authorities that no money shall change hands at table, and it is hoped that members will kindly co-operate in order that this scheme of payment may be a success.

To the list of colleges offering accommodation given on page 491 of the last issue of *Chemistry and Industry*, Corpus Christi is to be added. As previously stated, men requiring accommodation should communicate with Mr. J. E. G. Harris, the University Chemical Laboratory, Downing Street, Cambridge, who will supply any further information and forward a form to be filled up by the member.

Hotel Accommodation. There are still rooms available at The Bull and at The Blue Boar, but the other hotels are more or less full. There is good accommodation to be obtained in boarding houses (college rooms) should the supply of hotel rooms be exhausted.

Guide to Cambridge. A copy of the illustrated Guide to Cambridge will be forwarded to each member who has purchased his ticket as soon as supplies are received from the publishers.

J. P. Longstaff,
General Secretary

THE SOCIETY'S MEDAL

As already announced, the Council of the Society has this year awarded its medal to Dr. Charles Carpenter, C.B.E., in recognition of his distinguished services to chemical industry.

Dr. Carpenter, who became a member of the Society in 1893, is the President of the South Metropolitan Gas Company, having been appointed chairman at the end of 1908, soon after the death of Sir George Livesey. The whole of his business life has been spent in the service of the Company, which he entered as a young man fully appreciating the importance of chemical and physical science to industry. He was soon given an important post on the technical staff of the Company, and on being appointed chief engineer in 1899 he found ample scope for the exercise of his scientific and imaginative temperament in the application of science to gasworks operations. The standard burner for the determination of the illuminating power of towns' gas, and universally known as the No. 2 Metropolitan Argand, was evolved by him, and he further investigated and applied on the large scale the catalytic process of purification of coal gas from sulphur.

In 1914 he became associated with the late Lord Moulton in an endeavour to re-establish the dye industry in England. The supply of high explosives, however, becoming of supreme importance, he was appointed a member of the High Explosives Committee, where he was acknowledged by Lord Moulton to have been one of his most valued colleagues. He was also a member of the Munitions Inventions Department, of the Chemical Inventions Committee, and of the Nitrogen Products Committee.

He was President of the Society during the important stages of the War from 1915 to 1917, during which time, jointly with Dr. Rée of Manchester and Dr. Alexander Scott of London, he was instrumental in forming the Association of British Chemical Manufacturers, of which he became first chairman. He is a member of the Council of the Institution of Civil Engineers and throughout the whole of his professional career has always been an ardent advocate of the closest co-operation between the engineer and chemist.

MEETINGS OF OTHER SOCIETIES

CERAMIC SOCIETY

The spring meeting of the Refractory Materials Section was held at the Town Hall, Bournemouth, on May 3 and 4. There was a full programme of papers to be read, and in addition visits were paid to Messrs. Pike Bros.' clay mines at Wareham, and to two works at Parkstone.

The first paper was on "The Geology of the Bournemouth District," by Mr. H. Dewey, and was followed by a lecture on "The Physical Properties of Clays," by Mr. A. S. E. Ackerman, B.Sc. The latter paper was a somewhat disconnected review of the results obtained by the author during a period of more than five years occupied in investigations on the subject. Some very interesting results emerged from time to time, but they have been published in five separate papers, and could not be dealt with to any advantage in a brief report.

An important paper was contributed by Mr. G. M. Gill on "The Use of Refractory Materials in Gas Works." Mr. Gill discussed many of the aspects of gas-works practice, and pointed out the objects to be aimed at and the most promising methods of attaining those objects under actual working conditions. He had found that a temperature of 1280° C. in the combustion chamber of a retort setting sufficed to carbonise a 10½ cwt. charge of Durham unscreened coal in a 20-ft. retort in 12 hours. At 1320° C. the same charge could be carbonised in 10 hours, and at 1400° C. in 8 hours. Mr. A. H. Middleton's paper on "Silica Brick for Coke Ovens," mentioned a similar experience of a very large increase in the quantity of coal carbonised in coke ovens as the result of a comparatively small increase of temperature. During a visit to America, Mr. Gill found that 20 gas works and coke oven works which he inspected were all using the higher temperatures alluded to above, and carbonising at a much greater speed than is customary in this country. In America all the material used was high percentage silica material. In this country there was a large quantity of clay which could be employed to produce refractory materials possessing the disadvantages neither of fireclay nor of 95 per cent. silica material. This semi-silica or silicious material might even claim to be the happy medium between the two, neither, like fireclay, showing too much after-contraction and too ready a tendency to soften under load, nor, like 95 per cent. silica material, showing too much after-expansion, thus giving rise to the necessity of building in millboard, wooden strips, or of leaving spaces in the setting. There was scope for the production of more material having a silica content varying from, say, 76 to 92 per cent., according to the position in the setting and the purpose for which it was required. The same class of material could be used with great advantage for producer arches and walls, and for the crowns of arches in horizontal retort settings. Quite 75 per cent. of the material required for building modern retort settings should show not more than 1 per cent. maximum expansion or contraction at 1350° to 1400° C. under load, the remaining 25 per cent. being of a quality showing not more than 1 per cent. maximum expansion or contraction at 1280° C. under load. Well-made silica material of good quality should, in Mr. Gill's opinion, be used in all cases for combustion chamber arches. The same material, if carefully made of uniform quality, could be employed to great advantage for building retort settings. There would be required for regenerator chambers a well-made compressed material, without cracks of any sort, and which could be safely used in pieces 1 in. thick, for separating waste gas from secondary air flues. Emphasis was laid on the importance of bricks being burned to a temperature above that at which they will be used in a retort setting, thus obviating to a large extent the after-expansion or after-contraction which was otherwise likely. The question of standardising the dimensions of firebricks and blocks deserved more attention, as expenditure on retort settings was materially increased by the sorting and cutting of bricks, and the alternative of using a thicker joint was very objectionable. It was not unusual to find bricks from the same maker varying ¼ in. in length, breadth or thickness.

Mr. W. C. Hancock read a "Note on the Abrasion of Fireclay Materials." This relates to the simple rubbing away of a surface and not to erosion by impingement of a stream of particles (fuel ash, etc.). A new method was devised for carrying out the tests, and the conclusions reached from the results of many experiments show that :—(1) Fine grained firebricks resist abrasion more than those of coarser grain, and the admixture of grog in increased quantity or increased grain size decreases resistance to abrasion. (2) Abrasion appears to increase at higher temperatures. (3) Hard firing of the bricks tends to decrease abrasion. (4) Increase of abrasion is caused by the addition of load to the wearing surfaces.

The next paper was by Mr. H. S. Houldsworth, M.Sc., and Prof. J. W. Cobb, C.B.E., B.Sc., on "The Behaviour of Clays, Bauxites, etc., on Heating." This is a continuation of a previous investigation, and relates to changes in porosity, density, and refractive index. The authors summarise this work as follows :—"It would seem that definite changes in the kaolinite molecule or crystal unit, as shown by changes in the specific gravity and refractive index, occurred about 450° C., the temperature at which rapid dehydration began, and at 880°, and 950° C., where large shrinkages were observed together with a rapid evolution of heat at the latter temperature. The results indicate the possibility of minor changes at

625°, 680° and 760° C., temperatures at which kaolin exhibited very slight shrinkages. The porosities of the test-pieces increased gradually as the firing temperature of the kaolin was raised up to 1000° C. The true density of the kaolin and presumably the bulk density and the refractive index of the kaolin crystals, had reached their minimum value when dehydration was complete."

In a paper on "Dolomite," Dr. L. M. Parsons said dolomite is usually a pale yellow stony substance, but is sometimes light grey, and is then very difficult to distinguish from limestone. At times it is much darker, and then closely resembles a dark sandstone. It is occasionally tinted bright red by oxide of iron. Sometimes it is very compact, and at other times porous and friable. Dolomite is a double carbonate of calcium and magnesium, and when pure contains 45 per cent. of magnesium carbonate. Dolomite rocks fall into two groups, primary and secondary. Primary dolomites are rare in this country, and of little economic importance. Secondary dolomites were formed by the chemical alteration of rocks originally deposited as ordinary limestones, such alteration being brought about in most cases by the action of water containing magnesium salts in solution.

The last paper was by Mr. A. F. Greaves-Walker (President of the American Ceramic Society) on "The Manufacture of Refractories in America." This comprehensive article deals in a rather summary way with many important points in connexion with the production of refractory materials. As regards fireclay products, brief reference is made to the nature of the components (flint clays and plastic bond clays), and various processes of drying, setting and burning. Other topics of discussion included silica bricks and other products, magnesite and chrome products, plant equipment, and plant organisation. The Schaffer poidometer is now used to measure and weigh automatically mixtures of clays and water between bins and pug mill, the machine having eliminated the pug mill operator. Where wet pans are used, automatic weighing or measuring hoppers are installed in the discharge chute of the bin. The use of variable speed motors and chain drive (instead of belt drive) has added tremendously to plant efficiency as well as conserving floor space. For burning high grade fireclay products large round down-draught kilns are mostly used. One Dressler kiln is in use, and in it is being burned (to cone 12) the most difficult glasshouse shapes with perfect success and practically no loss. The average burning temperatures in different districts range from cone 7 or 8 to cone 14 or 15. Silica products are burned to cone 18 to 20, the burning time being 6 to 12 days. In a commercial burn 80 to 82 per cent. of the quartz is inverted. In conclusion the author described new labour-saving machinery used for making various types of refractory bricks.

IRON AND STEEL INSTITUTE

The meeting held in London, on May 10 and 11, attracted a large number of members, and so full a programme was offered as to suggest that the interest in research work in iron and steel is growing rapidly, and that two days are insufficient for the discussion of so large a number of papers, no less than twenty-four being presented at the meeting, with the resulting unfortunate necessity of curtailing discussions, and even of taking as read communications which would have deserved discussion had time permitted. Fuel questions occupied the attention of members at the first session, much interest being shown in the paper by Messrs. Sutcliffe and Evans on the reactivity of coke, with special reference to the blast furnace. The usual view has been that a good blast-furnace coke should not be too readily soluble in carbon dioxide, as high solubility involves loss of fuel. The authors urge that the blast-furnace should not be regarded as a gas producer, it being easy to generate gas from fuel much more cheaply in a separate apparatus, and that the function of the blast-furnace should be to produce iron of the required quality with a minimum consumption of coke. They concluded, from a comparison with charcoal furnaces, that a coke having a texture approaching that of charcoal, and therefore highly reactive, should give higher efficiency in the blast-furnace, the solubility being an advantage and not a defect. It should be possible to reduce to a startling degree the consumption of coke in the furnace by ensuring that the coke has a certain texture. Such a coke, resembling charcoal, is obtained by briquetting cleaned and finely-ground coal and carbonising slowly. The resulting textures were shown and compared with those of ordinary cokes by means of photo-micrographs. Such a revolutionary proposal did not pass without opposition, and the blast-furnace managers who spoke seemed to doubt the conclusions, and especially contested the application of results obtained from a charcoal furnace to one working with coke on entirely different ores. Much more will be heard of the proposal, the new principles being theoretically sound, though it is difficult to pronounce on their practical value until extensive experiments on a manufacturing scale have been made. This paper was followed by one by Mr. F. Clements, on gas-producer practice in British steel works. This is the third paper of the kind presented by Mr. Clements to the Institute, the former two dealing with blast-furnaces and Siemens furnaces, respectively. The three papers together form a monumental record, of the highest value to practical men and students alike. In each case a full account of experiments made at the Parkgate works is given, followed by a long series of tables giving the dimensions, working records, and full particulars of corresponding plants at the principal works throughout the country, arranged on a comparative plan, and illustrated by sections. It is a testimony to the liberal attitude adopted by British manufacturers of iron and steel that they have so readily consented to furnish Mr. Clements with the particulars of their plant, and the example is one that might well be followed by other branches of chemical industry. Another paper of a technical character was that of Mr. C. A. Ablett on the use of electrical power in iron and steel works, whilst Mr. J. E. Fletcher's account of the grain size and other properties of moulding sands was also of interest from the workshop point of view.

The remaining papers were mainly contributed by laboratory workers, and contained material of great scientific interest, the steel industry probably surpassing all others in the closeness of the relations between science and practice. Prof. Carpenter's communication was a summary of work published by him and by Miss Elam and Mr. G. I. Taylor on the mechanical properties of single crystals of aluminium, and was illustrated by a most striking collection of these remarkable test-pieces. The combined mechanical and X-ray examination of such single crystals is doing more than anything else to throw light on the nature of the processes in the deformation of metals, and practical applications of the discoveries are already in sight. Prof. Arnold gave a summary of his researches on the eutectoids, or "true steels," formed by the alloying of iron with carbon and with such elements as vanadium; researches which established the composition of several of the double carbides present in alloy steels. Two papers dealt with questions affecting the manufacture of open-hearth steel, Mr. T. P. Colclough presenting a review of the reactions in the basic process as depending on the composition of the slag, some useful results being arrived at from the analysis of a considerable number of typical slags and the determination of their relation to the composition of the metal. Some criticism was directed towards the author's explanation of the removal of sulphur, which he attributed entirely to the action of manganese, and opinions on the constitution of the slags were found to differ; but the study undoubtedly clears up some puzzling questions as to the removal of carbon and phosphorus in the process. Messrs. Whiteley and Braithwaite recorded observations on the effect of small quantities of tin, such as enter steel when tinplate scrap is used in its manufacture, on the properties of the product. Even 0·06 per cent. of tin has a harmful effect in rails, and the effect increases with the carbon content, but depends to some extent on the heat treatment.

Prof. Thompson and Mr. A. Goffey presented a note on the changes in iron and steel below 400° C., and by measuring several distinct properties at such temperatures succeeded in confirming the existence of a number of definite changes which are completely reproducible. Changes in the space lattice are out of the question, and for the present the authors are thrown back for an explanation on changes within the atom itself. Much further work will be required to establish a theory of these minute critical points, which have an important bearing on the behaviour of steel on heating to moderate temperatures. Prof. C. H. Desch and Mr. A. T. Roberts contributed an account of the properties of some high-carbon steels containing cementite in the globular form, with special reference to safety-razor blades, showing that the quality of the blades largely depends on that of the cold-rolled strip from which they are made. The cementite has to be brought into the globular condition before hardening, and the quality of the finished blade appears to depend on the uniformity in size and distribution of the globules. Col. N. Belaiew called attention to the properties of damascened steels, in which the whole of the cementite is in the globular form, and which are known to have good cutting qualities. The subject of hardness was treated in two papers, Mr. H. O'Neill considering the relation between the Brinell hardness and the load applied in making the test, arriving by extrapolation at a figure which he calls the "ultimate hardness," which is independent of cold-working; whilst Prof. Edwards and Mr. Austin compared the Brinell hardness with the figures obtained by means of a rebound test. Two papers, which might well have been discussed together had time permitted, dealt with the quantitative interpretation of the tensile test, Mr. J. Stead analysing carefully a series of tests of steel, and plotting the results in such a way as to obtain a straight line as soon as the yield point is passed, whilst Mr. T. F. Russell, by an analysis of similar data and the application of thermodynamical reasoning, attempted to deduce the proportion of vitreous material present in a test piece after elongation, and thence to calculate the probable thickness of the vitreous films between the gliding surfaces. A determination of the change in density of wrought iron by overstrain, by Mr. J. W. Landon, led to surprisingly high values, which call for further investigation. A number of papers remained, discussion on which was impossible, although several were of high interest, and will assuredly be criticised when they become available.

Nothing at recent meetings of the Institute has been more remarkable than the evidence of the value of such purely scientific work as the study of steel by means of X-rays and the examination of single crystals for the practice of metallurgy. Particularly do such researches hold out a prospect of replacing the present empirical methods of determining the mechanical properties of metals by a more logical and simpler process.

An interesting feature of the meeting was the presentation of the Bessemer Medal to the veteran technical journalist and engineer, Dr. W. H. Maw, whose long association with *Engineering* has been the means of rendering most valuable service to the iron and steel industry, as well as to the allied industries.

At the annual dinner, presided over by Mr. F. Samuelson, a large attendance of members listened to hopeful speeches in reference to the revival of industry, the conditions in the manufacture of iron and steel being much better than appeared to be probable last year.

THE FARADAY SOCIETY

Five papers were read at the meeting held on May 14.

(1) "Some Notes on the Etching Properties of the α and β Forms of Tri-Carbide of Iron." By Dr. F. C. Thompson and E. Whitehead. During work on the etching properties of the carbides in alloy steels it was found that a dilute solution of ammonium oxalate did not stain cementite red, whereas a tungsten steel containing a carbide which had the etching characteristics of cementite gave a deep red colour. The authors, therefore, investigated the possibility that a small amount of tungsten might have caused the retention of that form which is normally stable only above 200° C. Of etching reagents tried that which best differentiates between the two forms of carbide is potassium copper cyanide. Confirmation was found of the fact that samples quenched from below 300° C. are self-tempering. (2) "An Example of Polymorphism in an Inter-Metallic Compound." By D. Stockdale. The conclusions arrived at were that there is good evidence for the existence of the compound Cu_2Al and that this compound is capable of existing in two polymorphic forms. (3) "The Elasticity of Organogels of Cellulose Acetate." By Dr. E. W. J. Mardles. The determination of the elasticity of a gel is complicated by the persistence of deformation and optical anisotropy, after removal of stress, so that the elasticity is perfect only for very small stresses applied for a short time. The relation between the modulus of elasticity and concentration for the organogels of cellulose acetate is not expressed by any simple formula, and addition of substances to the gel mainly affects the modulus in proportion to the change in the number of particles which aggregate. (4) "The Vapour Pressures of Concentrated Cane Sugar Solutions." By E. P. Perman and H. L. Saunders. The authors gave an account of experimental work on cane sugar with concentrations ranging from 10 per cent. to saturation, and gave tables showing vapour pressures at various concentrations. (5) "Some Experiments on the Hardness and Spontaneous Annealing of Lead." By A. L. Norbury, M.Sc. The author described a method of making low-load Brinell impressions with a lever-tensile machine, and discussed the effect of cold-hammering on the hardness of lead, the results showing an increase in hardness and in spontaneous annealing.

A BURNING QUESTION AND A BONE'S CONTENTION

By CALORIFER

Prof. Bone is clearly, to use his own term, in an "activated"* condition, absorbing and giving out energy at a great rate. Recently, he delivered a course of Cantor Lectures, at the Royal Society of Arts, on "Australian Brown Coals and Lignites." On May 9 he appeared on the same platform as a modest resurrectionist, to demonstrate developments of the Bone-Court surface-combustion process. In the interval, on April 27, he brought before the Royal Society an account of the refined study he has made of gaseous combustion at high pressures together with Messrs. Newitt and Townend, a continuation of the work begun with the late Mr. W. A. Haward, whose untimely death, through the accident of an explosion, is to be lamented in connexion with the investigation. This work was further discussed by Prof. Bone in a Friday Evening Discourse, at the Royal Institution, on May 11. His appearance in the Press, as a sentimentalist, holding up his hands in pious horror at the percentage of carbonic oxide in coal gas, is also to be reckoned against him.

Apart from the interest attaching to all work on combustion and fuels at the present time, we may rejoice at the fact that the glorious yet greatly neglected art of gas analysis is not only kept alive but is being developed, under Prof. Bone's fostering care, in these inquiries; some day, perhaps, when our students think for themselves and consider what is good for their souls, when our Universities value efficiency and facilitate change of domicile to this end, a Pilgrim's Way will be established to the South Kensington School and the gentle art so faithfully fostered there will be extended over the country—the manner of our present neglect is a disgrace to us, the more so as we are now given over to the internal-combustion engine and the ignorance of engineers of all that pertains to its chemistry.

A little surface criticism of our artist's several activities may not be out of place and lead him to consider the validity even of some of his own conclusions. The Royal Institute lecture was disappointing, as it was read and there were no original demonstrations; there was too much personal matter.

Essentially, Prof. Bone's work has involved the comparative study of the combustion of hydrogen and carbonic oxide, whether by oxygen alone or in presence of gaseous diluents. We have long known that the behaviour of carbonic oxide is peculiar and that there is a "lag" in its combustion by air; this is the more surprising as the two gases are isothermic. The lag is not noticeable when oxygen is used alone with either gas. The work derives its value from the exact way in which the pressures developed throughout the explosions have been followed by means of a special Petavel manometer giving an optical trace on a moving photographic film.

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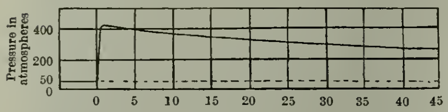
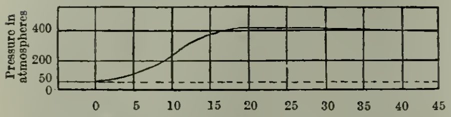
* A horrid, un-English word, which a self-respecting Royal Society publication committee should disallow.

Two curves given in the Royal Society Memoir are reproduced to illustrate the character of the results.



Expt. 1.—$2H_2+O_2+4N_2$ Time in 1/100 seconds.



Expt. 2.—$2CO+O_2+4N_2$ Time in 1/100 seconds.

The pressure rises, in the hydrogen-air mixture, almost instantaneously to a maximum and then declines in a regular, rather rapid manner. In the carbonic-oxide-air mixture, the pressure rises but slowly to about the maximum attained in the hydrogen mixture and then remains steady during a surprisingly long interval, when it gradually falls. If either carbonic oxide or oxygen or even argon be substituted for nitrogen (no other gas can replace it), the behaviour of the mixture is practically that of the hydrogen mixture.

It is clear, therefore, that nitrogen has a specific influence in retarding the combustion of carbonic oxide. What can this be ?

Prof. Bone and his co-workers seem to go out of their way to seek an explanation of the "anomaly." They suggest three possibilities. First, the resolution of the nitrogen molecule into its atoms. Secondly, a mere alteration of the electronic configuration of the molecule, such as has been suggested as possible by Langmuir : a sort of stretched spring hypothesis. Thirdly, that the nitrogen molecule is able to absorb and transfer into vibrational energy within itself a part of the total energy liberated when the carbonic oxide and oxygen interact.

Each of the three kinds of change postulated as possible in the nitrogen molecule, being the effect of heat, should be equally promoted in the isothermic process of combustion with hydrogen ; moreover, both oxygen and carbonic oxide should be thermally lowered in stability when present in excess in place of nitrogen and should have some if not an equal effect : argon alone might be expected to be without appreciable influence.

Peculiar to nitrogen is the power of being oxidised to nitric oxide. At the Royal Institution Prof. Bone both drew attention to the formation of "nitric acid" in the explosion of carbonic oxide and demonstrated its production. It seems but necessary to assume that nitric oxide is formed reversibly to account for the observed lag in the rise as well as in the fall of pressure ; in hydrogen, such action would occur, if at all, to so slight an extent or would be so rapidly reversible that the effect would not be obvious.

It is strange that Prof. Bone makes no attempt to consider the general course of change in gases ; he has gone out of his way in a previous paper to assume that either oxygen atoms or "activated" molecules of hydrone (how these may be made active is in no way clear) are required to oxidise carbon monoxide. It seems impossible for chemists to arrive at any rational conception of chemical change or to view the phenomena in any consistent comprehensive manner : the human mechanism apparently is so built that logical imagination comes rarely within its orbit. Prof. Bone will pardon these remarks, I trust, as he has lamented the fact that his explanation did not provoke discussion.

Turning to the Royal Society of Arts demonstration, the invention of a means of burning a gaseous mixture at the surface of a porous slab by Prof. Bone and Mr. McCourt will be in the memory of all who witnessed their remarkable demonstration, a dozen or more years ago : some of us thought we were on the eve of a new fuel era. In practice, the method was but partially successful in this country, as back-firing easily set in. Recently, Prof. Bone tells us, this difficulty has been overcome by Mr. Cox, who has devised means of properly grading the particles of which the slabs are composed. Various forms of the burner were shown and their use successfully demonstrated. These included a gas cooking stove which can be used in grilling steaks etc. ; numbers of these stoves are already in action in Messrs. Lyons' restaurants and elsewhere.

Prof. Bone originally claimed an efficiency of 93 per cent. for the boiler constructed on his principle. Now that the difficulty of back-firing is overcome, it is to be hoped that an exhaustive trial of the principle will be made without loss of time. It is proposed to call the new appliance a radiophragm. This is too awful a word for common use.

At the meeting, in proposing the vote of thanks, Professor Armstrong spoke of the possible near advent of a gas millennium and of electricity being used in the household merely in assisting the burning of gas—by blowing the bellows required to produce the necessary pressure of air.

Now that gas is coming so much to the fore, it will be necessary to establish a public gas conscience and that we become judges of gas. There has been absurd talk in the Press of late of displacing the carbonic oxide in coal gas by hydrogen by the time-honoured steam process. Even if this were an economically sound proposition, the change would be in the wrong direction and the gas less suitable for ordinary use than it is now. The inventor seems to have realised this, as methane is spoken of as a better substitute—but it is yet to be shown that the conversion into methane is practicable and then that it is economically possible.

PHOSPHATE DEPOSITS IN MOROCCO

According to a report furnished by H.M. Consul at Casablanca, Morocco is said to possess deposits of phosphates rivalling in extent those of Florida and in content those of any other country in the Eastern hemisphere. The Oued Zem-El-Bouroudj beds, 150 kilometres south of Casablanca, cover an area of 400,000 acres and are composed of a fine sand containing 73 to 78 per cent. of tricalcium phosphate. Deposits in other districts contain from 68 to 72 per cent. of phosphate. Thus, the Moroccan phosphates should assuredly find a ready market, provided production and transport expenses are kept low enough. At present exploitation is a State monopoly, the actual enterprise being conducted under a board of management; 7 square kilometres of deposit are being worked, and the phosphates extracted are dried in a machine which has a daily capacity of 30 tons. Production has increased from 8,230 tons in 1921 to 85,583 tons in 1922. Further development depends on the provision of adequate transport and port facilities, as the sale price at present does not cover the cost of extraction, but it is hoped to increase the output by 200,000 tons annually and to reach a total of 1,100,000 tons by 1927. The superphosphate factory now in erection at Casablanca will be completed this year and should produce annually 24,000 tons of superphosphates, which will be largely exported, as there is as yet but little local demand. Some indication of the potential market may be gathered from the fact that in 1913 the European consumption totalled 4,413,000 tons, of which North Africa supplied 2,345,000 tons, the United States 1,618,000 tons, and France and Belgium 450,000 tons. In addition to the anticipated production of over 1,000,000 tons from Moroccan deposits in 1928, Algeria and Tunisia should be producing from 3½ to 4 million tons at about the same date.

Dr. A. H. Hull, of the Research Laboratory of the General Electric Co., N.Y., has been awarded the Howard N. Potts gold medal of the Franklin Institute for his studies on the crystal structure of common elements by means of X-rays.

FORTHCOMING EVENTS

May 28.	The Faraday Society, at the Institution of Electrical Engineers, Victoria Embankment, W.C. 2, at 3 p.m. and 8 p.m. Discussion on "The Physical Chemistry of the Photographic Process." Between the afternoon and evening sessions dinner will be held at the Hotel Cecil at 6.45 p.m.
May 30.	Royal Microscopical Society, 20, Hanover Square, W. 1, at 6.30 p.m. "On the Microscopical Examination of China Clay," by J. M. Coon. "The Microscopical Investigation of Sands for Various Industrial Purposes," by H. B. Milner.
May 31.	Institution of Electrical Engineers, Annual General Meeting, Savoy Place, W.C. 2, at 6 p.m.
May 31.	The Royal Institution of Great Britain, at 3 p.m. "The Nature of Enzyme Action," by Sir W. M. Bayliss, LL.D., D.Sc. Also on June 7.
June 1.	The Royal Institution of Great Britain, at 9 p.m. "The Radiation of Light," by Prof. H. A. Lorentz.
June 1.	The Royal Society of Arts, at 4.30 p.m. (Indian Section.) "The Indian Section of the British Empire Exhibition, 1924," by A. Kendall, I.C.S. retd.

THE ELECTRONIC THEORY OF VALENCY

A General Discussion on the above subject is being arranged by the Faraday Society, to be held at Cambridge on July 13 and 14. Prof. G. N. Lewis will open the proceedings on the afternoon of July 13 (Friday) with an Introductory Address, and he will probably be followed by Mr. R. H. Fowler, who will contribute a paper intended to open discussion on the physical and inorganic side of the subject. Among those expected to speak are Sir J. J. Thomson, who will be in the chair, Sir E. Rutherford, Sir W. Bragg and Prof. W. L. Bragg. The Saturday morning session will be devoted chiefly to applications of the theory in organic chemistry. Sir R. Robertson, president of the Society, will preside, and opening papers will be given by Prof. T. M. Lowry and Dr. N. V. Sidgwick. Among those expected to speak are Prof. W. A. Noyes, Sir W. J. Pope, Prof. A. Lapworth, Prof. I. M. Heilbron, Dr. W. H. Mills, Prof. J. F. Thorpe and Prof. R. Robinson. On the Friday evening a complimentary dinner will be given to Profs. Lewis and Noyes and other guests at Trinity Hall. Arrangements are being made to accommodate those attending the meeting in one or other of the Colleges, and it will be possible to include a limited number of non-members of the Society. Particulars may be had from the Secretary of the Faraday Society, 10, Essex Street, London, W.C. 2, to whom applications should be made at once.

CORRESPONDENCE

THE TAXATION OF MOTOR FUEL

Sir,—The recent correspondence from Professor Procter and Dr. Ormandy raises two distinct issues. One concerns the comparative calorific values of motor fuels, the other deals with methods of levying the Road Tax. The two questions only overlap in deciding how to tax the fuel, should that course be adopted.

The first of these questions is liable to considerable misconception. There are three chief types of fuel, known commercially as petrol, benzol and alcohol; and the B.Th.U. per gallon of these may very roughly be stated in the proportion of 14 for petrol, 15 for benzol and 9 for alcohol. These figures are, of course, a measure of the relative amount of work obtainable from each fuel, but that is not all.

In the first place, for complete combustion, the air to fuel ratios (by weight) are roughly as 15 to 13 to 9. This means that very much more alcohol may be used in one explosion than benzol or petrol. Secondly, the relative latent heats are (again roughly) in the ratios 12 to 16 to 40. The larger the latent heat the lower the temperature of the mixture and consequently the bigger the charge. These two factors enable one to get as much as 20 per cent. more power output from alcohol than from benzol and petrol, but at a correspondingly increased consumption. There are numerous other considerations of efficiency which have their smaller effects on the relative merits of the fuels and it is sufficiently accurate to state that, when developing the same power output, the alcohol fuels will entail a consumption, say, 30 per cent. greater than benzol and 20 per cent. greater than petrol.

Whether the fuel of the future will be of the alcohol and benzol type which can be used at very high compression without combustion knock, and consequently with superior efficiency, is open to question. At the moment there are indications of a tendency in quite the opposite direction, that is to the use of heavy paraffin fuels which cannot be employed except at relatively low compression and with hot running, but which are economical on account of their cheapness. In any case, the motor engineer is finding that the bark of the much discussed "pinking" is worse than its bite.

I hesitate to tackle the second problem (that of the Road Tax) as so much has already been said about the matter by all manner of experts. If the tax is to come again on to the fuel there will certainly be waste enough without the introduction of a tax graded according to the physical properties of the fuel.

But to the humble mind it seems quite reasonable that the present system could be modified to make the tax equitable and just to all parties. First let the experts decide the relative road-usage of the various types of private and commercial vehicles when in fullest use throughout the whole year, and the value to the community of this usage. Then let them fix a scale of charges for each type when in fullest use.

Let those who wish to, take out a full licence for the year, but for the week-end motorist and the less successful transport contractor let us have a short time licence at a not too exorbitant figure. Why not a daily licence at about ½ per cent. of the annual cost? The police would be able to control evasions as easily as they can under the present system.

By this means the injustice of the contractor being forced to pay for a yearly licence, when he can only find work for his lorries on a hundred days or so, and of the private motorist having to take out his licence for the winter months, when he scarcely uses the car at all, will be avoided, and a state of affairs which is a serious setback to the whole motor industry will be abolished.—I am, Sir, etc., P. J. Bate

Sanderstead
May 14, 1923

CALCIUM LACTATE

Sir,—Concerning Mr. J. C. Stead's remarks on the price of calcium lactate, in your issue of May 4, I should like to point out that whey is by no means the only source of this material. If he will refer to Mr. Claflin's paper on the Avery process, in the *Journal* for 1897, p. 516, he will find that by inoculation of sterilised saccharine matter, such as liquid glucose, with lactic acid bacilli (*B. acidi lactis*, *B. lactis ærogenes*, *etc.*) in the presence of chalk and nitrogenous matter, very high yields of calcium lactate are obtained. The process can be extremely cheap, and is used—in America, at any rate—to produce the bulk of the lactic acid (by decomposition of the calcium lactate) used in the dyeing, tanning and other industries.

The uses of calcium lactate in comparison with those of lactic acid are small, being chiefly pharmaceutical, and hence the price is to some extent a fancy one.—I am, Sir, etc.,

S. B. Tallantyre

Blackheath, S.E. 3
May 15, 1923

LABORATORY ORGANISATION

Sir,—It may seem churlish on our part to cavil at anything in your excellent and sympathetic review of our book on *Laboratory Organisation*, but in justice to ourselves we should like to point out that the gas-fired combustion furnace referred to stands under the main ventilating shaft of the laboratory, which does not come into the field of view of the photo, and a hood for it is therefore unnecessary.—We are, Sir, etc.,

Seymour Pile
Reginald G. Johnston

Queen's College, Birmingham
May 15, 1923

Sir,—I am glad to note Mr. Seymour Pile's explanation of the apparent discrepancy between precept and practice in the matter of the ventilation of the combustion furnace referred to in my review. I, however, having no personal acquaintance with the structure of the laboratory was obliged to gain my impression from the plate and I think this impression, which Mr. Seymour Pile now shows to be an erroneous one due to the limitations of the photograph, will be shared by most readers of the volume.—I am, Sir, etc.,

T. Callan

Crumpsall, Manchester
May 15, 1923

PERSONALIA

It is announced that £12,000 has been given anonymously to Armstrong College, Newcastle-on-Tyne, to provide more facilities for research in pure and applied science.

In the entrance hall of the chemistry laboratories of University College, London, Viscount Chelmsford recently unveiled a tablet to commemorate the donations of Sir Ralph Forster towards the erection and equipment of the new chemistry laboratories.

* * *

The death is reported, at the age of 77, of Dr. Charles Liven, late of Aberdeen University.

With regret we announce the death on May 16 of Mrs. Mond, the widow of the late Dr. Ludwig Mond, F.R.S. Under the provisions of the late Dr. Mond's will, a bequest will now be paid of £50,000 to the Royal Society, which is to utilise the income to endow research in natural science and particularly in chemistry and physics, to publish the Society's reports and papers, and to prepare and publish catalogues and indexes of scientific literature. A similar sum is bequeathed to the University of Heidelberg to endow research in natural science, and £20,000 for pensions or assistance to workmen of Messrs. Brunner, Mond and Co.

The death is announced of Monsieur F. Devignes, a member of the International Petroleum Commission.

THE CHEMICAL ENGINEERING GROUP
THE INSTITUTION OF CHEMICAL ENGINEERS

We are requested to announce that the offices of the Chemical Engineering Group have been removed from 24, Buckingham Street, Strand, W.C. 2, to Abbey House, Room 308, Victoria Street, S.W. 1, to which address all communications to the Group should in future be sent.

It is also announced that the offices of the Institution of Chemical Engineers have been removed from 166, Piccadilly, W. 1, to Abbey House, Rooms 306 and 307, at the same address as that of the Chemical Engineering Group.

NEWS AND NOTES

UNITED STATES

Research on Soap

It is announced that the Palmolive Co., of Milwaukee, has established a Fellowship of $2000 per annum for the study of the fundamental principles connected with the detergent action of soap. The Fellow, who must possess the equivalent of a Master's degree, will be allowed to carry out his research at any Institution in the United States that is properly equipped for the purpose.

Sulphur and Pyrites in 1921

The output of sulphur in the United States in 1921 was 1,879,150 long tons, valued at $17,000,000, the largest output recorded, being 52,565 t. larger than that of 1918, a former record year. Roughly only half of the production was shipped, however, and stocks of sulphur held at the mines consequently reached large figures, 2,000,000 t. being in stock at the end of the year. Exports totalled 285,762 t., chiefly to Canada, France, Australia, Germany, England and Sweden. The domestic production of pyrites increased by 49 per cent. in quantity and 55 per cent. in value to 157,118 t., valued at $711,432. Sulphur was produced chiefly in Texas, and pyrites was produced chiefly by California (63 per cent. of the total), New York, and Wisconsin. Imports of pyrites were 216,229 t. (332,606 t. in 1920) and were the smallest recorded since 1896.

FRANCE

Industrial Notes

The sequestrated factories belonging to the German firm of Baeyer and Co. at Flers, near Lille, have been put up for sale in six lots, but no buyers came forward.

The Minister of Public Works has invited metallurgists to stock one-third of the coke that they are now receiving from the Ruhr until a total of 250,000 metric tons, *i.e.*, enough to supply French metallurgists for fifteen days, has been accumulated.

Wool Disinfection

The Central Committee for Wool has announced that in its opinion the question of the disinfection of wool is not within the competence of the International Labour Bureau and that it should not be put on the agenda of the meeting in 1923. If, however, the subject is still discussed, the Council of the Central Committee for Wool considers that the cost of disinfecting infected wool should be paid by the country of origin and not by the importers.

Output of Potash in Alsace

The output of potash in Alsace reached the record amount of 1,326,727 tons in 1922, as compared with 903,134 t. in 1921, 1,222,370 t. in 1920, and 592,365 t. in 1919. At present not only are chloride manufacturers working at full capacity, and producing over 250,000 t.

of potassium chloride per annum, but the Société Commerciale des Potasses d'Alsace is producing a large amount of potassium sulphate.—(*U.S. Comm. Rep.*, *Apr.* 9, 1923.)

GENERAL

Synthetic Ammonia in Spain

It is reported that Monsieur G. Claude is establishing a factory in Spain for a Spanish Syndicate to manufacture synthetic ammonia by his process. The plant is designed to utilise from 3000 to 4000 cb. m. of hydrogen per day, the output of the adjacent electrolytic soda plant of the Electro Quimica de Felix Co.

New Process for Manufacturing Superphosphates

It is reported from Spain that a process has been evolved for the manufacture of superphosphates containing 20 to 30 per cent. of water-soluble phosphoric acid from low-grade phosphate deposits. Experiments hitherto made at Caceres are to be repeated on an industrial scale, and, if successful, should make it possible to utilise large deposits of low-grade phosphates in the central regions of Spain.—(*U.S. Comm. Rep.*, *Apr.* 2, 1923.)

European Beet Crop, 1922-23

Dr. Prinsen Geerligs, in a cable dated February 16, 1923, reports that the 1922-23 beet-sugar crop in Europe amounted to 4,550,000 metric tons, raw value, a decrease of 180,000 tons from the previous estimate (4,730,000 tons). The total production is distributed as follows :—Germany, 1,500,000 t.; Czechoslovakia, 720,000 t.; Poland, 330,000 t.; Russia, 200,000 t.; Holland, 270,000 t.; Belgium, 280,000 t.; France, 475,000 t.; Italy, 290,000 t.; Spain, 140,000 t.; other European countries, 345,000 t. (*Ind. Tr. J.*, *Apr.* 19, 1923.)

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Formaldehyde and Rochelle Salt

In a written answer to Capt. W. Benn, Lieut.-Col. Buckley stated that application had been received for the exclusion of Rochelle salt and formaldehyde, respectively, from the schedule under Part 2 of the Safeguarding of Industries Act. The cases would be brought before the Referee in due course.—(May 11.)

Preservatives in Foodstuffs

Mr. N. Chamberlain, answering Mr. A. Bennett, said that he was considering the composition of the proposed committee to enquire into the use of preservative colouring matter in foods.—(May 16.)

Dangerous Drugs and Poisons (Amendment) Bill

The amendments added to this Bill in the House of Lords were considered and passed on May 16.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for May* 17)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Belgium	Rubber goods	627
,,	Metal ingots	628
,,	Pharmaceutical specialities	630
British India	Gutta-percha cable (tender)	*
Bulgaria	Metallurgical coke (tender)	10681/F.E./T.C.
Germany	Metals, plate-glass, chemicals, iron, oils	632
Canada	Canada plates, sheets, tinplate	625
Colombia	Hardware, hollow-ware, chemicals, drugs	656
Egypt	Glassware, paint, oil	652
,,	Chemicals, dyes, varnish, copper circles	653
Norway	Sugar	640
,,	Photographic materials	641
South Africa	Red oxide paint (tender No. 442)	11264/E.D./C.C./2
Sweden	Asbestos, optical goods	647
Switzerland	Copper, spelter, zinc, nickel	648
,,	Scientific, optical and surgical instruments	651

* Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E.

TARIFF CUSTOMS EXCISE

Denmark.—The issue for May 17 contains a copy of the amended "Luxury Tax" Law, which affects, among other goods, glassware, rubber, artificial silk, machinery, iron and steel, metals, sensitised photographic paper, hides and skins.

Italy.—The duty on imported sugar has been withdrawn.

Newfoundland.—The duty on sugar has been reduced.

Sarawak.—Restrictions have been placed on exports of rubber.

Switzerland.—The period during which the importation of goods may be restricted has been extended to March 31, 1924.

REVIEWS

An Introduction to the Chemistry of Plant Products. *Vol. II.* Metabolic Processes. *By* Paul Haas, D.Sc., Ph.D., *and* T. G. Hill, A.R.C.S., F.L.S. *Pp. viii*+140. *London: Longmans, Green and Co.*, 1922. *Price 7s. 6d. net.*

This book contains much valuable information on the synthesis of fats, carbohydrates and proteins, and on the chemistry of respiration and growth. It is concise in its presentation, and provides not only a digest of the extensive relevant literature which is dealt with faithfully and historically, but it is also commendable for much valuable comment essential to a true estimation of the present state of knowledge on many debatable points in plant chemistry. The book is remarkable for the lucidity of explanation with which each chapter is opened. This is conspicuously the case in the presentation of the subject matter on the synthesis of proteins and on respiration, regarding which the writer knows no statement both so brief and yet clear. There is perhaps no other book of the dimensions of the present volume to which the student of organic chemistry can turn with such satisfaction for an epitome of modern views on the chemistry of plant metabolism. Its authors are to be heartily congratulated on its production. John McLean Thompson

Vital Factors of Foods, Vitamins and Nutrition. *By* Carleton Ellis, S.B., F.C.S., *and* Dr. Annie Louise Macleod. *Pp. ix* + 391. *London: Chapman and Hall, Ltd.*, 1923. *Price 25s.*

There are two classes into which the majority of books on vitamins can broadly be classified; those which deal with the subject in an elementary manner for popular reading, and those which are compiled as scientific monographs. Both types, if well written, have their particular value, but it is not easy to classify the volume under review. It is quite unsuitable, and was probably never intended for the general public, whereas, on the other hand, it lacks most of the desirable features of a scientific treatise. In its exhaustive treatment of the voluminous literature on the vitamins which has grown up during the last ten years it resembles a monograph, but there is an almost entire absence of any critical examination of this material, without which such a work becomes merely a lengthy and extended bibliography. To some extent this may be due to the authors not being, so far as the reviewer is aware, actually engaged in research in this field, but, on the other hand, when such is the case, the work should gain by the impartial handling of the subject.

As a mere compilation of the work that has been published on vitamins the book is good, and few references of importance appear to have been omitted. The main criticism is, as we have remarked above, the almost complete lack of judgment in presenting the material. To give only one example, we find on pages 182 and 184 references to the work of Uhlmann on the pharmacological action of one of the vitamins. The conclusions of this worker are given without any comment, in spite of the fact that Uhlmann was working with a commercial product, which from its method of preparation must have contained many substances other than vitamin B showing physiological activity, amongst them probably choline, and that, therefore, the interpretation of his experimental observations is, to say the least, very much under suspicion. On the whole the book is well produced. There are, however, numerous evidences of imperfect proof correction, whilst in the copy submitted for review the photographs facing page 289 would be unintelligible were it not that the subscription informs us that they represent rats. There is a note of appropriateness in the first sentence of a paragraph from one of Joseph Conrad's books with which the authors introduce their book: "All one's work might have been better done." J. C. Drummond

Practical Plant Biology. *By* Prof. H. H. Dixon, F.R.S. *Pp. xi* + 291. *London: Longmans, Green and Co.*, 1922. *Price 6s.*

This is a book of considerable interest to a much wider field of students than that for which it was designed. It professes to present an introductory course in botany for medical and other science students. This profession is admirably fulfilled. The book will also commend itself readily to many teachers by its novel presentation of many familiar objects. It contains much interesting information on plant chemistry which is seldom detailed with simplicity and directness in such books. In this it provides a happy offset to the more rigidly systematic and morphological statements which have characterised so many modern botanical treatises.

The book may be viewed as a welcome representation of biological phenomena, and its author is to be congratulated upon it. Much of the illustration has been prepared personally by the author; and though it cannot be viewed as of a high standard, it possesses the merit of being well selected.

John McLean Thompson

Die Beziehungen zwischen den Fettkonstanten. *By* Jakob Lund. *Pp.* 75. *Berlin: Julius Springer*, 1922.

This pamphlet consists of a reprint from the *Zeitschrift für Untersuchung der Nahrungs und Genussmittel sowie der Gebrauchsgegenstände* (Vol. 44, Part 3), an abstract of which has already been given in this Journal (1922, 944a). In the present reprint the analytical data have been amplified, and it will doubtless be found useful for purposes of reference.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acetic Acid, 40% tech.	£24 per ton.
Acid Hydrochloric	4s.-5s. per carboy d/d.
Acid Nitric 80° Tw.	£24 10s. per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton.
Arsenic (White)	£70-£75 per ton.
Bleaching Powder	Spot £11 7s. 6d. d/d. Contract £10 7s. 6d. d/d.
Bisulphite of Lime	£7 per ton, packages extra.
Calcium Chloride	£5 17s. 6d. per ton d/d.
Copper Sulphate	£27 per ton
Potash Caustic	£35-£36 per ton
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b.
Soda Caustic 76%	£20-£21 per ton.
Soda Crystals	£5 10s. per ton.
Sod. Acetate 97/98%	£26 per ton.
Sod. Bicarbonate	£10 10s. per ton.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	2⅞d.-3d. per lb.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, conc.	£16 per ton carr. paid.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£26-£28 per ton according to quantity.
Carbon Black	1s. 5½d. per lb. ex wharf. Still very scarce.
Chromium Oxide	1s. 5d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb. Firmer on advance in price of Rape Seed Oil.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood-distillation products. Wood tar has advanced in price.

Acetate of Lime—	
Brown	£10 15s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 10s. per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 9d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£6 per ton d/d.
Brown Sugar of Lead	£43 5s. per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 5d. per lb. Little movement in the market.
Crude 60's	3s. 6d.-3s. 9d. per gall. Market weaker.
Acid Cresylic—97/99	2s. 2d.-2s. 5d. per gall. Market quiet.
Pale 95%	2s.-2s. 4d. per gall. Not much demand.
Dark	1s. 10d.-2s. 0½d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	9½d.-10d. per gall. Not much demand.
Unstrained	9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8½d. per gall. Business slack, abundant supplies.
Pure	2s.-2s. 3d. per gall.
Toluole—90%	1s. 9d.-2s. per gall.
Pure	2s.-2s. 6d. per gall. Not much inquiry.
Xylol	3s.-4s. per gall. according to quality.
Creosote—	
Cresylic 20/24%	11½d.-1s. per gall. Not much business.
Middle Oil Heavy Standard Specification	8½d.-9½d. per gall; Market steady.
Naphtha—	
Crude	9d.-9¼d. per gall.
Solvent 90/160	1s. 7d.-1s. 9d. per gall. Fewer inquiries.
Solvent 90/190	1s. 5d.-1s. 8d. per gall. Market steady.
Naphthalene Crude—	
Drained Creosote Salts	£7-£8 per ton.
Whizzed or hot pressed	£11 10s.-£14 per ton. Plenty of enquiries.
Naphthalene—	
Crystals	£18 per ton.
Flaked	£16 per ton.
Pitch, medium soft	No business for this season. Prices for Autumn delivery 130s.-135s. per ton.
Pyridine—90/140	11s.-12s. per gall. More enquiry.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

A slight falling off of business in dyestuffs is fully accounted for by the Whitsun holidays. Orders for forward delivery have been coming in fairly well and still further improvement is anticipated. Prices remain firm.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
p-Dichlorbenzol	£70 per ton.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	4s. per lb. d/d.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Metanitraniline	5s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works. Good demand.
Nitronaphthalene	1s. per lb. d/d.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market generally is quiet, the forward position being uncertain in view of the Continent being unable to offer supplies except at values which are considerably higher than present spot prices. In several cases holders are willing to accept low prices in order to realise part of their stocks, but the general tendency is towards higher prices in the near future if the position in Germany remains unchanged.

Acid, Acetic 80%	£50 per ton.
Acid, Acetyl Salicylic	3s. 2d.-3s. 3d. per lb. Smaller demand and market weaker.
Acid, Benzoic	2s. 6d. per lb. Still very scarce at this figure.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton. Prices reduced by £5 per ton.
Acid, Citric	1s. 9d. per lb., less 5%. Dearer; demand active; higher prices expected.
Acid, Gallic	3s. per lb. Steady demand.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb.
Acid, Salicylic	2s. 3d. per lb. still quoted. For firm orders in quantity 2s. 1d. would be accepted.
Acid, Tannic	3s. 3d. per lb. for good light quality.
Acid, Tartaric	1s. 4d.-1s. 4½d. Demand good.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d. per lb. Very firmly held.
Amidopyrin	13s. 6d. per lb. Unchanged. Stocks are small and any heavy demand would result in higher prices.
Ammon. Benzoate	3s. 6d. per lb.
Ammon. Carbonate B.P.	£37 10s. per ton.
Atropine Sulphate	12s. per oz. neglected.
Barbitone	Quoted up to 20s. per lb. Much firmer owing to lack of supplies in quantity.
Benzonaphthol	4s. 6d. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Bromides	Better inquiry. Prices steady. Potass. 8d., Sod. 9d., Ammon. 10d. per lb.
Calcium Lactate	2s. 9d. per lb. for best makes.
Chloral Hydrate	4s. per lb. Price well maintained. More inquiry.
Chloroform	2s. 3d. per lb. for cwt. lots, ton lots being quoted down to 2s. per lb.
Creosote Carbonate	10s. per lb., with little enquiry.
Formaldehyde 40%	£90 per ton. Very firm.
Guiacol Carbonate	8s. 6d. per lb.
Hexamine	4s. per lb. would now be accepted for quantity.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Market good with considerable inquiry.
Magnesium Carbonate—	
Light Commercial	£38 per ton nett.
Magnesium Oxide—	
Light Commercial	£85 per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Menthol	35s. per lb. spot.
Methyl Salicylate	2s. 6d. per lb. for carboys.
Methyl Sulphonal	15s. per lb. Slightly higher in value.
Mercurials	Unchanged. Market quiet.
Paraformaldehyde	4s.
Paraldehyde	1s. 7d. per lb. Very steady. Forward prices show a higher tendency for best makes.
Phenacetin	6s. 6d. per lb. spot value.
Phenazone	7s. 6d. per lb. Very firm.

Phenolphthalein	5s. 6d. per lb. In short supply. Larger quantities appear to be unobtainable even at this figure.
Potass. Bitartrate—99/100% (Cream of Tartar)	98s. per cwt., less 2½%. Firmer.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. Demand still continues good.
Potass. Permanganate	10d. per lb. for large quantities. Forward market very much firmer.
Resorcin	6s. per lb.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Salol	2s. 9d. per lb.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 6d. per lb. Still in short supply, fresh stocks being quickly absorbed.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality.
Sod. Hyposulphite—Photographic	£15-£17 per ton, according to quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d. per cwt. Fairly good demand.
Sod. Salicylate	In good supply. Values unaltered, being 2s. 9d. per lb. for Powder, 2s. 11d. per lb. for Crystal. Some prominent makers have reduced their rates to meet competition.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. per ton, according to quantity for home trade, 1-cwt. packages included.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.
Thymol	In view of fairly large stocks being held keen competition still exists to obtain orders. The value of genuine good White Crystal remains at 17s. per lb.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.	
Aubepine	14s. ,, ,,	
Amyl Acetate	3s. ,, ,,	
Amyl Butyrate	7s. ,, ,,	Reduced.
Amyl Salicylate	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	2s. 9d. ,, ,,	Lower.
Benzyl Benzoate	3s. 3d. ,, ,,	Advanced.
Cinnamic Aldehyde	14s. 9d. ,, ,,	
Coumarin	16s. 3d. ,, ,,	
Citronellol	19s. 6d. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate	15s. ,, ,,	
Ethyl Phthalate	4s. 3d. ,, ,,	
Eugenol	11s. 6d. ,, ,,	
Geraniol (Palmarosa)	30s. ,, ,,	
Geraniol	5s. 6d.-12s. 6d. per lb.	
Heliotropine	8s. per lb.	
Iso Eugenol	16s. 6d. ,, ,,	
Linalol ex Bois de Rose	21s. ,, ,,	
Linalyl Acetate	25s. 6d. ,, ,,	
Methyl Anthranilate	6s. ,, ,,	
Methyl Benzoate	8s. 6d. ,, ,,	
Musk Xylol	9s. 6d. ,, ,,	
Phenyl Ethyl Acetate	10s. ,, ,,	
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,	
Rhodinol	45s. ,, ,,	
Safrol	2s. 3d. ,, ,,	
Terpineol	3s. 1d. ,, ,,	
Vanillin	23s.-24s. per lb.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.	
Anise Oil	2s. ,, ,,	
Bergamot Oil	12s. 6d. ,, ,,	spot.
Bourbon Geranium Oil	31s. 6d. ,, ,,	
Cananga Oil, Java	9s. ,, ,,	
Cinnamon Oil, Leaf	4½d. per oz.	
Cassia Oil 80/85%	8s. 6d. per lb.	
Citronella Oil—Java 85/90%	4s. 2d. ,, ,,	
Ceylon	3s. 4d. ,, ,,	
Clove Oil	8s.-8s. 6d. per lb.	
Eucalyptus Oil 70/75%	1s. 9d. per lb.	
Lavender Oil, Mont Blanc 38/40%	13s. ,, ,,	
Lemon Oil	3s. 1d. ,, ,,	
Lemongrass Oil	2¾d. per oz.	
Orange Oil, Sweet	11s. 6d. per lb.	
Otto of Rose Oil—Anatolian	24s. per oz.	
Bulgarian	30s. per oz.	
Palma Rosa Oil	17s. 6d. per lb.	
Peppermint Oil—English	80s. ,, ,,	
Wayne County	13s. ,, ,,	
Japanese	6s. 4½d. ,, ,,	
Petitgrain Oil	8s. 3d. ,, ,,	

TRADE NOTE

Reparation Dyestuffs

The Board of Trade draws attention to the fact that, under the Reparation Clauses of the Peace Treaty, requisitions are made periodically for the delivery of certain German dyestuffs on reparation account. Information on the requirements of colour users for dyestuffs which cannot be obtained from British manufacturers is collected by the Colour Users' Association and furnished periodically to the Board of Trade. In order that this information may be as complete as possible the Board would be glad if all users—whether members of the Association or not—would furnish particulars of their estimated requirements for German dyestuffs, say once every three months, to the Secretary, Colour Users' Association, Cromwell Buildings, Blackfriars Street, Manchester.

PUBLICATION RECEIVED

LOW TEMPERATURE CARBONISATION OF BITUMINOUS COAL. *By* A. McCULLOCH, A.I.C., *and* N. SIMPKIN, M.Sc. *Pp. xii+248. London: H. F. & G. Witherby,* 1923. *Price* 18s. *net.*

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EDITORIAL

THE latest Bulletin of the Société de Chimie Industrielle contains an interesting editorial on the subject of the Union Internationale de la Chimie and its approaching meeting at Cambridge. In an article published last December in the *Journal of Industrial and Engineering Chemistry*, Prof. W. A. Noyes, of the University of Illinois, asked for the admission of Germany to the Union Internationale. This request is discussed in the editorial we have referred to, and special mention is made of a suggestion by Prof. Noyes that the reason why Germany and Austria have not been admitted is that the Allies consider themselves on a higher plane than the Central Powers. The French attitude on this point is very frankly displayed by the Bulletin, and with due recognition of his friendliness and high-mindedness they regard Prof. Noyes as misinformed as to the French mentality. "*La réserve que nous manifestons vis-à-vis des Allemands n'a jamais eu pour mobile cette présomption, qui serait pour le moins bien ridicule, de nous considérer sur un plan plus élevé que quiconque. Nous ne pensons pas être le jouet de la vanité, ni d'un sentimentalisme exagéré, encore moins d'un esprit nationaliste qui aveuglerait notre bon sens.*" It is pointed out that the manifesto of some of the German savants has neither been disavowed by its authors nor regretted by the others, and that some such step is desirable in the interest of pleasant relations. We do not venture to express any opinion on such a question of delicacy.

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We have no claim or wish to speak on behalf of British chemists on such a topic as the policy of the Union, nor any intention of so posing. But the point is one of considerable importance, and if the question is to be canvassed at Cambridge it is no use shirking the discussion either from a desire to escape responsibility or from a reluctance to be frank. There is no reason why such a question should not be considered primarily from the point of view of the Union Internationale. If any nation desires that its chemists shall meet in friendly fashion those of other countries for the better advancement of the science, the questions which naturally first arise are,—will any degree of friendliness actually exist ? and, is the proposal made with the idea of helping on the activities of the Union Internationale ? The meetings of the Union held so far have been particularly cordial and harmonious. It is undoubted that, other conditions being equal, the more countries that are represented the better ; but if Germany is admitted, will an element of discord spring up which will reduce the usefulness of the conferences ? This is not an easy question to answer. Hitherto it has never been necessary to consider whether at lunch Monsieur A or Signor B or Professor C would feel any awkwardness in sitting next door to each other. Whether a German manufacturer, whose works on the Rhine are now guarded or occupied by French troops cares to enjoy a *tête-à-tête* with a French manufacturer whose works, say in Lille or Chauny, were destroyed by German troops, we have no means of judging ; but in a period when continuity is so important for its progress the Union Internationale perhaps cannot afford to be split up by two inharmonious elements, each striving to secure the adhesion of a considerable mass of more or less neutral sentiment.

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In our columns we remember to have read a few reviews of German books on chemistry, in which the reviewer has suggested that the recent work of British chemists on the particular subject has been ignored. Whether it is a mere accident or not, we are not sufficiently informed on the matter to hold an opinion ; but if by any chance it is considered by some few writers to be patriotic when a convenient opportunity occurs for a German to ignore or treat lightly the work of the British and other foreign chemists in order that the reader of the book may infer that German chemistry alone is worth troubling about, the policy would appear to us to be one which is singularly injudicious and unfortunate. We have had sharp disagreements at times with the French, and we do not suppose that the British are unduly popular in France at the present moment; but whatever may be our political differences, we know that the French chemists have worked hard during the last three years to make the Union Internationale a success, with perfect sincerity and goodwill. They have not been inspired by the need to call our attention to the importance of French chemists and the superiority of French methods over every other. This sort of spirit has characterised French scientific men for a long period. Was not a famous memoir of Davy crowned by the Académie des Sciences in Paris, in 1807, when a fierce war divided France from England? It may well be that the point of view we have indicated in these notes is merely evidence of our ignorance; those who control the destinies of the Union Internationale need neither our advice nor our support. We merely indicate some of the considerations which affect a decision at the moment and express the hope so pleasantly phrased by our contemporary a year ago, "*qu'aucun malentendu ne devait diviser ceux qui ont pour mission commune d'ameliorer le sort des hommes.*" In time a better spirit will prevail in Europe; there ought to be no jealousies, no resentments, no bitter memories; few of us are entirely free from blame. But whether an attempt by any third party at such a time as this to promote friendly conferences between the French and German chemists will advance or retard an era of cordiality must be a matter of conjecture. On the other hand, no one will dispute that when the French and German chemists have mitigated some of their present feelings of hostility, and when both are willing to work together to increase the usefulness of the Union, not to justify the claim to be on any particular plane of intellectual or other activity, then the time will have appeared for a new and greater importance of the Union Internationale in the domain of chemistry. The publication of the French point of view requires some comment, and we put forward these observations quite modestly, believing that a little preliminary thought on the matter will show how difficult are the questions involved. More than a score of nations are represented in the Union; many different points of view may be urged. We, in this country, are only one factor, but our columns are open for the expression of opinion on all matters of interest to chemists, and our considerable circulation outside the United Kingdom will give us special facilities for learning the views of many chemists in many lands. It is possible that when these are available Prof. Noyes may consider the advisability of postponing any formal proposition.

CHEMISTRY—THE KEY TO INTERNATIONAL RELATIONS

By H. E. HOWE

(*Continued*)

Japan has for years enjoyed a monopoly of camphor which has been a distinct advantage to that country. Camphor is used extensively in the arts, notably for the production of celluloid, motion-picture films and the like, and in international relations cannot be ignored. This advantage to Japan has been partly lost of late through the demonstration that camphor trees can be grown in other countries, through the remarkable synthesis of camphor in the laboratory, and through research which has been successful in producing certain substitutes for camphor. It is said that for some industrial purposes none of these materials give quite the same results as the native camphor, but there is no reason to doubt that the cause for any difference will be found.

Like soda ash, sulphur is basic in the chemical industry, particularly in those phases essential for the sinews of war. Sulphur is the raw material for making sulphuric acid. The prosperity of a nation in peace and its strength in war can almost be measured by its production and consumption of sulphuric acid, and it has even been said that the civilisation of a country can be so estimated. The Sicilian corner in sulphur, managed by an English syndicate, has been entirely broken through the success of chemical engineering in America. Sulphur formerly came almost entirely from Sicily, but this sulphur was seldom pure and was unsatisfactory for some uses. It was known that a thousand feet below the surface in Louisiana and Texas deposits of sulphur were to be found. Several attempts to reach them had only resulted in a loss of life and investment. Then came a chemical engineer, who believed that he could successfully work within those narrow temperature limits where sulphur changes from an easy running liquid to a viscous, sticky mass. His plan was to force superheated water and steam down to the deposit so that the sulphur would melt and under pressure flow to the surface. When the experimental plant was ready and the first hot water turned into the pipes it was but a few moments until a stream of liquid sulphur more than 99 per cent. pure appeared at the surface. Presently the operation was stopped and it was weeks before it could be made to function again. However, it had been demonstrated that the plan was sound, and the engineer persisted. Today America has the commanding position with respect to sulphur. Indeed, but for an arrangement with the English syndicate regarding price, the entire Sicilian industry would have been destroyed and the people left without a means for earning their livelihood. It is interesting to note that when the report of how pure sulphur was being pumped from the ground in America was first made to the English sulphur syndicate, the man who dared pass along such an exaggerated Yankee story was dismissed.

Canada enjoys a certain power through her great resources of nickel and asbestos. She has also relied upon her wood pulp, a product of chemical industry, to back her claims in international councils.

Few nations have been so favoured as has Germany through the control of the natural resources made valuable by chemistry. This is particularly true of the great potash beds which, however, were not discovered until long after the deposits had been worked for ordinary salt. With the utilisation of rock salt deposits in various localities, a time came when the price of salt fell, and the Stassfurt works ceased to yield their former large revenue to the Prussian Government. With a view to making them more valuable, it was decided to sink the shaft further, in the hope that rock salt might be discovered. At a depth of 1800 feet a stratum of rock salt was found, but in reaching it the shaft passed through a heavy deposit of refuse salts which were considered worthless. Chemical analysis showed these salts to consist largely of magnesium-potassium chloride and potassium chloride. The Dutch scholar Van't Hoff demonstrated that these materials could be separated by crystallisation, and to-day these refuse salts are the world's chief source of supply of potashes and potassium salts.

An effort is being made in the United States as a result of war activity to break this potash monopoly. Whilst a part of the deposit is no longer German property, the deposit as a whole might at any time give those nations controlling it a commanding position. The natural lakes of Nebraska, the alunite ores of Utah, and the greensands of New Jersey are sources of potash that at present prices cannot compete with very low mining and purification costs abroad. The fact that the greensands of New Jersey yield as a by-product the material for sand lime brick in an area where construction creates a demand for this building material may well prove a saving factor in that instance. The greatest deposits now being worked in America are those at Searles Lake, California, where research similar to that conducted by Van't Hoff on German deposits, but of a different and higher order of complexity, has shown that the mixed deposit of that lake can be commercially separated. Potash of high purity is being produced, with quantities of borax among the by-products. We are also told that Texas may at any time be able to announce extensive potash deposits. Italy is supporting research in the hope of recovering potash from leucite.

Another weapon which Germany has not hesitated to use has been her manufactured chemicals, especially her dyes. Years ago she began with cunning to make a world monopoly to be utilised for the furtherance of her ambition. The use of patents, particularly product patents, extensive propaganda and advertising, and even the adoption of specifications for colours, strengthened her hold. There is reason to believe that the requirement that dyes used in dyeing our military uniforms must withstand washing in a bleach solution dates back to the time when the only colours that would withstand this test were made in Germany. The effort to hold world textile trade by limiting the export of dyes to this country early in the war will be remembered, and a careful watch of the literature of Germany to-day and of the addresses presented before various conferences indicates that the Germany of the present puts her greatest hope for rebuilding her world influence upon the potentialities of her chemistry.

The changes in world relations due to new explosives will be obvious. Many world policies were changed with the completion of the Panama Canal, which would have been impossible but for the work of medicine and sanitation combined with chemical explosives. TNT., our most recent example, was responsible for the rapid reduction of those Belgian cities which were protected with concrete fortifications. Concrete, itself made by a chemical process, might not have been so easily crumbled but for the research on toluol. Toluol is used as a basic material in certain types of dyes. When it is nitrated, two mono-nitro-toluols are formed simultaneously. One of these mono-nitro-toluols was desired for dyes ; for the other there was no known use. Research was therefore undertaken with two objects in view : first, to produce a larger proportion of the mono-nitro-toluol which was wanted for dyes ; and second, to discover a use for the other variety. Little progress was made, and suddenly the problem disappeared from the scientific literature. After Liége it became known that upon further nitration it had been found that tri-nitro-toluol could be formed from that mono-nitro variety undesirable for dye uses. Consequently efforts were bent toward increasing rather than decreasing the toluol which could be transformed into this high explosive.

Aircraft problems of to-day are chemical problems in large measure. These include materials of construction, not only metals which must have a minimum of weight with a maximum of strength, but laminated propellers protected so that their dimensions and balance may not be disturbed, and a variety of fabrics as well. The varnishes, adhesives, and the many other items which taken together give us aircraft, depend upon either chemical manufacture or chemical control. The materials of operation, the lubricants, the fuels, which in themselves are difficult problems, also belong to chemistry. Materials for buoyancy, the balloon fabrics which are required to remain flexible and yet impermeable to gases, present a real chemical problem. Helium appears to be a natural American monopoly, and through chemical engineering we have learned how to separate it from the other gases with which it is found, purify it, store it, and use it in our balloons. In few instances has science had a better opportunity to dictate international relations than in the development of aircraft.

Fats and oils of vegetable origin have taken and hold a real place in affairs. They have even brought about strange tariff problems. Such oils have always been of commercial importance, but with the advent of hydrogenation it lies within the power of any country possessing the chemical knowledge and skill and the ability to grow such crops as peanut, cotton and other oil-bearing seeds to prevent fat starvation among its people. Hydrogenation of oils is another example of the efficiency of catalysts. The difference between certain liquid fats or oils and the hard fats like lard is, chemically speaking, an atom or two of hydrogen in each molecule. To add this hydrogen was not so simple, but eventually it was found that the heated oil passing concurrently to a stream of hydrogen in the presence of nickel, the catalyst, took up this hydrogen in the proper form and upon cooling a hard fat resulted. Sixty million pounds of such fat were made by a single plant in the United States in 1922. It has meant an increase in the value of many oils which have thus been elevated from technical to food uses, leaving a place in turn for cheaper oils which, after hydrogenation, have become suited to be their successors.

No one doubts that power in the future will rest very largely with that nation which controls such sources of energy as petroleum or the materials from which future fuels may be made. The utilisation of the constituents of petroleum depends upon chemistry. Scientists have for some time been conducting research on possible substitutes for petroleum, and in Germany $5,000,000 has already been invested in research designed to produce a method for making liquid fuel from coal by hydrogenation and chlorination. Intensive work is under way in the United States on improved methods for cracking off those parts of petroleum which are suitable for internal combustion motors, and at last the automotive engineer is directing his attention to more efficient forms of motors with which available stocks and possible future supplies of liquid fuel may be profitably used.

All over the world people have been looking to alcohol as a source of energy. The problems are economic rather than technical, and depend to a large extent on our ability to find cheap annual crops sufficiently rich in starch or the type of cellulose that can be converted into fermentable sugars to produce cheap alcohol. Coal may become essential to motor-driven vehicles, for the production of gas, benzol by-products and electricity, and the opinion has been ventured that hydro-electric power may be called upon to furnish the energy for electric motor vehicles. The desire to use high compression engines has introduced the great problem of so-called anti-knock compounds, and here again the chemist is working hand-in-hand with the engineer.

The internal combustion motor must also be considered in the light of what our future source of food may be. Many expect the tropics eventually to feed the world. The motor may be looked upon as a means by which man may overcome the tropics, so that this whole problem of fuel and food which lies at the very basis of all civilisation may be directly concerned in tropical agriculture.

In the War of the Revolution opposing forces are said to have held their fire till they could see the white of the combatants' eyes. By the time of the Civil War the range had lengthened, but firing was often point-blank, and in the Spanish-American War 60,000 yards was the maximum graduation required on the range finders. Now it is the horizon which must be within the measurement of the larger range finders, and we have gone on to sound ranging, observation balloons and data secured by the airplane. In all this distance work optical instruments are essential, and for their manufacture ordinary glass will not do.

Not so long ago a single nation controlled the production of the finer grades of optical glass, and was successful in discouraging its attempted manufacture elsewhere. The shortage of glass early in the world war was a really serious affair, and alarming consequences might have resulted. However, optical glass is a chemical product, and American chemists overcame the handicap. Glass makers of long experience marvel that these scientifically trained men became familiar with and solved production problems so quickly. Early in the work chemists who had specialised in the chemistry of the silicates were able to evolve a diagram from which they could predict the physical characteristics of glass from its predetermined chemical composition. When this work had been demonstrated as successful, there was no longer any difficulty in obtaining the co-operation of experienced makers, with the result that no finer glass has ever been produced than that made in the United States.

From the earliest times disease has been an overwhelming factor in international relations. It is now thought that the Aztecs were conquered not by the Europeans but by the smallpox which the Europeans brought with them. Greece and Rome fell before malaria, and in our own day the Panama Canal became possible only when disease was conquered. The white man can never realise on the wealth of the tropics until ways are found for protecting him from numerous tropical fevers and diseases. Perhaps in no war were such great pains taken to protect and keep normal the health of the forces both in the field and at home as was the case in the world war. Scientific reports now state that, recognising what a mighty host medicine is, our former enemies proposed to secure and hold for themselves the key to tropical Africa by means of a certain remedy. This chemical compound has given encouraging results with tropical diseases, particularly fevers, and it was proposed to make this remedy available to the people of other nations only on terms which required the restoration of lost colonies. Modern sanitation and preventive medicine make many an outpost tenable which otherwise could not be held, and constantly extend to the ends of the earth the influence of those nations which have seen to it that their scientific development has not been allowed to lag.

Chemical warfare, a development forced upon the world through the acts of a single nation, is capable of becoming the most feared, humane, efficient, and financially economical military weapon. Despite treaties and prejudices, it remains one of the few outstanding factors of to-day in its influence upon world relations. It places a premium upon intelligence, for in chemical warfare it is the intelligent who are best able to defend themselves and attack the enemy. It is in a large measure a leveller of nations, since a small country efficient in chemical warfare is more than a match for a great country unprepared.

The products of peace-time research are knowledge, skill, and technical perfection, which present no storage problems and find their healthful exercise, not in playing at war nor in its foment, but in the chemical industry. The relation of research to sanitation, the destruction of insects, rodents and other pests, and the importance of developing a real centre for toxicological information are obvious. Many opponents of chemical warfare are to be found; but, the world over, it is recognised that the nation which knows most of the fundamental science, chemistry, upon which defensive and offensive chemical warfare rests, may some day dictate international policies.

Electrometallurgical products have not been without a part in these international relations. Without European magnesite for the linings of steel furnaces, it might have been difficult to produce ferrous alloys to the exacting specifications of the war period. But we learned how to use American linings, and, thanks to success in the production of artificial graphite, there was no difficulty in providing huge electrodes for steel furnaces with a uniform quality and the dependable characteristics which were essential. Ferrochromium, necessary in armour-plate production, is also used in making projectiles. Ferrosilicon is an essential for basic open-hearth steel production, which makes up the greatest part of our steel output. Without ferrosilicon we could make no sound steel castings nor shrapnel. Without ferrotungsten and the other tool-steel alloys, our munition production would have been in a sad plight, for it is with such steel that a lathe which has been using high carbon steel can be made to nearly triple its output. Calcium carbide, from which acetylene is produced, became important in the last war in an unexpected way, for this acetylene became the source of solvents which heretofore had only been made by the distillation of certain hardwoods. To-day the electric furnace is being turned to many other production problems, including phosphoric acid from the phosphate ores and a process for sodium carbonate which may eventually displace those now so well established.

A discussion of this sort would be far from complete without reference to rubber, used in insulation, which is so necessary for modern methods of communication and in many parts of modern transportation systems, as well as for weather, water, and wind-proofing. For balloon fabrics, gas-masks, and scores of other items it is essential. Whilst there is probably no country in which the manufacture of rubber products has been developed more extensively than in the United States, the centre of crude rubber production has shifted from the western hemisphere to the eastern, and American manufacturers are now not only without sources of crude rubber controlled by them, but have no facilities for training men to perform the special task of managing and developing rubber plantations. Certainly no industry can allow this condition to continue, for rubber as an item of world importance can no longer be ignored. The synthesis of artificial rubber must also be developed. One of the latest contributions of chemistry to the rubber industry has been the development of organic accelerators. With these organic compounds vulcanisation can be carried on in something like 20 per cent. of the time formerly required, so that a given vulcanisisng department can now support the requirements of a plant at least twice the size formerly possible.

In view of the fundamental research now in progress upon the structure of the atom and the molecule, it is not unreasonable to believe that the chemist will have obtained the skill which will enable him to produce uniformly and in quantity the types of molecules specified. When the physician understands what is required to combat a new form of disease or to overcome an old one, he may, and before long, specify to the research chemist the type of molecule which will be efficient in overcoming it. This does not seem so visionary when we remember that we already have available many wonderful medicines and remedies, the counterpart of which is not found in Nature, and that we have indeed set up, as in the use of mercurial and arsenic compounds, a molecule that will conquer the organism invading the body without disturbing that extremely delicate balance which characterises the human being.

The contributions of science, and particularly of chemistry, have been the means by which we have made our world grow smaller. Through modern methods of communication and transportation we have become near neighbours to nations which formerly were so far away as to seem to be on another star. In the short space of a hundred years developments in electricity and a little knowledge of the radioactivity of matter have produced wireless telegraphy and telephony. With an increase in our knowledge of how to make energy available, and how to apply it efficiently, has come a speeding up of all kinds of transportation. Pure and applied science has gone a long way towards eliminating time and distance in international affairs, and in consequence the peoples of this world must learn to live closer together. Perhaps this also may be accomplished through science and scientific men. Their labours make life easier, more profitable, and longer. These fruits cannot be fully enjoyed in the midst of turmoil.

All this is but a part of the story—just a few illustrations of what chemistry does to justify the designation of a " key to international relations." The safety of a country's world position and its influence in international relations may indeed be measured by the degree to which fundamental research is fostered, science applied in the solution of industrial problems, and by the extent to which its people generally appreciate the significance of chemistry.

In most respects the signs of the times are encouraging. While at the moment our facilities for trained men exceed the demand for them, yet support is being given pure research. Our university and college equipment is being greatly improved, so that North America may assume world leadership in fundamental research. Industries are also turning to science. More than forty trade associations in the United States include research in their programme of activity. Military establishments realise that no treaties forbid the acquirement of knowledge, which is the really vital factor in defence. For the sake of a peaceful future, it behoves all peaceful nations to make an ally of chemistry and of all science. Perhaps science can succeed where other means have failed in stabilising world affairs.

History is replete with examples of nations which have tried all manner of physical means to exclude the rest of the world and grew strong within their own boundaries. Superior intelligence has usually been the overpowering force. The Great Wall of China, which held for centuries, is but a line on the landscape to the airplane developed by science. Blockades by land and sea have been made ineffective by science within. Natural barriers, such as mountain ranges and the sea, are overcome, while the power inherent in natural resources is minimised by the synthesis of the laboratory.

More and more the key to international relations and national prosperity becomes superior knowledge to be obtained only through the encouragement of invention and the support of fundamental research in the sciences. As ever, " knowledge is power," and science ever calls upon those who appreciate her to undertake the accomplishment of the impossible.

THE ELECTRON THEORY OF VALENCY APPLIED TO CO-ORDINATION COMPOUNDS

By C. H. SPIERS, M.A., B.Sc.

The present writer has been engaged in a study of co-ordination compounds for a considerable time, and some months back he arrived at a theory of their structure which appears to be the same as that advanced by Professor Lowry in *Chemistry and Industry*, March 29, 1923, p. 316. That is to say, he came to the conclusion that the formation of complex ions was the expression of the tendency of the central atom to increase the number of electrons in its outer layer to the number in the outer layer of the inert gas immediately following. It achieves this by sharing one pair of electrons with :—(1) Groups or atoms which are one electron short of completion—*e.g.*, Cl, CN, NO_3, NO_2, $\frac{1}{2}$ (SO_4), $\frac{1}{2}$ (OOC.COO), etc., thereby gaining one electron for each group or atom held. (2) Molecules which have a separate existence—*e.g.*, NH_3, H_2O, CO, NO, etc., thereby gaining two electrons for each molecule held.

Thus, in $K_2[PtCl_6]$, the platinum atom with 24 electrons in its outer layer, gains two electrons from two potassium atoms and six electrons from six chlorine atoms, by sharing a pair of electrons with each. The platinum atom thus completes its shell to 32. In $[Co(NH_3)_6]Cl_3$, the cobalt atom, with 9 electrons in its outer layer, loses three electrons to three chlorine atoms, and acquires 12 electrons by sharing one pair of electrons with each of six ammonia molecules. It thus completes its shell to 18. This is Lowry's view, but it is somewhat different from that of Langmuir (*J. Am. Chem. Soc.*, 1919, **41**, 868.)

This simple theory does not, however, account for all the facts satisfactorily, and the writer therefore did not desire to publish his views until he had made a further study of the problem, and had made some attempt to overcome the various difficulties.

Several points in Professor Lowry's article may require comment. If the equation expressing the reducing action of $K_4[Co(CN)_6]$ is written ionically thus,

$$4K^+ + \left[Co(CN)_6\right]^{----} + H^+ + Cl^- =$$

$$4K^+ + \left[Co(CN)_6\right]^{---} + Cl^- + H$$

it will be seen that the potassium plays no part—it is not reasonable to say " the surplus atom of potassium in potassium cobaltocyanide therefore behaves almost as if it were in the metallic state, and is almost ready to decompose water like metallic potassium, in the effort to get rid of an unwanted electron." The reducing action is due to the complex anion. The formula suggested for potassium ferrioxalate is not altogether satisfactory, since it does not express the different behaviour of the iron and potassium with regard to ionisation.

It is necessary to decide whether to build the theory upon complex ions which exist in solution, or upon those which exist in the solid state. Werner, in his classical work, deals with co-ordinatively saturated complexes, without considering the conditions under which they exist. In the solid state we have $\left[Ni(NH_3)_6\right]^{++}$, $\left[Cu(NH_3)_6\right]^{++}$, and $\left[Zn(NH_3)_6\right]^{++}$, in which, on the present theory, the central atoms acquire outer layers of 20 (10—2+12), 21 (11—2+12), and 22 (12—2+12) electrons, respectively. They all readily lose ammonia. Ammoniacal nickel solutions contain mainly $\left[Ni(NH_3)_4\right]^{++}$ and $\left[Ni(NH_3)_5\right]^{++}$, although we must presume $\left[Ni(NH_3)_6\right]^{++}$ to be also present, since its salts can be crystallised from solutions containing excess of ammonia. Ammoniacal copper and zinc solutions contain only the tetrammine ion, and the salts of the hexammine ion cannot be crystallised from solution. On the whole it seems reasonable to base a theory on complex ions which are known to exist in solution. The existence of ions, such as the above, which contain an excess of electrons, may be explained by the stabilising influence of the solid state (*cf.* dynamic isomers). It is, of course, of great importance that Werner's theories should be tested by the investigation of crystals of complex salts by X-rays. Wyckoff has already obtained some confirmatory evidence.

As Lowry shows, certain complex ions exhibit a shortage of electrons and, in some cases, these are remarkably stable. It was felt that this stability was inconsistent with such a deficiency. It is now suggested that the innermost pair of electrons, both of the central atom and of the co-ordinated atoms or groups, may be utilised to help the completion of the shell of the central atom (*cf.* Eastman, *J. Am. Chem. Soc.*, 1922, **44**, 438). This hypothesis reduces the number of incomplete shells to a very small number. In general those complex ions whose shells are completed with the aid of these innermost electrons are less stable than those completed without, and those completed with the aid of one of the inner electrons are not so stable as those completed with two. There are no nickel salts of the type, $K_2Ni(X)_6$ corresponding to the salts, $K_2Pt(X)_6$, because nickel does not give Ni^{++++}. We should expect nickel to give $K_3Ni(CN)_5$(18) instead of $K_2Ni(CN)_4$, (16 or extended 18), but apparently complexes containing the unsymmetrical arrangements of 5 and 7, are seldom formed (*cf.*, however, complex halogen salts). When the inner electrons of the central atom are used in assisting the completion of its outer layer, the positive charge of its kernel is increased. This will help to stabilise the complexion.

The assumption, that an atom completes its shell to that of the inert gas immediately following, is not sufficient. It is necessary to assume that, under certain circumstances, an atom will complete its shell to a higher or a lower stable number. Thus, titanium (2, 8, 8, 4) in H_2TiO_3 probably completes its outer layer to 8 instead of 18 (*cf.* H_2CO_3). Uranium (2, 8, 8, 18, 18, 6), in $\left[\begin{matrix}O_2\\UF_5\end{matrix}\right]K_3$, probably achieves an 18 instead of a 32. Copper and silver form compounds $\left[\begin{matrix}I_2\\Cu(S_2O_3)_4\end{matrix}\right](NH_4)_9$ and $\left[\begin{matrix}I_2\\Ag(S_2O_3)_4\end{matrix}\right](NH_4)_9$, in which the central atom completes to 32 instead of 18. {11 (Cu)+9(NH_4)+2 (I_2)+8 (S_2O_3)+2 (inner)=32.}

According to the present theory, the ammonia in an ammine has a definite link with the central atom. If this is so, it should be possible to resolve an ammine containing an odd number of molecules of a tertiary amine, $NR_1R_2R_3$. Another suggested test of the theory is pointed out below. The writer hopes shortly to investigate these points experimentally.

Cyanides.—In the table below, 32 complex cyanides of 20 metals are set out. All of them exist in solution. Twelve achieve the complete layer, three are one electron short, eleven are two short, two are three short and three are four short, while one has an electron in excess. The fourth column contains the number of electrons in the outer shell of the central atom, assuming that one or both of the inner electrons are utilised. Under these conditions 26 cyanides achieve a complete shell. The utilisation of one electron is not satisfactory, since it leaves a single electron near the kernel. Thus, the ions, $\left[Fe(CN)_6\right]^{---}$ and $\left[W(CN)_8\right]^{---}$ (17 or extended 18, and 31 or extended 32) readily pick up an electron giving $\left[Fe(CN)_6\right]^{----}$ and $\left[W(CN)_8\right]^{----}$ (18 and 32). The ion, $\left[Mn(CN)_6\right]^{----}$ (17 or extended 18), by gaining one electron, would form $\left[Mn(CN)_6\right]^{-----}$. This is not possible, since Mn^+ does not exist. Hence it loses an electron giving $\left[Mn(CN)_6\right]^{---}$ (16 or extended 18). $\left[Cr(CN)_6\right]^{---}$ (15 or extended 17) does not pass into $\left[Cr(CN)_6\right]^{----}$ (16 or extended 18) owing to the instability of Cr^{++}. The cyanide ions completed with the aid of two electrons do not usually change by acquiring electrons, which alters the valency of the central atom. They sometimes attract another cyanide ion, thereby gaining two electrons. The five incomplete ions, except chromium, very readily undergo change.

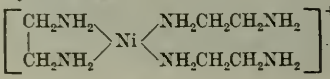
TABLE I

Element		Complex salt		No. of electrons in outer layer on simple hypothesis		No. of electrons in outer layer utilising inner electron
Vanadium (5)	..	$K_3V(CN)_6$	..	14	..	16
Chromium (6)	..	$K_3Cr(CN)_6$*	..	15	..	17
		$K_4Cr(CN)_6$	..	16	..	18
Manganese (7)	..	$K_3Mn(CN)_6$*	..	16	..	18
		$K_4Mn(CN)_6$	..	17	..	18
Iron (8)	..	$K_3Fe(CN)_6$	..	17	..	18
		$K_4Fe(CN)_6$*	..	18	..	18
Cobalt (9)	..	$K_3Co(CN)_6$*	..	18	..	18
		$K_4Co(CN)_6$	..	19	..	19
Nickel (10)	..	$K_2Ni(CN)_4$	..	16	..	18
Copper (11)	..	$K_2Cu(CN)_3$	..	16	..	18
		$K_3Cu(CN)_4$	..	18	..	18
Zinc (12)	..	$NaZn(CN)_3$	..	16	..	18
		$K_2Zn(CN)_4$	..	18	..	18
Molybdenum (6)	..	$K_4Mo(CN)_8$	..	18	..	18
Ruthenium (8)	..	$K_4Ru(CN)_6$	..	18	..	18
Rhodium (9)	..	$K_3Rh(CN)_6$	..	18	..	18
Palladium (10)	..	$K_2Pd(CN)_4$	..	16	..	18
Silver (11)	..	$KAg(CN)_2$	..	14	..	16
		$K_2Ag(CN)_3$*	..	16	..	18
Cadmium (12)	..	$NaCd(CN)_3$	..	16	..	18
		$K_2Cd(CN)_4$*	..	18	..	18
Tungsten (20)	..	$K_3W(CN)_8$	..	31	..	32
		$K_4W(CN)_8$*	..	32	..	32
Osmium (22)	..	$K_4Os(CN)_6$	..	32	..	32
Iridium (23)	..	$K_3Ir(CN)_6$	..	32	..	32
Platinum (24)	..	$KPt(CN)_4$	..	29	..	31
		$K_2Pt(CN)_4$*	..	30	..	32
Gold (25)	..	$KAu(CN)_2$	..	28	..	30
		$KAu(CN)_4$	..	30	..	32
Mercury (26)	..	$KHg(CN)_3$	..	30	..	32
		$K_2Hg(CN)_4$	..	32	..	32

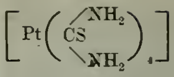
The number after the name of the element denotes the number of electrons in its outer layer. Where an element gives more than one complex, the stabler is marked by an asterisk. It is not always possible to decide this point satisfactorily.

Complexes Containing Ammonia and Nitrogen Bases

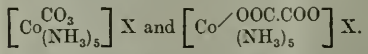
Table II. contains 17 complex ions which exist in solution in pure water. Nine have ordinary complete shells, six have complete "extended" shells, and two, silver and chromium, incomplete "extended" shells. Here, again, chromium gives a remarkably stable complex. Although nickel does not form a stable ion $\left[Ni(NH_3)_6\right]^{++}$, it nevertheless gives stable ions $\left[NiEn_3\right]^{++}$ and $\left[NiPn_3\right]^{++}$, whose salts can be crystallised from hot water. These salts have not been resolved into optical antipodes, though the corresponding salts of some other metals have been resolved. It is suggested that two of the diacid base molecules may be held by one nitrogen atom only. The co-ordination number of the nickel would then be four as in the cyanide. The ion $\left[NiEn_3\right]^{++}$ may be written



$$\left[\begin{matrix}CH_2NH_2 \\ | \\ CH_2NH_2\end{matrix}{>}Ni{<}\begin{matrix}NH_2CH_2CH_2NH_2 \\ \\ NH_2CH_2CH_2NH_2\end{matrix}\right]^{++}.$$

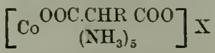


In $\left[Pt\left(CS{<}\begin{matrix}NH_2 \\ NH_2\end{matrix}\right)_4\right]X_2$, we have one molecule of a diamide occupying one co-ordination position instead of two. There are also cases where dibasic acid residues occupy only one co-ordination position—*e.g.*,



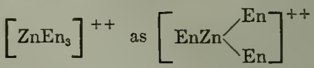
$$\left[Co\begin{matrix}CO_3 \\ (NH_3)_5\end{matrix}\right]X \text{ and } \left[Co{\diagup}\begin{matrix}OOC.COO \\ (NH_3)_5\end{matrix}\right]X.$$

In these latter, the cobalt atom gives up one electron to the halogen atom and one to the unattached oxygen atom. If a residue such as OOC.COO is held thus, we might expect a compound



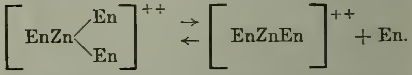
$$\left[Co\begin{matrix}OOC.CHR\ COO \\ (NH_3)_5\end{matrix}\right]X$$

to be capable of resolution. It would, therefore, be of interest to investigate a compound of this type. Perhaps we may also write



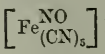
$$\left[ZnEn_3\right]^{++} \text{ as } \left[EnZn{<}\begin{matrix}En \\ En\end{matrix}\right]^{++}$$

This is weakly alkaline in aqueous solution doubtless owing to the change,



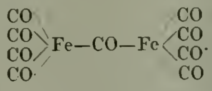
$$\left[EnZn{<}\begin{matrix}En \\ En\end{matrix}\right]^{++} \rightleftarrows \left[EnZnEn\right]^{++} + En.$$

Ruthenium forms compounds in which a molecule of NO shares a pair of electrons with the central atom and contributes two to its shell. This also occurs in such compounds as

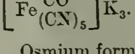


$$\left[Fe\begin{matrix}NO \\ (CN)_5\end{matrix}\right]Na_2. \text{ (extended 18).}$$

Carbon monoxide is similarly held in the carbonyls. It should be pointed out that Mond and Wallace, (*T.* 1922, 121, 29) ascribe to molybdenum carbonyl the formula $Mo_5(CO)_{26}$, but such a formula is not probable from the point of view of the present theory. We can write $Fe_2(CO)_9$ as



This would account for its decomposition into $Fe(CO)_5$ and CO and Fe, on being heated to 100° C. and into $Fe(CO)_5$ and $Fe(CO)_4$ on being heated to 95° C. in solution. There are also other types of substances containing CO—*e.g.*,



$$\left[Fe\begin{matrix}CO \\ (CN)_5\end{matrix}\right]K_3.$$

Osmium forms a complex in which two atoms of oxygen occupy two co-ordination positions. They each contribute two electrons to the shell of the central atom. The modes in which this may occur are discussed below.

The readiness with which ammoniacal silver solutions are reduced can be accounted for on the present theory. $\left[Ag(NH_3)_2\right]^+$ has only 16 electrons even using the two inner electrons of the silver atom. It is therefore very unstable and tries to pick up electrons, if possible, from OH ions, for example. This occurs very readily in the presence of an oxidisable substance. Thus :—

$$2\left[Ag(NH_3)_2\right]^+ + 2(OH)^- = 2\left[Ag(NH_3)_2\right] + H_2O + O.$$

The complex, having taken up one electron, becomes electrically neutral, and therefore decomposes into silver and ammonia. A similar explanation accounts for the ready reduction to cuprous oxide of the complex copper anions in, say, Fehling's solution.

TABLE II

Element	Complex salt	No. of electrons in outer layer on simple hypothesis	No. of electrons in outer layer utilising two inner electrons
Chromium (6) ..	$[Cr(NH_3)_6]X_3$	.. 15	.. 17
Iron (8) ..	$[Fe(Dipy)_3]X_2$*	.. 18	.. 18
	$[Fe(Dipy)_3]X_3$	.. 17	.. 18
Cobalt (9) ..	$[Co(NH_3)_6]X_3$	.. 18	.. 18
Nickel (10) ..	$[Ni(NH_3)_5]X_2$	.. 18	.. 18
	$[Ni(NH_3)_4]X_2$	.. 16	.. 18
Copper (11) ..	$[Cu(NH_3)_4]X_2$	.. 17	.. 18
Zinc (12) ..	$[Zn(NH_3)_4]X_2$	.. 18	.. 18
Ruthenium (8)..	$\left[\begin{matrix}NO\\ ClRu(NH_3)_4\end{matrix}\right]X_2$	17	.. 18
Rhodium (9) ..	$[Rh(NH_3)_6]X_3$	.. 18	.. 18
Palladium (10)..	$[Pd(NH_3)_4]X_2$	.. 16	.. 18
Silver (11) ..	$[Ag(NH_3)_2]X$	.. 14	.. 16
Cadmium (12) ..	$[Cd(NH_3)_4]X_2$	.. 18	.. 18
Osmium (22) ..	$\left[Os^{O_2}_{(NH_3)_4}\right]X_2$	.. 32	.. 32
Iridium (23) ..	$[Ir(NH_3)_8]X_3$	.. 32	.. 32
Platinum (24) ..	$[Pt(NH_3)_4]X_2$	.. 30	.. 23
	$[Pt(NH_3)_6]X_4$	.. 32	.. 23

Dipy= *aa′* dipyridyl.

Oxyacids

Langmuir has dealt satisfactorily with many oxyacids. However, he meets with difficulties in the case of such compounds as the manganates. According to the usual theory, in the oxyacids, oxygen is held to the central atom in one of two modes, viz. :—

(1) By sharing one pair of electrons with it, as in H_2SO_4.

(2) By sharing two pairs of electrons with it, as in HNO_3.

In all cases the central atom completes its shell to 8. In the series commencing with potassium we should expect to find a tendency to complete the shell to 18, as in the cases of the complex cyanides and ammines. It is reasonable to suppose that an element, such as titanium, which has but four electrons towards its 18, may not be able to acquire enough electrons to complete its shell. We can therefore suppose that H_2TiO_3 has a structure similar to that of H_2CO_3—*i.e.*, the titanium atom achieves an 8 layer. Vanadium, as we have seen, achieves a layer of 16 in its complex cyanide, $K_3V(CN)_6$. In the case of H_3VO_4 we can choose between a structure analogous to that of H_3PO_4 (8 layer) and a structure in which the oxygen atoms share two pairs of electrons with the vanadium atom, which thus acquires a shell of 18 (with the help of the two inner electrons of the vanadium atom). The acid HVO_3, which forms colourless ions, can only be represented on an 8 basis.

It seems necessary to assume structures, for the oxyacids of the elements from vanadium, different from those of the elements of the previous series because (*a*) colour begins to manifest itself in the third series with the vanadium oxyacids. The titanate ion (8 shell) is colourless. The chemistry of the vanadate ions is very complicated. It appears that there are colourless and coloured ions. Probably in the colourless ions, we may assume that the vanadium atom completes its shell to 8 in a manner comparable with the elements of the first two series, while in the coloured ions it completes its shell to 18. In the succeeding elements, which give coloured ions only, an 18 shell is built up.

TABLE III

Element		Oxyacids		No. of electrons in outer layer on basis of above theories
Titanium (4)	..	H_2TiO_3	..	8
Vanadium (5)	..	HVO_3	..	8
		H_3VO_4	..	18
Chromium (6)	..	H_2CrO_4	..	18
		H_3CrO_8	..	18
		H_3CrO_7	..	18
		$HCrO_5$	..	17
Manganese (7)	..	$HMnO_4$	..	18
		H_2MnO_4	..	18
Iron (8)	..	H_2FeO_4	..	18
Cobalt (9)	..	$H_2CoO_3(_3)$	..	18
Zinc (12)	..	H_2ZnO_2	..	18

(*b*) On the assumption that an 8 shell is built up, we cannot explain all the complex ions which are formed by the metals of the third series after titanium. On the basis of the 18 shell, we can explain all these ions by one hypothesis. Besides the above two modes whereby oxygen atoms may be held to the central atom, there is a third way—viz., (3) the oxygen atom may complete its outer layer to 8 by utilising its two inner electrons, and may then share a pair of electrons with the central atom, thereby contributing two electrons to its shell. In this mode of linking, the central atom gains just as many electrons as in mode 2, but there is the difference that more of the electrons of the central atom are left free to bind other oxygen atoms by mode 1.

Possibly mode 3 is to be preferred over mode 2, since this conception enables the highly oxygenated chromium complexes to receive explanation. In $\left[CrO_8\right]^{---}$ $\left[CrO_7\right]^{---}$ and $\left[CrO_5\right]^{-}$

we have four oxygen atoms held according to mode 3 and contributing 8 electrons, and 4, 3 and 1 atoms respectively, held by mode 1 and contributing no electrons. The fact that $\left[ZnO_2\right]^{--}$ is colourless needs some further hypothesis. Table III exhibits the oxyacids of some of the metals of the third series.

Halides

It is not often clear whether a metal forms true complex ions of any degree of stability with the halogens. We find the term " double salt " used more often than the term " complex salt " in describing compounds of the metals with the halogens. However, whatever the nature of these compounds may be, their formulæ usually correspond with those of the cyanides. The complex fluoride, H_2SiF_6, can be explained in terms of the present theory thus. Possibly here the fluorine atoms complete their outer layers to 8 by the help of one inner electron and then share two electrons each with the central atom, thereby contributing 12 electrons to its shell. These together with 2 electrons from the hydrogen atoms and 4 from the silicon atom make up 18 electrons round the silicon kernel. A similar explanation holds for K_3AlF_6.

INTERNATIONAL MINING EXHIBITION

The following papers will be read at the Oil Conference to be held at the Sixth International Mining Exhibition from June 4 to 8, 1923 :—

Monday, June 4, *a.m.*—" The Riddle of the Carpathians " (Opening Address), by E. H. Cunningham Craig, B.A., F.R.S.E., F.G.S., M.Inst.P.T. " Oil Deposits and the Tectonics of Vertical Pressure," by Dr. Maxmilian Kraus.

Monday, June 4, *p.m.*—" Note on the Genesis of Hydrocarbons and their Localisation in certain Zones of the Earth's Crust," by R. d'Andrimont.

Tuesday, June 5, *a.m.*—" Oilfield Waste," by A. Beeby Thompson, O.B.E., M.I.Mech.E.

Thursday, June 7, *a.m.*—" The Mode of appearance of the Petroleum Deposits in the Carpathian Region, with general consideration on the Genesis of the Petroleum and the Source of the Actual Deposits," by J. Voitasti, Professor, Cluj University.

Thursday, June 7, *p.m.*—" An Economic Study of Petroleum Mining by Underground Drainage," by Major J. A. Lautier, M.Inst.P.T.

Friday, June 8, *a.m.*—" The Standardisation Movement in America and its relation to and application towards the Elimination of Waste in the Petroleum Industry," by O. A. Young and S. D. Tuthill.

Friday, June 8, *p.m.*—" The Caribbean Oil Region," by George Howell, F.G.S., F.R.G.S., M.Inst.P.T.

THE DETERMINATION OF PARA-AMIDOPHENOL IN THE PRESENCE OF METOL

By W. F. A. ERMEN

In the course of our investigations on the preparation of metol (*cf. Chem. and Ind.*, May 18, 1923, p. 486), it was necessary to know the amount of this substance formed and the percentage of unaltered amidophenol and other bodies present in the mixtures.

The method we employed at first was to treat a dilute solution of our sample with excess of sodium acetate and benzaldelhyde. The benzylidene-amidophenol formed was filtered off, washed with a little cold alcohol, dried and weighed. With pure para-amidophenol the results obtained were very satisfactory, but for mixtures the process proved unreliable. It also failed to differentiate between metol and dimethyl amidophenol.

The method finally adopted was one suggested by Mr. L. E. Vlies :—About 2 grams of the sample is dissolved in 100 c.c. of water, with excess of hydrochloric acid, and N/10 sodium nitrite added until free nitrous acid can be detected. The amidophenol is thus diazotised and the metol converted into the corresponding nitrosamine, which slowly separates as white crystalline hairs. Sodium acetate is next added, followed by a known excess of metaphenylenediamine. This couples with the diazotised amidophenol, but does not affect the metol nitrosamine. The coupling process is rather slow, but may be accelerated by warming the mixture to about 25° C. When completed, the mixture is once more cooled, and the excess of metaphenylenediamine titrated back with a normal solution of freshly-prepared diazobenzene. Knowing the amount of diazobenzene required for the total quantity of metaphenylenediamine added, the difference between this and the quantity required for the titration of the sample gives the quantity that has been taken up by the amidophenol present. The total nitrite used for the first titration, less that required for the amidophenol found, gives the proportion of metol present. Dimethylamidophenol, if present, is not determined: sym. dimethylparaphenylenediamine reacts like metol, and will introduce a serious error if not previously removed by thorough washing of the sample with alcohol, in which the sulphate of this body is readily soluble.

The results obtained by this method are accurate to within 1 per cent., and a complete titration can be carried through in about half an hour.

* * *

On June 14. Professor Moureu will deliver an address on " Les Gazes Rares des Sources Thermales des Grisous et Autres Gazes Naturels," before the Chemical Society, at Burlington House, Piccadilly, W. 1. The address will be given at 8.30 p.m., not 8 p.m.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

THE NEW PRIME MINISTER

probably knows more about Chemical Industry than any former occupant of the office, and with the exception of Sir Alfred Mond, probably more than any other past or present Minister of the Crown. While President of the Board of Trade, Mr. Baldwin, with that thoroughness which has characterised all his public work, made a careful study of the position of the industry in this country in connexion with the Dyestuffs Act and the Safeguarding of Industries Act. He is one who misses no opportunity to make himself acquainted with the details of any industry, and both in the smoking room at the House of Commons, and at the Board of Trade he made constant inquiries as to the progress being made in this country. Some readers of these notes will also remember that he attended the annual dinner of the Association of British Chemical Manufacturers last year, and I am told that he put some very pertinent questions to his hosts. We cannot be satisfied that we have educated the public as to the importance of the industry until all our legislators as well as the general public are made to understand the facts of the case.

I OFTEN WONDER

how to estimate the value of publicity. It is a most interesting speculation. One thinks of the time when a restrained and dignified advertisement was all that could be considered useful; then of the growth of the shop window, the hoardings, the illuminated signs and sky-writing by aeroplanes. Of recent years publicity has become more subtle, and I suppose nothing has ever been attempted comparable with the propaganda carried on during the war; this left a mark on the art of publicity which persisted after the war, and to-day no project of any magnitude can be carried through without the subtle influence of the press. In a way it places more power in the hands of the press than was ever wielded by our most autocratic monarchs in days gone by. It used to be said that the platform would always ultimately beat the press, but I believe this is wrong, and power is with the party that controls the largest number of newspapers. One can only hope that the responsibility placed on the shoulders of the newspaper proprietors will be wisely used.

"CHEMISTRY AND INDUSTRY"

has its part to play in the leading of public opinion. The inspired paragraph in the public press has had its day, and the intelligent members of the public are beginning to discount the sometimes inspired letter to the newspaper. On the other hand, journals which are not too technical in character are being widely read, and are not open to the charge of manufacturing public opinion in the same manner as the daily press. The technical journal is expected to, and does, represent the views of the members of the Society for which it caters; this is honest, though partisan, statement of a case, and as such, the public reads it.

THE UNITED STATES TARIFF COMMISSION

is a body about which, up till now, we have had very little first-hand information. The visit of Mr. De Long, the head of the Chemical Division, and two of his colleagues, is the forerunner of what may prove to be some rather interesting experiences. The President of the United States has the power to vary the Tariff within certain limits on the recommendation of the Tariff Commission when application has been made in due form. Before arriving at any recommendation the Commission has to go through what looks like a very laborious process. First, it is necessary to ascertain the cost of production in competing countries, and obtain from the foreign manufacturer the cost of production in his country. Rather a delicate operation. At first, one would imagine that the Commission would be met with a blank refusal, but in practice this is not found to be the case. I believe those who are responsible for working the tariff in America are only concerned in placing the tariff at such a figure as will give the American manufacturer an even chance in the American market. The Tariff Commission will have, on the one hand, the importer who desires to obtain his goods in the cheapest market, and on the other, the American manufacturer who desires to establish his industry. The Commission must hold the balance between the two. If, therefore, the British manufacturer is likely to be penalised by the raising of the tariff at the request of the American manufacturer, he should be prepared to furnish in strict confidence the necessary evidence which would combat the demand for a raising of the American tariff. I cannot, therefore, see any other course for the British manufacturer to pursue than to state his side of the case, and supplement it with such evidence as is available.

IT IS INTERESTING TO NOTE

in this as in so many other public matters, how like our American cousins are to ourselves in their weaknesses as well as their strength. The cumbersome proceedings under the Safeguarding of Industries Act seem almost simple, when compared with the alterations of the American tariff. Imagine an enquiry with regard to Barium Peroxide, Potassium Chloride, Oxalic Acid and Veronal necessitating a visit to England, Germany, Scandinavia, Holland and Switzerland.

SOCIETY OF CHEMICAL INDUSTRY

THE ANNUAL MEETING

CAMBRIDGE. JUNE 20 TO 23, 1923

Addresses. The title of the President's address to be delivered on Thursday, June 21, is "Chemistry and Industry," and that of Dr. Charles Carpenter's address on the following day is "The Evolution of a Chemical Industry."

Accommodation of Members in Colleges. Accommodation will be available for men in various colleges from the afternoon of Wednesday, June 20, to the afternoon of Saturday, June 23. Members who arrive on Wednesday will be charged an inclusive fee of £3, those arriving on Thursday an inclusive fee of £2. These fees include the use of a set of rooms (bedroom and sitting-room), attendance, gratuities to college servants and the following meals: *Wednesday, June* 20.—Tea (if required) and dinner. *Thursday, June* 21.—Breakfast, lunch and dinner. *Friday, June* 22.—Breakfast, lunch and dinner (if required). *Saturday, June* 23.—Breakfast, and lunch (if required). Members will usually take their breakfasts in their rooms. Luncheon and dinner will be served in the halls of colleges. On Thursday and Friday tea will be served at the Vice-Chancellor's reception, and at the Garden Party at Sidney Sussex College respectively. Members who arrive before five o'clock on Wednesday, and who will require tea, are requested to give notice to that effect on a form to be supplied. There will be no extra charge. Members unable to attend the Annual Dinner of the Society on Friday, and desirous of dining in college that evening, may do so without extra charge by giving notice to that effect on the form above referred to. Members who do not make the trip to Ely, and who require luncheon before leaving Cambridge on Saturday, may obtain it in college on that day without extra charge.

It is important to note that alcoholic drinks are not included in the charges specified above, and members requiring such drinks with their meals must sign a chit presented by the waiter at the time of ordering. Payment for such must be made by members at the office of the Society at the Arts School, Bene't Street, on Saturday, before departure. It is the wish of the college authorities that no money shall change hands at table, and it is hoped that members will kindly co-operate in order that this scheme of payment may be a success.

To the list of colleges offering accommodation given on page 491 of *Chemistry and Industry* of 18th May, Corpus Christi is to be added. As previously stated, men requiring accommodation should communicate with Mr. J. E. G. Harris, the University Chemical Laboratory, Downing Street, Cambridge, who will supply any further information and forward a form to be filled up by the member.

Hotel Accommodation. There are still rooms available at The Bull and at The Blue Boar, but the other hotels are more or less full. There is good accommodation to be obtained in boarding houses (college rooms) should the supply of hotel rooms be exhausted.

The Smoking Concert on June 20 will be held in the dining room of the University Arms Hotel.

Group Photograph. A photograph of the members will be taken at the close of the Annual General Meeting on Thursday, June 21.

Tickets. Tickets for the Smoking Concert, the Reception and Dance, the Annual Dinner, and the excursion to Ely with lunch will be handed to members who have paid the inclusive fee when they register at the office in the Arts School, Bene't Street, Cambridge.

Guide to Cambridge. A copy of the illustrated Guide to Cambridge will be forwarded to each member who has purchased his ticket as soon as supplies are received from the publishers.

News. Further information will be published from week to week in *Chemistry and Industry.*

Members intending to be present at the meetings are asked to send in their forms with the appropriate remittance as soon as possible if they have not already done so, in order that adequate arrangements may be made for them.

Nominations to Council.—The following have been nominated under By-law 24 to fill four vacancies among the ordinary members of Council: Professor P. Phillips Bedson, Dr. R. T. Colgate, Mr. William Cullen, Professor A. R. Ling, Dr. Joseph Reilly, and Dr. E. W. Smith. A ballot list has been posted to every member entitled to vote.

J. P. Longstaff,
General Secretary

Central House,
Finsbury Square, E.C.2

ADVANCE PROOFS OF PAPERS

Authors of papers which are to be read before local sections or groups, may in some cases desire to have a few advance proofs for distribution among those likely to make useful contributions to the discussion. Any author who requires such advance proofs is requested to hand the manuscript of his paper to the Local Secretary so that it may reach the Editor at least *one month* before the date of the meeting at which it is to be read, in order to allow sufficient time for it to be considered by the Publications Committee and, if approved, set up in type.

UNION INTERNATIONALE DE LA CHIMIE PURE ET APPLIQUÉE

The programme provisionally arranged for the meeting of the International Union, to be held in Cambridge from June 16 to June 20, is given below :—

Saturday, June 16

Arrival of Delegates.

Sunday, June 17

4 p.m.—Reception by Sir Charles and Lady Walston at Newton Hall.

9 p.m.—Reception of the Delegates by the President and the British Federal Council.

Monday, June 18

10 a.m.—Council Meeting.

11 a.m.—General Meeting.

2.30 p.m.—Committee Meetings.

4.30 p.m.—Full Session. Presentation and discussion of a Report by Prof. J. W. McBain, "The Nature of Soap Solutions."

9 p.m.—Reception of the Union by the Master of Sidney Sussex College and Mrs. Weekes. Music.

Tuesday, June 19

10 a.m.—Council Meeting.

10.30 a.m.—Committee Meetings.

12 noon.—Presentation and discussion of a Report by Dr. E. K. Rideal, "Recent Developments in Contact Catalysis."

2.30 p.m.—Committee Meetings.

5.30 p.m.—Presentation and discussion of a Report by Prof. J. F. Thorpe, "New Aspects of Tautomerism."

Tea will be served in the gardens of Sidney Sussex College during the afternoon.

8 p.m.—Annual Dinner of the Union in the Hall of Trinity College.

Wednesday, June 20

10 a.m.—Council Meeting.

11 a.m.—Presentation and discussion of a Report by Prof. F. G. Hopkins, "Chemical Mechanisms Involved in the Oxidations which Occur in Living Tissues."

2.30 p.m.—General Meeting.

4 p.m.—Honorary Degrees. Ceremony at the Senate House.

5 p.m.—Reception by the Vice-Chancellor of the University at the Fitzwilliam Museum. Tea.

In addition to the British members of the Council of the Union Internationale the British Delegation will include, amongst others, Professors G. Barger, A. W. Crossley, H. B. Dixon, F. S. Kipping, J. W. McBain, J. F. Thorpe, Sir R. Robertson, and Messrs. E. F. Armstrong, E. R. Bolton, F. H. Carr, A. Chaston Chapman, A. Harden, J. A. Harker, T. H. Henry, C. T. Heycock, H. F. E. Hulton, C. A. Mitchell, R. H. Pickards, E. K. Rideal, E. W. Voelcker and W. J. U. Woolcock.

MEETINGS OF OTHER SOCIETIES

ACADÉMIE DES SCIENCES

At the meeting on April 30, Monsieur P. Brémond read a paper on the persistence or the re-appearance at high temperatures in ceramic colours of shades which are associated usually with unstable salts. As explanation, it was suggested that the coloration was due to the coloration of the ions of these salts.

A paper by Monsieur F. Michaud recorded the observation that on passing an electric current through a gel of gelatin, the gelatin contracted at the anode and swelled at the cathode, and the author suggested that muscular contraction might be explained by a similar mechanism.

On May 7, Messieurs Bordas and Touplain continued their paper on a new denaturant for alcohol. The authors showed that alcohol containing 1-20,000 part of creosote oil gave a fine blue coloration on treatment with baryta water or lime water.

Prof. A. Noyes, of Chicago, communicated a note on the decomposition of solids by light.

ROYAL MICROSCOPICAL SOCIETY

A meeting was held on May 16, 1923, Mr. E. J. Sheppard, vice-president, in the chair, and Mr. W. M. Ames, M.A., B.Sc., read a paper on "Applications of the Microscope in the Manufacture of Rubber."

The microscope can be used for the examination of pigments used in making rubber, and also for the examination of rubber itself. A special method (Green's) is available for making slides of pigments. The determination of average particle size can be carried out accurately (using Green's method) only for a few pigments, but the relative surface development of various pigments can be ascertained by means of the microscope. In addition to the two methods in use for preparing microsections of rubber, a third is suggested of vulcanising a sheet of rubber sufficiently thin to be used for microscopic examination.

The distribution of pigments in rubber is of great importance. Carbon black appears to form aggregates less readily than other compounding materials. Diminution in the quantity of free sulphur when rubber is caused to perish by being kept in a hot atmosphere, and alteration in the appearance of the sulphur formations is due to migration of the sulphur to the surface of the rubber and to evaporation. This does not take place in rubber allowed to perish in the ordinary way. When rubber under strain is examined, vacua are found between the separate units of sulphur formations, and at the poles of crystalline pigments, but no effect is noticeable in the case of zinc oxide or gas black; permanent internal deformation is visible in the rubber after retraction. The increase in solubility of sulphur in rubber with rise in temperature can be observed microscopically.

SOCIÉTÉ DES INGÉNIEURS CIVILS

On May 4, this Society celebrated its 75th anniversary at the Sorbonne in the presence of the President of the Republic and of numerous French and foreign technicians, the English delegates including Monsieur Paul Kestner, who represented both the Society of Chemical Industry and the Société de Chimie Industrielle, Sir A. Denny and Sir V. Raven. The opening address was delivered by Monsieur L. Guillet, president of the Society, and Sir V. Raven presented Monsieur Rateau with a Medal of the Institution of Mechanical Engineers. Monsieur R. Jordan in an address on the metallurgical industry, outlined the results and aims of the French factories, and numerous papers were read, ranging in subject from the uses of Hertzian waves, and the electrical resources of France, to aviation. Visits were paid to the aerodrome of Bourget, the Eiffel Tower, and the new electrical generating station at Genevilliers.

At a later meeting Monsieur A. Portevin presented a paper on magnesium and other ultra-light alloys. Monsieur Portevin showed that the use of light alloys in engineering, especially aeronautical, work has given to magnesium a definite place as a metallurgical product. To improve the mechanical properties of magnesium it is alloyed with aluminium, zinc, copper or cadmium, the choice of the type of alloy depending on the use for which it is destined. Magnesium alloys are well suited for use in engineering work as they can be easily worked in a variety of ways. For the reduction of the weight of machine parts ultra-light alloys as compared with light alloys play the same *rôle* as that of special steels compared with ordinary steels in mechanical construction.

FORTHCOMING EVENTS

June 4.	University College, University of London, Gower Street, W.C. 1, at 5.30 p.m. "Problems in Relativity," by Prof. H. A. Lorentz, F.R.S. Also on June 5 and 7.
June 4.	Society of Chemical Industry, *London Section*. The Chemical Society's Rooms, Burlington House, Piccadilly, W. 1, at 8 p.m. "The Stream Line Filter, with Demonstrations of the Filter in Operation," by Dr. H. S. Hele-Shaw.
June 5 to 8.	The Institution of Electrical Engineers. Summer Meeting at North-Western Centre.
June 5.	The Textile Institute, *Lancashire Section*. The Institute, Manchester, at 4 p.m. "Cotton and Some of its Problems," by W. R. Dunlop.
June 6.	University College, University of London, Gower Street, W.C. 1, at 5 p.m. "The Structure and Behaviour of the Molecule," by Prof. G. N. Lewis, Ph.D. Also on June 8 and 12.

CORRESPONDENCE

"CELANESE" ARTIFICIAL SILK

Sir,—In the note on "The Artificial Silk Industry," which appeared on page 432 of *Chemistry and Industry* of April 27, we observe that mention is made of "Celanese" artificial silk made from cellulose acetate. Will you permit us to point out that the word "Celanese" is the registered Trade Mark of our Company for artificial silk goods, both in this country and abroad, and that we are sole proprietors of this Trade Mark. In view of the importance of the Trade Mark to us we shall be much obliged if you will be good enough to publish the present letter in your next issue.—We are, Sir, etc.,

British Cellulose and Chemical
Manufacturing Co., Ltd.
M. P. Dickie, Secretary
8, Waterloo Place, London., S.W. 1
May 25. 1923

GASEOUS COMBUSTION

Sir,—*Calorifer's* remarks (in your issue of to-day's date) on the explanation given by Professor Bone of his results obtained with explosive mixtures of carbon monoxide, nitrogen and oxygen appear to me very sound. I might add that Professor Bone would seem to be unaware of the results obtained fourteen years ago by Haber and Coates when studying the products of combustion furnished by flames of carbon monoxide, nitrogen and oxygen burning under pressure.

At ordinary pressures, such flames yielded a trace only of nitrogen oxides—at higher pressures, proportions which more or less corresponded to true temperature equilibrium. The difference was connected by them with the much increased luminosity of these flames under pressure, a luminosity accompanied by increased ionisation and catalytic effect on the sluggish nitric oxide formation.

I recall these facts, because, after all, a flame is an explosion of sorts.—I am, Sir, etc.,

A. J. Allmand
King's College, University of London
May 25, 1923

PERSONALIA

The honorary degree of LL.D. will be conferred on Sir R. Robertson, Chief Government Chemist, at the graduation ceremonial at the University of St. Andrew's on July 6.

Dr. H. A. Curtis has been appointed to take charge of the investigation of nitrates in the U.S. Department of Commerce survey of essential raw materials produced under monopoly conditions abroad. The object of the investigation is stated to be to safeguard American consumers in obtaining adequate supplies at reasonable prices.

Amongst recent nominations to the Consulting Committee for Arts and Manufactures of France are J. Branet, manufacturer; E. Roux, director of the "Repression des Fraudes" R. Duchemin, president of the Union of Chemical Industries; E. Fleurent, director of the Office of Chemical Products, etc.

Monsieur J. Schneider, of the well-known firm of Schneider and Co. (Creusot) and Monsieur Aubrun, managing director of that company, have resigned from the directorate of the "Comité des Forges." Schneider and Co. still adhere to the Comité, but will take no further part in directing its work.

NEWS AND NOTES

FRANCE

Notes from Paris

A technical congress of the ceramic industry was held in Paris on May 14 to 18. The first day was devoted to the study of forced versus natural draught in ceramic furnaces. Monsieur Denisse discussed the advantages and disadvantages of the various furnaces and compared the tunnel and continuous ovens, and showed that the use of a fan increased production by 25 per cent. He concluded that a fan, whether employed for drying or for firing, was a valuable aid to the ceramic industry. During the discussion various speakers defended natural draught, and Monsieur Norroy in particular claimed that the use of forced draught was useless in connexion with Hoffmann ovens, and that it would be wrong to use it in every case. Monsieur Granger, chief of the Testing Laboratory of the Sèvres porcelain factory, then described improvements in the manufacture of plates and gave an account of modern plant and processes.

On May 15 Prof. L. Bertrand, of the École Normale Supérieure, spoke on the composition and structure of various clays and the changes they undergo on heating. Methods of microscopical examination were described, and it was shown how these could be used to give results with a precision unobtainable by chemical analysis; for instance, a microscope made it possible to ascertain the degree of firing of certain delicate ceramic products. The plasticity of ceramic materials was considered by Dr. Bigot, who said that colloidal plasticity was of vital importance in ceramics, and he described methods of measuring it, the variations it underwent during pressure and firing, and pointed out that processes of rapid manufacture should be preceded by laboratory studies on plasticity. An interesting paper on the costing of refractory products was contributed by Monsieur Bodin, who pointed out the necessity of laying down a definite quality of product for a given use.

On May 16 a general meeting was held, and on May 17 and 18 visits were paid to various factories.

CANADA

Titanium

Although the existence of titanium was discovered some 130 years ago, it was not isolated in a pure state until 1910, when Hunter produced the metal. Similarly, only in very recent years has any progress been made in the utilisation of titanium compounds, although various titanium compounds had been suggested for use as pigments as long ago as 1846. Ferro-titanium has, however, been utilised in the iron industry since 1895 and titanium white, a new pigment consisting essentially of titanium dioxide, is now being made. The useful report on "Titanium" by A. H. A. Robinson, published by the Department of Mines, Canada (Pp. 119, Mines Branch, Ottawa), discusses the manufacture, properties and uses of this new pigment, as well as those of other useful titanium compounds, and describes in detail the occurrence in Canada of large unexploited deposits of titanium ores that may in future become of great industrial importance.

Titanium is not rare; in fact Clark estimates that it constitutes 0·44 per cent. of the solid crust of the earth, ranging ninth for abundance among the elements, but the only commercial ores are rutile and ilmenite. In the province of Quebec there are large deposits of ilmenite that are readily accessible, can be cheaply mined, and seem capable of furnishing an output large enough to meet the probable demands for many years. In the past a few small shipments from these deposits have been exported to the United States for use in making ferro-titanium, but conditions are eminently favourable for establishing the manufacture of titanium white and other titanium compounds in Quebec, as the deposits are reasonably close to abundant supplies of hydro-electric energy and markets for the finished product. The monograph from which the above information is taken concludes with an interesting list of uses of titanium and its compounds, among which may be mentioned metallic alloys, filaments for incandescent lamps, paint pigments, dyes and mordants in the textile and leather industries, and refractory colouring materials in the ceramic industries. In addition certain titanium salts are said to be finding extended use on account of their great power as acid reducing agents, the oxide is said to form a very efficient catalyst in the esterification of acetic acid; titanium nitride has been suggested as a basis for fertilisers and as an abrasive, whilst the metal itself has been used in pyrotechny.

The Leather Industry in 1921

The Dominion Bureau of Statistics reports that in 1921 the number of tanneries was 119, 64 being in Quebec and 40 in Ontario. Statistics of the industry are as follows:—Value of output, \$22,905,528; capital invested, \$32,137,488; persons employed, 4208; cost of materials used, \$15,157.358; the principal products were sole leather 23,502,370 lb., and upper leather 34,896,226 sq. ft. Exports in 1922 increased in value to \$5,091,384 and the outlook for 1923 appears to be more favourable.

GERMANY

Production of Artificial Silk

Recent statistics show that in 1922 Germany produced 6000 metric tons of artificial silk. The average monthly output at the beginning of the year was 350 m.t., but by the end of the year it had reached 600 m.t. The average monthly export rose from 100 m.t. at the beginning of 1922 to 200 m.t. per month by the end of the year.—(*U.S. Comm. Rep., May* 7, 1923.)

Justus Liebig and Chemical Industry

Liebig, the 50th anniversary of whose death (April 18, 1873) has just been passed, possessed extraordinary technical interest and insight, as is clearly seen from letters written during his first journey in Great Britain and Ireland (in 1837) to his friend Wöhler. Nevertheless, he derived little financial gain from the results of his researches. He made, for example, no attempt to utilise his improved preparation of potassium cyanide (addition of potash to the molten ferrocyanide), or his preparations of aldehyde and chloroform. His suggestions for employing artificial fertilisers containing potassium, nitrogen and phosphorus, though received with enthusiasm in England, met at first with bitter opposition in Germany. Nor was his process for producing silver mirrors a commercial success, though it is nowadays extensively used, and the trouble he lavished on the production of a suitable baking powder passed practically unrewarded. Even from his perhaps best known achievement, commonly styled "Liebig's Extract of Meat," he derived but little remuneration, the greater part of the profits passing to an English firm of manufacturers. Liebig's indirect influence on chemical industry, especially in his own country, can, however, hardly be exaggerated. He and his school (which included Hofmann and Kekulé) were the first to show that it is not the empiricist but the chemist with a broad scientific education, the man who has learnt to think and work exactly, who is qualified to build up and advance a chemical industry. Finally, by his work on organic elementary analysis, he provided the groundwork for our modern organic chemical industry; by his study of plant nutrition he promoted the development of the synthetic fertiliser industry; and by his literary activities, in particular his chemical letters, he brought home for the first time to the general public something of the meaning of chemistry.—(*Z. angew. Chem., April* 18, 1923).

GENERAL

Institute of Chemical Engineers

The first Annual Corporate Meeting of the Institution of Chemical Engineers will be held on Friday, June 8, at the Engineers' Club, 39, Coventry Street, London, W. 1. The President, Sir Arthur Duckham, K.C.B., M.I.C.E., will take the chair, and after the formal business has been concluded, tea will be served. At 5.0 p.m., Mr. T. C. Finlayson, B.Sc., will give a short account of his paper on "Industrial Oxygen," which will be followed by a discussion. An informal dinner will be held in the Club at 8.0 p.m. Corporate members are invited to bring friends who are interested to the meeting, tea and dinner, but due notice should be given to the Hon. Secretary, Prof. J. W. Hinchley, 307, Abbey House, Victoria Street, London, S.W. 1.

The Influence of Road Dressings on Fish Life

The Standing Committee on Rivers Pollution (1921) has issued a report (No. 187, 1d.), which states that the results of numerous experiments show that the drainage from bituminous roads is without appreciable toxic effect on fish, due either to soluble materials extracted by rain from the bitumen itself or to colloidal particles derived from disintegration of the bituminous surface. The term "bitumen" is understood to include both hard bitumen or asphalt, and soft bitumen or malthas, so that a bituminous road surface may contain, without producing harmful results to fish, either natural bitumen or the pitch-like residue left when crude petroleum is fractionated. Mixtures containing pitch or other coal-tar products did not come within the scope of the investigation.

New Heating System for Chemical Works

The disadvantages of the use of radiators, hot-water pipes, etc. for heating large rooms require little elaboration. The initial heating up of large masses of iron and the subsequent currents of heated air ascending directly to the ceiling without warming the lower strata hardly tend towards efficiency. A considerable advance over previous systems appears to have been made in the "Thermon" heating apparatus, an account of which is given in a recent number of the *Chemiker-Zeitung* (1923, p. 361). Steam from any source, fresh or waste, or hot water, passes through a small battery of heating tubes enclosed in an iron box and air is circulated around the battery and out into the room by means of a powerful fan. The temperature of the battery can be regulated by means of dampers and the direction of the expelled warm air by adjustable shutters. The radiation is effective within a radius of 15–20 yards, and models are made giving 15,000–200,000 cals. per hour. The arrangement would appear to be a distinct improvement on its forerunners, from the point of view both of economy and hygiene.

REPORT

Report on the Economic and Financial Conditions in Belgium, December, 1922. *By* J. P. Bagge, *H.M. Commercial Secretary, Brussels.* Together with an Annex on the Economic Situation in the Grand Duchy of Luxembourg. *Department of Overseas Trade. Pp.* 79. *H.M. Stationery Office,* 1923. *Price* 2*s.* 6*d.*

Since the publication of the last report (*see* J., 1922, 318 R) the stagnation affecting Belgian economic life has passed, trade has revived and reconstruction is almost complete. In fact only 4 per cent. of the industrial wage-earners were unemployed in December, 1922, the proportion being high, however, in the chemical industry.

The number of blast-furnaces in operation doubled during 1922, and now amounts to two-thirds of the number in operation before the war, whilst production has increased from 250 to 300 per cent. The production of unrefined zinc practically doubled as compared with 1921. The situation in the glass industry improved continuously and producers have been finding difficulty in meeting demands. The present prosperity applies to all branches of the industry. In the chemical industry the general outlook is good. In view of the high costs of raw materials efforts are being made to curtail imports from countries with appreciated currencies. The demand for sulphuric, hydrochloric, and nitric acids is good, and the revival in the glass industry has led to a shortage of sulphate of soda. The soap industry, however, is in a bad way. Superphosphate is in demand though shortage of labour has retarded deliveries. The principal chemical products exported were sulphuric acid, valued at 32 million fr. and nitrate of soda, 55·7 million fr. A factory is being erected at Colen to treat radio-active minerals from the Belgian Congo.

During the early part of 1922 the coal trade was stagnant, but the coal strike in America improved the position by diverting British competition, and by September the demand was greater than the supply, the output being still below the pre-war average. Increased prosperity prevailed in the sugar industry, 63,630 tons being produced in October, compared with 38,116 t. in October, 1921.

Imports into Belgium in the first nine months of 1922 amounted to 6428·2 million fr., compared with 7727·0 million fr. in the corresponding period of 1921. Exports in the same periods amounted to 4298·8 million fr., and 5441·6 million fr., respectively.

In the annex dealing with Luxembourg the important metallurgical industry of this State is discussed. The situation, which was bad in 1921, improved last year, though at present the shortage of coke is a serious hindrance. In 1922, 1,685,700 t. of pig iron and 1,394.103 t. of steel were produced.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for May* 17)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Railway material, tyres ..	658
Belgium ..	Brass and iron	672
British India	Iron and steel, tubes, fittings (tender)	*
Canada ..	Pulp and paper	660
,, ..	Hardware, pig and sheet iron	662
,, ..	Silk	663
,, ..	Earthenware	11104/ E.D./M.C./ 2
Denmark ..	Oils, fat	673
Netherlands	Iron, brass	676
,, ..	Leather	677
Norway ..	Tinfoil	678
Palestine ..	Zinc, aluminium foil ..	†
South Africa	Glass	11230/E. D./M.C./2
,, ,, ..	Electric cable (tender) ..	11309/E. D./C.C./2
Spain ..	Chemicals, potash, phosphates	679
,, ..	Surgical instruments, rubber goods	7424/22/ F.L./C.C.
United States	Steel wire	19498/F. W./E.C./2

* Director-General, India Store Department, 10, Belvedere Road, London, S.E. 1.

† D.O.T., 35, Old Queen Street, S.W. 1.

TARIFF CUSTOMS EXCISE

Mexico.—The duty on imported pneumatic tyres, indiarubber tyres and inner tubes has been modified.

Poland.—The issue of May 24 contains a list of articles which are subject to surtaxes, among which are included oils, chemicals, minerals, iron and steel, leather, glass, building materials, paint, varnish, paper, etc.

Rumania.—Regulations regarding the exemption from, and credit in respect of, the payment of duties on sugar, have been issued.

South Africa.—A revised statement of the duty on patent medicines is given in the issue of May 24.

Yugoslavia.—Exports of fresh and dried beet and sugar-beet parings are now permissible, subject to duty.

REVIEWS

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By J. W. Mellor, D.Sc. Vol. III. *Pp.* $x+927$. *London: Longmans, Green and Co.*, 1923. *Price* £3 3*s*.

In the volume under review Dr. Mellor has continued on similar general lines the work so well begun in Vols. I and II of his book. Justly indeed is it termed a "comprehensive" treatise; contemplating the task which must be represented by its compilation one is at a loss whether to admire more the incredible industry or the sheer pluck of the author. Legends grow around the man who does such things; rumour has it that dictaphones, typists, card-indexes, and the other paraphernalia of modern "systems" play a vital part in this compilation, and perhaps the jade in this does not lie. But there is overwhelming internal evidence that the book, and the credit for it, is Dr. Mellor's. A great deal of the detail work may have been, indeed one would think must have been, delegated to assistants; but the author's hand is on every page. The publishers have dealt with the book in accordance with its merits: it is well printed in good readable type on sound paper and thoroughly well bound.

It will be remembered that Vol. I is occupied with a consideration of general chemical theory and the chemistry of oxygen and hydrogen, whilst Vol. II deals with the alkali metals and the halogens. This volume consists of the four chapters XXI-XXIV, dealing respectively with copper, silver, gold and the alkaline earths. Calcium, barium and strontium, as is obviously convenient, in view of their close chemical and physical similarity, are discussed together. Within the chapters, numbered sections are devoted successively to the history, occurrence, extraction, physical properties, chemical properties and atomic weights of the metals; and to the preparation and properties of their oxides, fluorides, chlorides, bromides, iodides, sulphides, sulphates, carbonates, nitrates and phosphates and groups of compounds derived therefrom. Several sections are frequently employed to discuss one part of the foregoing broad scheme and sections are inserted to cover special subjects, for example, the alleged allotropic forms of copper, hydrated and colloidal copper oxides, the action of light on silver halides, etc. The carbides, nitrides, phosphides, nitrites, sulphites, cyanides and a host of other compounds are omitted and will find their place in a later volume, just as the bromates, hypochlorites, etc., have already been described in Vol. II. The references appear at the end of each section, grouped in paragraphs, the connexion of the group of references with the text being indicated by superscript figures in the usual way.

The matter is carefully arranged, and well indexed, and heavy and italic types are judiciously used to emphasise key words in such a way as to guide the eye rapidly to the point sought. As in the earlier volumes, each topic is discussed in a most exhaustive fashion; a very searching study of the book leaves one with the impression that the number of cases where any point of interest has been slurred or omitted must be quite insignificant.

Much useful detail is given about methods of preparation, and in many cases the special methods which have been worked out for preparing substances in an unusual state of purity, *e.g.*, by Richards and his co-workers, are adequately described. Throughout the book frequent and effective use is made of diagrams, on a small but sufficient scale, to illustrate the relations in binary and ternary systems. In general, no attempt is made to describe technical processes as such, though their chemistry is fully discussed, and this principle is obviously appropriate to a text-book of pure chemistry.

Special commendation must be given to the statement of physical properties, whether of metals or of their compounds, and to the description of the chemical reactions of each substance. As an example, the section on the chemical properties of copper occupies 34 pages whilst the references thereto fill six pages of very solid small type; and the whole is full of the most interesting detail, of which by far the greater part must be new to any one chemist. The book fulfils the promise of the earlier volumes in being, as a whole, extraordinarily readable. Serious students of chemistry, young and old, may be advised to make hearty meals of this good meat; provided they have the common sense not to try to eat the bones, they will inevitably derive both pleasure and much solid nourishment. One misses, however, as section headings, the apt and often amusing quotations we have learned to expect from the author: presumably the demand has outrun the supply.

One is tempted to quote many parts of the book, but space forbids. The old speculations as to the means whereby Moses reduced Aaron's golden calf to ashes are reported, and dismissed with a characteristic quotation from Socrates. A most interesting account is given of the phosphorescence of the sulphides of the alkaline earths. Under the density and structure of copper there is a good discussion of the amorphous and crystalline states in metals; and by taking together a section on colloidal copper oxides and several sections in the chapter on gold one has a fairly thorough account of colloidal solutions in general. This list could be prolonged almost indefinitely, but enough has perhaps been said to convey some impression of the solid excellence of the book.

It obviously offers so large a target that some part of it must inevitably be vulnerable to criticism, and it may be permissible and useful to consider some apparent blemishes; but only upon the clear understanding that they are, in the reviewer's opinion, negligible as compared with the positive merits of the book: criticism otherwise would simply be unfair to the author.

Misprints and clerical errors can be found, but their scarcity is remarkable. A few matters might have been omitted: *e.g.*, on p. 45 we find the times required for stated currents to melt copper wires of various thicknesses, data which should be relegated to an engineer's pocket book. Omissions are harder to find, but one which may be noted is that the discussion of the atomic weight of silver contains no reference to the work of Richards and Willard on the combined ratios $LiClO_4$: LiCl and LiCl : AgCl, which give perhaps the best figure for the silver : oxygen ratio. In some few cases there is a duplication of statements, one of the worst being on p. 46 where, separated by four lines only, we find "H. C. Greenwood found the b. pt. of copper to be 2310° (760 mm.)" and "H. C. Greenwood found the *vapour pressure* to be 1 atm. at 2310°." This duplication seems the more irritating by reason of the repetition of the name.

Possibly the reviewer has an idiosyncrasy in this matter, but his one solid complaint about the book is upon this matter of names. The initials are a minor matter—most sensible chemists have only one or two. There is, of course, a jerk when one meets: "R. Luther electrolysed H. von Fehling's soln." (Yes, this *is* ordinary Fehling's solution), but this happens infrequently and does not really matter. The real trouble is just names: singly, and in pairs, triplets and platoons, they are dotted over every page until at times one inevitably receives the impression, the more unfortunate because so unfair, of fragments of chemistry floating in a sea of surnames.

Now the cause of this trouble is the system whereby references are grouped, often in twenties and thirties, so that the name is necessary to locate the reference within the group. Evidently individual numbering of references would run into big numbers, but even so, surely there would be much saving of space and increase in clarity. As it is, one finds very frequently the statement that certain matter "has been studied by" a string of half a dozen names, or even "M. Prud'homme made some observations on this subject"; whereas a single number and the magic words "see also" would dismiss the lot to the end of the section, where undoubtedly they belong.

Evidently, however, these criticisms are either upon matters of opinion or else upon points of minor importance, and detract nothing from the merits of the book. It is very true of this volume, as of its predecessors, that it is not merely a work of reference: it is that and much more. Though comprehensive, to the uttermost meaning of that word, it is a real text-book which every chemist should possess, so that he may enjoy the pleasure and profit of its frequent study and also secure its full value as a work of reference.

H. V. A. Briscoe

Glue and Gelatin. *By* Jerome Alexander. *American Chemical Society, Monograph Series. Pp.* 236. *New York: The Chemical Catalog Co., Inc.*, 1923. *Price* $3.

The volumes of the series of Monographs, published under the auspices of the American Chemical Society, are intended to serve two distinct purposes, viz., firstly, to present the knowledge available upon the chosen subject in a readable form, intelligible to those whose activities may lie in wholly different directions, and secondly to promote research by furnishing a well-digested survey of the work already done. The present volume is admirably adapted to serve these purposes. It is divided into fourteen chapters and an appendix. The first nine chapters, or 129 pages, are devoted to the chemical and physical properties of gelatin; twenty pages to the manufacture of, and the remainder to the uses and grading of glue and gelatin. A description of fish glue and isinglass is also given. It is impossible to deal adequately with so many subjects in such a small space, and the book suffers somewhat in consequence. The chemistry of gelatin and glue is treated very ably, and, as in Bogue's recent book, considerable stress is laid on the importance of hydrogen-ion concentration. In discussing the question: "Is gelatin a distinct chemical entity?" the author concludes that no one has hitherto made or experimented with chemically pure gelatin. Since this is so it is a pity, as he states, that so much of the recorded work has been done with gelatins of varying constitution, even the ash and water content rarely being stated. According to Alexander much of the published work should be repeated upon a standard or ash-free gelatin. This is all very sound advice. The chapter on the viscosity of solutions of glue and gelatin, and the factors which affect this constant are of practical interest to the glue chemist or manufacturer.

In dealing with collagen and ossein the author treats of chondrin as a body quite distinct from ordinary gelatin, though he quotes Mörner's experiments which tended to prove that it is readily converted into gelatin and mucin. The reviewer (J. 1910, 662) confirmed Mörner's work by preparing normal gelatin from cartilage. The method of preparation of chondrin so commonly copied from Allen should be scrapped. The section devoted to the chemical examination of glue and gelatin is good, but the co-precipitation of arsenic with phosphoric acid in the presence of organic matter is open to criticism. The methods given for the determination of lead, copper and zinc require some modification now that aluminium vessels are so commonly used.

Alexander, like all American authors, refers to Peter Cooper standards which are not used by English chemists, but he admits that nothing has been published regarding their origin and that they are perfectly arbitrary in nature. The only disappointing part of the book is the chapter devoted to the manufacture of glue and gelatin, though it serves to emphasise the fact that the chemistry of gelatin still remains a totally distinct subject from the chemistry of glue manufacture. The colloidal chemist tries to get pure gelatin for his experiments, rejecting all the concomitant impurities. The manufacturer, on the contrary, does not even desire to make a pure product, and sells the impurities at the price of the glue. The first question that one is asked, when recommending any alteration in methods with a view of improving quality is: How will it affect the yield? and the second is: Will it mean increased "handling" of the material? The time will come when the application of the principles of colloidal chemistry will be used to control manufacture, but much work is required before this ideal can be reached. Books such as this and Bogue's are of the greatest use, because they give us a good knowledge of the chemical principles involved and indicate, though they do not solve, the difficulties the manufacturer has to contend with. They mark, in fact, the dawn of a new era in the technology of gelatin. The two books will serve different purposes. Bogue's is the best "treatise" we have on the subject, while Alexander's does not attempt to be more than is indicated above, namely, a "compendium," useful chiefly to chemists capable of undertaking research work. It is rather curious that the author should, under these circumstances, devote four pages to explaining the meaning of hydrogen-ion concentration, though it is done excellently.

S. R. Trotman

Leitfaden der Quantitativen Analyse. *By* Dr. F. Hahn. *Pp. viii*+230. *Dresden and Leipzig: Theodor Steinkopff,* 1922. *Price: paper* 6*s.*; *bound,* 7*s.* 2*d.*

This volume possesses certain features which differentiate it from the usual run of text-books dealing with quantitative analysis. It is divided into sections dealing with gravimetric, volumetric and colorimetric methods of analysis and with electrolysis and gas-volumetric methods. The theoretical considerations underlying these various divisions are brought together in the first part of the book, and constitute a very clear exposition of the principles and practices of quantitative analysis, the theory of volumetric analysis, including the theory of indicators, being particularly well treated. One is struck by the many practical suggestions for simplifying and improving manipulative technique embodied in this theoretical section, which combines in a very happy way pure theory and manipulative "tips." In dealing with the determination of cations and anions, the procedure adopted is to take each metal or acid radicle and preface the account of its gravimetric determination with a list of compounds in which it is quantitatively precipitatable and the corresponding compounds in which these are weighable, with a direct reference to its volumetric, colorimetric, electrolytic or gas volumetric method of determination in the appropriate sections, where such methods are grouped together.

All methods are given very briefly, and copious references are given to the literature of the method where the author is not able to give sufficient details in the limited space he allots to each determination. The volume gives one the impression that the author was restricted to a limited number of pages, and that he has endeavoured to keep to this limit by discarding superfluous and wordy descriptions whilst retaining all essentials. In this he has been very successful, and the result is in pleasant contrast to the padded volumes usually met with. The book does not treat of the analyses of technical products. The illustrations are mostly crude in the extreme, and greatly detract from the merits of the book.

T. Callan

Flavouring Materials, Natural and Synthetic. *By* A. Clarke. *Oxford Technical Publications. Pp. xxi*+166. *London: Henry Frowde and Hodder & Stoughton,* 1922. *Price* 8*s.* 6*d.*

This little volume is intended as a guide to manufacturers of beverages and foodstuffs who have occasion to use natural and artificial flavouring materials. In a short introduction the author deals briefly with the anatomy and physiology of the nose and palate and gives an elementary account of recent theories on the connexion between the taste and smell of substances and their chemical constitution.

The main portion of the book is divided into four sections:—(1) Spices and condiments and other flavouring substances of animal and vegetable origin. (2) Essential oils. (3) Floral perfumes, fruit juices and compounded flavours for special purposes. (4) Odorous chemical products.

The first section embraces all the spices in common use and gives in each case some account of their origin, the chemical substances to which their flavour is due and the adulterations to which they are subject. It contains a useful collection of analytical constants and official standards and limits (where such exist) not only of the substances themselves but of the adulterants likely to be found in them, with, in the pages devoted to the spices, a short paragraph on the structures of diagnostic value visible under the microscope. The illustrations of these are not very satisfactory, the more so as no indication of the degree of magnification is given.

Section II, on essential oils, gives a good and comprehensive account of a wide range of these oils, their origin and chemical and physical characters, and also briefly describes the chief processes by which they are obtained and the methods adopted for their analysis.

The next section (Floral perfumes, fruit juices, etc.), is not quite so satisfactory. The methods of production are hardly described in sufficient detail and although there may not be many published figures relative to the composition of fruit juices, that hardly justifies their total omission. The chapter on compounded flavours contains a number of recipes which will no doubt be useful to those for whom the book is mainly intended.

The final section deals with numerous odorous bodies, many of them of synthetic origin, the information given being sometimes limited to the name of the substance and the odour it bears, whilst in others there is an account of the origin, preparation, physical constants and mode of assaying.

As will be gathered the work is somewhat unequal and has the defects attendant on extreme condensation. In the description of analytical processes the details are hardly sufficient for those without some acquaintance with this sort of work, but this defect is obviated to some extent by numerous references to current literature. In the chapter on the spices the calcium-carbide method for the determination of water might well have been mentioned, and it is a pity that the diastase and acid conversion methods for starch estimation should have been referred to as if they were of the same value.

There are very few printer's errors, but an unfortunate one on p. 28 causes the ash *soluble* in hydrochloric acid to be described as " sand." As a whole the book is clear, accurate and, for its size, remarkably comprehensive and with such full chapter headings and the index it is extremely handy to refer to. The clear type and excellent paper make it a credit to author and publisher alike.

CECIL H. CRIBB

INSTITUTE OF CHEMISTRY

We are asked to announce that the Council of the Institute of Chemistry of Great Britain and Ireland advises any Fellow or Associate of the Institute who may contemplate accepting appointment as Public Analyst for the County of Gloucester or for the City of Gloucester on the terms recently advertised to communicate at once with the Registrar.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Whitsuntide holidays have naturally affected trading adversely during the last fortnight. Apart from the expected reduction of business from this cause, however, there has also been a tone of depression for which it is a little difficult to account. Political unsteadiness both at home and on the Continent reacts so quickly on trade that this may be the cause, and if so an early revival of confidence may be expected. The competition of Continental imports is not of very much consequence in most directions to-day as the prices of such are on similar lines to home produced products.

Acetic Acid, 40% tech.	£24-£25 per ton. Still very firm with little available supplies.
Acid Hydrochloric ..	4s.-5s. per carboy d/d.
Acid Nitric 80° Tw. ..	£24 10s. per ton. Quiet.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d.-£8 per ton.
Arsenic (White) ..	£70-£72 per ton. Not much business passing.
Bleaching Powder ..	Spot £11 7s. 6d. d/d. ; Contract £10 7s. 6d. d/d. Keen competition for orders, especially export.
Bisulphite of Lime ..	£7 per ton, packages extra.
Calcium Chloride ..	£5 17s. 6d. per ton d/d. Very quiet.
Copper Sulphate ..	£27 per ton.
Potash Caustic	£34-£35 per ton. Slightly easier.
Potass. Bichromate ..	5¾d.-6d. per lb. d/d.
Potass. Chlorate ..	3d. per lb. Somewhat firmer but very quiet.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d. ; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76% ..	£20-£21 per ton. Quieter.
Soda Crystals	£5 10s. per ton carr. paid stations ; £5 at certain ports—Home trade.
Sod. Acetate 97/98% ..	£26 per ton.
Sod. Bicarbonate ..	£10 10s. per ton.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	2⅞d.-3d. per lb. Small demand.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, conc. ..	£16 per ton carr. paid. Little doing. Keen competition for export orders.

Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£26-£28 per ton according to quantity.
Carbon Black	1s. 5½d. per lb. ex wharf. Still very scarce.
Chromium Oxide	1s. 5d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb. Firmer on advance in price of Rape Seed Oil.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood-distillation products. Brown sugar of lead has still further advanced.

Acetate of Lime—		
Brown	£10 15s. per ton d/d.	
Grey	£22 per ton d/d.	
Liquor	9d. per gall.	32° Tw.
Charcoal	£9 10s.-£10 10s. per ton.	
Iron Liquor	1s. 6d. per gall.	32° Tw.
	1s. 2d. „ „	24° Tw.
Red Liquor	1s. 3d. „ „	14/15° Tw.
Wood Creosote	2s. 7d. „ „	Unrefined.
Wood Naphtha—		
Miscible	6s. 9d. „ „	60% O.P.
Solvent	5s. „ „	40% O.P.
Wood Tar	£6 per ton d/d.	
Brown Sugar of Lead	£45 per ton d/d.	

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 5d. per lb. Little movement in the market.
Crude 60's	3s. 6d.-3s. 9d. per gall. Market weaker.
Acid Cresylic—97/99	2s. 2d.-2s. 5d. per gall. Market quiet.
Pale 95%	2s.-2s. 4d. per gall. Not much demand.
Dark	1s. 10d.-2s. 1d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	9d.-11d. per gall. Not much demand.
Unstrained	8¾d.-9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8½d. per gall. Business slack, abundant supplies.
Pure	2s. 2d.-2s. 3d. per gall.
Toluole—90%	1s. 9d.-2s. per gall.
Pure	2s.-2s. 6d. per gall. Not much inquiry.
Xylol	3s.-4s. per gall. according to quality. Good demand.
Creosote—	
Cresylic 20/24%	11¼d.-1s. per gall. Not much business.
Middle Oil Heavy Standard Specification	8½d.-9½d. per gall. Market steady.
Naphtha—	
Crude	9d.-9¼d. per gall.
Solvent 90/160	1s. 7d.-1s. 9d. per gall. Fewer inquiries.
Solvent 90/190	1s. 5d.-1s. 8d. per gall. Market steady.
Naphthalene Crude—	
Drained Creosote Salts	£8-£8 15s. per ton.
Whizzed or hot pressed	£11 10s.-£14 per ton. Plenty of inquiries.
Naphthalene—	
Crystals	£18 per ton.
Flaked	£16 10s. per ton.
Pitch, medium soft	No business for this season. Prices for Autumn delivery 130s.-145s. per ton.
Pyridine—90/140	11s.-12s. per gall. More inquiry.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

A slight falling off of business in dyestuffs is fully accounted for by the Whitsun holidays. Orders for forward delivery have been coming in fairly well and still further improvement is anticipated. Prices remain firm.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 9d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.

m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works. Good demand.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Business has been fairly good during the week and improvement is expected in the near future as stocks become depleted. Very little in the way of fresh supplies can be expected from the Continent at present.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. 3d.-3s. 4d. per lb. Steady demand.
Acid, Benzoic	2s.-2s. 9d. per lb. Still very scarce.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton. Prices reduced by £5 per ton.
Acid, Citric	1s. 9d. per lb., less 5%. Less demand.
Acid, Gallic	3s. per lb. Steady demand.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb.
Acid, Salicylic	2s. 3d. per lb. Firmer.
Acid, Tannic	3s. 6d. per lb. Slightly dearer.
Acid, Tartaric	1s. 4d.-1s. 4½d. Demand good.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d. per lb.
Amidopyrin	14s. per lb. Little inquiry.
Ammon. Benzoate	3s. 6d. per lb.
Ammon. Carbonate B.P.	£32 15s. per ton. Price reduced by £4 15s. per ton.
Atropine Sulphate	12s. per oz.
Barbitone	Quoted up to 20s. per lb. Very firmly held. Higher prices quoted for forward delivery.
Benzonaphthol	4s. 6d. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Bromides	Better inquiry. Prices steady. Potass. 8d., Sod. 9d., Ammon. 10d. per lb.
Calcium Lactate	2s. 9d. per lb. for best makes.
Chloral Hydrate	4s. 3d. per lb. now wanted. Firmer tendency.
Chloroform	2s. 3d. per lb. for cwt. lots, ton lots being quoted down to 2s. per lb.
Creosote Carbonate	10s. per lb., with little inquiry.
Formaldehyde 40%	£90-£92 per ton. Very firm.
Guiacol Carbonate	8s. 6d. per lb.
Hexamine	4s. 3d. per lb.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Market good with considerable inquiry.
Magnesium Carbonate—	
Light Commercial	£37-£38 per ton net, according to quantity.
Magnesium Oxide—	
Light Commercial	£85 per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	1s. 8d.-2s. per lb. Good demand.
Menthol	35s. per lb. spot.
Methyl Salicylate	2s. 6d. per lb. for carboys. Not quite so firm.
Methyl Sulphonal	15s. per lb.
Mercurials	Unchanged. Market quiet.
Paraformaldehyde	3s. 6d. per lb. would now be accepted.
Paraldehyde	1s. 7d. per lb. Very steady. Forward prices show a higher tendency for best makes.
Phenacetin	6s. 6d. per lb. spot value. Better inquiry.
Phenazone	7s. 6d. per lb. Very firm.
Phenolphthalein	6s. per lb. now wanted by most holders.
Potass. Bitartrate—99/100% (Cream of Tartar)	98s. per cwt., less 2½%. Demand not quite so good.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. Demand still continues good.
Potass. Permanganate	10d. per lb. for large quantities. Forward market very much firmer.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	6s. per lb.
Salol	3s. per lb. now asked.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 9d. per lb. now wanted by holders. Still in short supply, fresh stocks being quickly absorbed.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality.
Sod. Hyposulphite—Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d. per cwt. Fairly good demand.
Sod. Salicylate	In good demand. Values unaltered, being 2s. 9d. per lb. for Powder, 2s. 11d. per lb. for Crystal. These prices show very little profit to the makers, and higher rates are mentioned for forward delivery.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. per ton, according to quantity for home trade, 1-cwt. packages included.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.

Thymol	.. In view of fairly large stocks being held keen competition still exists to obtain orders. The value of genuine good White Crystal remains at 17s. per lb.

PERFUMERY CHEMICALS

Acetophenone ..	.. 10s. 6d. per lb.	
Aubepine ..	.. 14s. ,, ,,	
Amyl Acetate ..	.. 3s. ,, ,,	
Amyl Butyrate ..	.. 7s. ,, ,,	
Amyl Salicylate	.. 3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol ..	.. 3s. ,, ,,	
Benzyl Alcohol free from Chlorine ..	.. 3s. ,, ,,	
Benzaldehyde free from Chlorine ..	.. 2s. 9d. ,, ,,	
Benzyl Benzoate	.. 3s. 3d. ,, ,,	
Cinnamic Aldehyde	.. 14s. 9d. ,, ,,	
Coumarin ..	.. 18s. 6d. ,, ,,	Considerably dearer.
Citronellol ..	.. 19s. 6d. ,, ,,	
Citral	.. 9s. 6d. ,, ,,	
Ethyl Cinnamate	.. 15s. ,, ,,	
Ethyl Phthalate	.. 4s. 3d. ,, ,,	
Eugenol	.. 11s. 6d. ,, ,,	
Geraniol (Palmarosa)	.. 30s. ,, ,,	
Geraniol	.. 5s. 6d.-12s. 6d. per lb.	
Heliotropine ..	.. 8s. per lb.	
Iso Eugenol ..	.. 16s. 6d. ,, ,,	
Linalol ex Bois de Rose ..	21s. ,, ,,	
Linalyl Acetate ..	.. 25s. 6d. ,, ,,	
Methyl Anthranilate	.. 6s. ,, ,,	
Methyl Benzoate	.. 8s. 6d. ,, ,,	
Musk Xylol ..	.. 9s. 6d. ,, ,,	
Phenyl Ethyl Acetate	.. 10s. ,, ,,	
Phenyl Ethyl Alcohol	.. 17s. 6d. ,, ,,	
Rhodinol ..	.. 45s. ,, ,,	
Safrol	.. 2s. 3d. ,, ,,	
Terpineol ..	.. 3s. 1d. ,, ,,	
Vanillin	.. 23s.-24s. per lb.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	.. 14s. 6d. per lb.	
Anise Oil	.. 2s. ,, ,,	
Bergamot Oil ..	.. 12s. 6d. ,, ,,	spot.
Bourbon Geranium Oil ..	31s. 6d. ,, ,,	
Cananga Oil, Java	.. 9s. ,, ,,	
Cinnamon Oil, Leaf	.. 4½d. per oz.	
Cassia Oil 80/85%	.. 8s. 6d. per lb.	
Citronella Oil—		
Java 85/90%	.. 4s. 2d. ,, ,,	
Ceylon	.. 3s. 4d. ,, ,,	
Clove Oil	.. 8s.-8s. 6d. per lb.	
Eucalyptus Oil 70/75%	1s. 9d. per lb.	
Lavender Oil, Mont Blanc 38/40%	.. 13s. ,, ,,	
Lemon Oil ..	.. 3s. 1d. ,, ,,	
Lemongrass Oil ..	.. 2¾d. per oz.	
Orange Oil, Sweet	.. 12s. 6d. per lb.	Advanced.
Otto of Rose Oil—		
Anatolian ..	.. 24s. per oz.	
Bulgarian ..	.. 30s. per oz.	
Palma Rosa Oil	.. 17s. 6d. per lb.	
Peppermint Oil—		
English ..	.. 80s. ,, ,,	
Wayne County	.. 13s. ,, ,,	
Japanese ..	.. 6s. 4½d. ,, ,,	
Petitgrain Oil ..	.. 7s. 9d. ,, ,,	Lower.

TRADE NOTES

Trade Information

The Calorizing Process.—We have received an interesting booklet describing the process and varied applications of calorizing. This process consists in forming a surface alloy of aluminium on ferrous and non-ferrous metals, by subjecting them to a high temperature in an atmosphere of hydrogen in an airtight retort partly filled with a mixture of finely divided metallic aluminium suspended in aluminium oxide. The depth of alloy formed depends on the duration of the treatment and the composition of the mixture, but it is quite homogeneous. The pamphlet gives an account of the physical properties of calorized metals and discusses the application to various metals and a variety of industrial articles. Further information can be obtained from the Scarab Oil Burning Co., Ltd., Calorizing Department, Carlton House, Lower Regent Street, London, S.W. 1.

A New Electrical Generator.—The British Thomson-Houston Co., Ltd., inform us that a 40,000-h.p. generator, the largest power-generating unit in the United Kingdom, and made by the Company, was started recently at the Electricity Works of the Rotherham Corporation. The set comprises a 40,000-h.p. turbine which runs at 15,000 revs. per minute, and drives an electrical generator which develops 30,000 kw. A.C. at 6600 volts.

PUBLICATIONS RECEIVED

The Manufacture of Acids and Alkalis. *By* Prof. G. Lunge, Ph.D. *Completely revised and re-written under the editorship of* A. C. Cumming, O.B.E., D.Sc. *London: Gurney and Jackson*, 1923:—

Vol. I. Raw Materials for the Manufacture of Sulphuric Acid and Sulphur Dioxide. *By* W. Wyld. *Pp. xiii*+558. *Price* 36*s*.

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JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY.

CHEMISTRY & INDUSTRY

Official Organ of the Federal Council for Pure and Applied Chemistry

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EDITORIAL

ONE of our correspondents has sent to us some specimens of propaganda leaflets directed against the French and sent out with German chemical journals which are controlled by the German Chemical Society. This policy seems to us to be unfortunate ; let us so far as possible keep science and politics—at any rate, foreign politics—apart. This cannot be done completely, of course, but let us do it so far as possible. The Germans have circulated a number of gruesome photographs ; we cannot complain of this, what we do complain of is that they shall be circulated by a learned Chemical Society as a piece of political propaganda. We hope that the Belgian and French Chemical Societies will not retaliate by circulating some equally unpleasant photographs taken a few years ago at Termonde, Dinant, Louvain and some other places. There is every reason why a chemist should be patriotic. Pasteur was a great patriot as well as a great chemist, but then he was a great man. But let learned societies in their publications try so far as possible to keep to the subject with which they are identified ; some political references are occasionally necessary, as affecting problems of chemical manufacture or as items of news which may specially appeal to a small and select body of readers. Surely the issue of such propaganda by the German Chemical Society does that Society no good and does Germany no good. In the interests of that civilisation which chemistry does so much to promote we appeal to all scientific societies in every country to do nothing which will add to the bitterness which already exists. The Germans perhaps do not realise that to make use of German chemistry for political purposes is a policy which does not find favour in most countries. We are perfectly convinced that such a policy does infinitely more harm to Germany than good. The essence of science is the zeal for truth ; truth and bias cannot be reconciled ; political propaganda is necessarily, and quite properly, biassed. That the science of a great nation may be suspected is a very grave circumstance ; and in the case we are considering the effect is quite insignificant and futile from the point of view of politics. It will be better for German politics and for German science if their respective publications are kept rigidly apart and we urge chemists of all nations to consider carefully whether it will not necessarily degrade the science from its high position if it is to be made use of as an advertising medium on political questions.

* * *

It is announced in *Nature* that Dr. Aston has developed a new method of obtaining mass-spectra of the light elements ; the results so obtained confirm the data already published by Aston and by Dempster. The difficulties of obtaining mass-spectra of many of the elements of high atomic weight are very considerable, but no doubt in time our knowledge of these will be greatly extended and when it is possible to compare the mass-spectra of all the rare earth elements a singularly interesting problem will have been solved. Mass spectra, X-ray spectra and the ordinary light spectra have all contributed to our knowledge of physical and theoretical chemistry. What new spectra shall we be able to investigate a hundred years hence ? What sort of a table of atomic weights and statistics will be published by the International Committee of the elements even fifty years hence. There is one little problem which will require its attention at no distant date in connexion with the new element hafnium. Is hafnium identical with Urbain's celtium ? If so what should it be called ? Messrs. Coster and Hevesy have made an important discovery and it has received a well-deserved measure of public interest and attention. On the other hand we do not remember that Professor Urbain has ever abandoned his claim to have discovered and named an element which should occupy the seventy-second house in the long street of chemical elements. These conflicting claims are the more delicate because both the French and the Danes will feel a just pride in their share in the achievement and neither nation will be inclined to abandon a name specially selected to honour the country of origin in favour of a name specially selected to honour some rival country. We are glad to think that it will not fall to our lot to study the minute details of this intricate piece of chemical history and summarise the evidence on both sides. But we suppose someone will have to worry out this little matter before very long.

* * *

Hardly anything in this world is so important as etiquette. We are therefore very grateful to a Cambridge correspondent who has furnished us with some kindly hints. Perhaps dress plays as important a part as behaviour in the minds of many people, and the rules as to dress vary as one travels from place to place. Our obliging correspondent informs us that one ought not to take as an example the Don who apologised for attending a College feast minus a collar, because it was in the wash. This incident belongs to some years ago, and even those who wear beards should dress remembering that our clerical friends lay stress on the reality of the unseen. We are informed that unless one is a College porter and *ex-officio* entitled to the distinction, one should not wear a silk hat in Cambridge; nor are frock coats or morning coats expected at garden parties, receptions or meetings. Visitors do not wear academic dress at Cambridge; it simply is not done. Those dining in the Hall do not wear evening dress unless the occasion is a special banquet or the dinner is to be followed by some entertainment which imperatively calls for evening dress. Visitors staying in College are expected to walk round the quadrangle in scanty raiment when seeking a bath before breakfast. In no circumstances may anyone walk on the grass in the quadrangles. The lawns here and in some of the gardens have been rolled and mown for several hundred years and are to be admired, not used for exercise. A number of minor points of difficulty have been indicated, and every visitor to Cambridge should take an early opportunity of learning the traditions. A new M.P. once asked Mr. Dillon how to learn the rules of the House of Commons. The reply was, " Break them ! " This is what Calorifer calls the heuristic method, but the rule about walking on the grass is an exception, even for experimental and heuristic purposes this feat must not be attempted.

PASTEUR CENTENARY CELEBRATIONS

By H. LLOYD HIND, B.Sc.

It was an honour for a simple member of the Society of Chemical Industry to find himself, in the picturesque French phrase, a " personnalité," guest of the French Government, and associated with the learned of the world in doing homage to France's great scientist, Pasteur. The *fêtes* were much more than the centenary of the birth of Pasteur; they were in truth a celebration of the fraternity of science in all countries. Pasteur stands for the spirit of French science in a way that no other man does, and probably in no other country is such a representative figure known. His name marks a new epoch in medicine and industry, indissolubly linked with that of his beloved country, but the benefits of his work have spread worldwide. It was fitting that the French Government should take this chance of consolidating foreign friendships by the chain he forged: a chain whose links are the bonds that bind humanity in a common effort to stamp out disease and misery.

Delegates have come from East and West, from America to China, representing Governments, universities and scientific societies, united in their sympathy with France and their desire to honour her famous son whose guiding stars were patriotism and humanity. The celebrations have taken many forms, solemn ceremonies and entertainments. Received in the gorgeous rooms of the Elysée Palace by the President of the Republic and his gracious wife, the delegates were at once set at their ease and made at home. There was no sign of the coincident Cabinet crisis as M. Millerand turned from the heavy duties of his office to welcome the guests in the name of France. There old friendships were renewed as visitors from one continent met those from others, as they settled down to enjoy the entertainment provided in the brilliantly-lit Grand Salon. It is perhaps to be feared that the words of the scene from Molière were lost in the babel of whispered conversation, but the dances by members of the ballet from the opera were understood and appreciated by all.

The following two days were given up to solemn and moving commemorative ceremonial. Meeting at the Institut Pasteur, the monument the master lived to see raised to crown his work, and where he lies buried with the simple statement of achievements as his noble epitaph, the delegates visited the scenes of his later work, saw his apparatus and stood before his tomb adorned with wreaths and flowers among which one bore the inscription :—

> From His Britannic Majesty's Government with deepest admiration and profound gratitude to a great savant to whom mankind owes so lasting a debt of beneficence.

The afternoon saw the climax of the Paris celebrations; the meeting in the great theatre of the Sorbonne presided over by the President of the Republic, when orations in honour of Pasteur were delivered by the Rector of the Academy of Paris and by the Ministers of Education and Hygiene, and addresses were presented by the representatives of Governments and universities, including Sir Charles Sherrington and Sir Anthony Bowlby, representing the Royal Society and the Royal College of Surgeons respectively. Amongst those present were Brigadier-General Leishman, representing the War Office; Sir W. J. Pope, K.B.E., and Prof. H. E. Armstrong, representing the Chemical Society; Mr. A. Chaston Chapman, representing the Institute of Chemistry; Professors H. B. Baker, A. Findlay, and T. M. Lowry; and Messrs. J. M. Lones and Lloyd Hind, representing the Institute of Brewing. Feeling was intensely stirred by the music of the "Marseillaise," sung by girls of the secondary schools of Paris to the band of the Republican Guard. At the Sorbonne the British delegates took a very intimate part in celebrating with France the tie that binds the two countries through the association of Lister and Pasteur. Here is the great picture showing Lister's tribute to Pasteur, and here in the presence of the British Ambassador and delegates in their academical robes, was unveiled the marble tablet erected by the University of Paris to commemorate the fraternal embrace of the two scientists, symbolic of the friendships of the two peoples.

On the Saturday thoughts of the earlier days of Pasteur at Paris were called up by a visit to the Ecole Normale and of the fame of his later years there by a reception given by the Municipality of Paris. A commemorative plaque was unveiled on the house in which he lived when a student at the Ecole Normale, and in the little room in the college which later served as his modest laboratory, now decorated with a fresco portraying him at work, one seemed to sense the enthusiasm with which the young experimenter carried on his epoch-making work on the tartrates and the excitement when he found his views on optical activity and crystalline form confirmed by the polariscope. In this work was the germ of all his future studies. The minuteness of experimentation was typical of the care which was the basis of his far-reaching discoveries on fermentation and disease: discoveries which made it possible to associate with the centenary of one man advances in medicine, biology and chemistry contributed to by many hands but built on the foundations he so surely laid. The splendours of the reception at the Hôtel de Ville were worthy of so great a city. Paris, in common with Strasbourg and many a smaller town visited by the President during this memorable week, rendered its tribute to the devoted work which so closely touched the well-being of their hospitals and their public health. So far as Paris was concerned, the commemoration ceremonies were now over, but the hospitality of the French Government was far from exhausted. Sunday was a day of rest for some, but not for a large number of ladies at Paris who carried the war in the streets of the city and, by selling "Laboratory Day" emblems, gained 500,000 francs for the Pasteur Institute. The day was closed by a grand gala performance at the Opéra and followed on Monday and Tuesday by a banquet to 1200 guests at Versailles and a visit to the Palace of Chantilly organised by the Institute of France. Dining in the great hall at Versailles, surrounded by the gigantic battle pictures, and wandering in the park, where the Grands Eaux delighted the eye, or among the ghosts of Marie Antoinette's Court at Trianon, one felt how out of place the modern man in black is among the golden galleries decorated for the Grand Monarque and his glittering court. Here another bust to Pasteur was unveiled, placed, perhaps rather incongruously, in the Galerie des Glaces among the glories of a departed age, but typifying the dawn of a better if more drab age of health. Chantilly was more intimate, the pleasures of the charming park being added to by the echoing calls of the French horn and completed by a visit to the Museum and Picture Gallery.

Carried by special trains to Strasbourg, the delegates assisted at what the French called the Apotheosis of Pasteur at the City and University of Strasbourg, where several years of his busy life were spent. A permanent museum built in connexion with the Institute of Bacteriology to show every phase of Pasteur's work, and an international exhibition, unfortunately still incomplete, connected with such industries as have benefited by his discoveries, were opened by the President of the Republic. The evening was made memorable by a reception at the Town Hall. The great Place de Broglie, gay with festoons of blue, white and red lamps, was thronged with people calling for speeches from Millerand and Poincaré from the balcony. The playing and singing of the "Marseillaise" and the torchlight parade of soldiers marked with enthusiasm the climax and concluding scenes of a memorable week—memorable to France politically, showing the unity of Alsace and itself and the friendship of the nations who had sent scientific delegates, and an indelible memory to the delegates who had come so far to honour France in her great chemist. They had met old friends and made many new ones, and would return impressed with a sense of the confidence of the people in a future bright with hopes of health and prosperity founded on scientific progress.

The Chair of Agricultural Chemistry and Bacteriology in the University of Göttingen has been offered to Dr. A. Kipple.

A METHOD OF MAKING NON-FINGERY COKE FROM BITUMINOUS COALS HIGH IN VOLATILE MATTER

By KOTARO SHIMOMURA

Practically all the coals in Japan are high in volatile matter, ranging from 38 to 40 per cent., and when heated in coke ovens give what the Americans call "fingery" coke. The usual method to remedy the ill effect is to mix with anthracitic coals in order to lessen the percentage of volatile matter. It has been found that by-product coke-ovens have a tendency to increase the density at the expense of augmenting the fingery condition, an effect rendered more conspicuous after stamping. For such coals, beehive ovens give better results, owing, it is supposed, partly to slower heating and partly to the tar running down and filling up the incipient cleavages. Experience showed that with such coals the by-product ovens gave a product no better than gas coke.

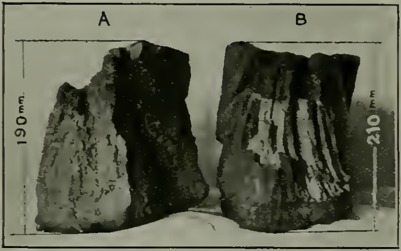

Fig. 1

In 1908 the writer was granted a patent (Jap. pat. 13,583) for his method of making metallurgical coke with bituminous coals, which being translated into English runs thus:—

Our coals having mostly a high percentage of volatile matter, the coke produced from them contains the lines of cleavage so closely situated that it easily shatters to pieces, which renders it worthless for metallurgical purposes. Generally speaking, in order to produce good coke out of such coals it is a common practice to mix them with coals of low percentage of volatile matter, especially with coals of an anthracitic nature. But the resources of such coals in our country are so limited that dependence on the anthracites makes the manufacture of coke a very precarious business.

The object of my invention is to make the coke manufacturer independent of anthracites or coals of low volatile matter, in the production of non-fingery coke. The method of attaining this object I will explain hereunder.

A coal of high volatile matter is charged into a suitable retort or oven, and distilled till it parts with a certain portion of volatile matter, when it is quenched. To accomplish this beehive ovens are unsuitable; a special apparatus heated with gas from the outside gives the best results. The proper degree of heating depends upon the nature of the coals used; but generally the temperature most suitable lies between 300° and 600° C. The object in view is to leave in the coal an amount of volatile matter ranging from 15 to 25 per cent., depending on the nature of coal. The amount of volatile matter to be left is to be decided by actual experiments with the particular coals employed. The product thus obtained is quenched in water, and if necessary, ground and washed free from foreign matter. It is then mixed with the bituminous coals in the proportion of 20 to 35 per cent. of the former, and 80 to 65 per cent. of the latter. With good caking coals it is possible to mix the product to the amount of 35 per cent. The mixture is then charged into coke ovens and heated at the usual temperature, ranging from 1000° C. to 1400° C. If it is desired to obtain coke of high density, it is recommended to heat it at a temperature as high as the bricks of the oven permit; when it is desired to obtain coke of comparatively porous character, a temperature of about 1000° C. is most suitable.

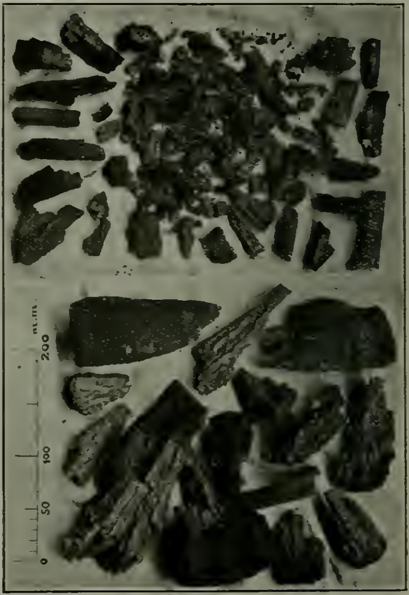

Fig. 2

The sphere of my invention for which I claim the right of patent is stated as follows:—

(1) The method of making non-fingery coke out of a bituminous coal, without using natural coals of low volatile matter; according to which a certain coal is heated at a temperature between about 300° C. and about 600° C., so as to leave from 15 to 25 per cent. of volatile matter in the coal; this coal is mixed with the unheated coal in the proportion of 20 to 35 per cent. of the heated coal, and 80 to 65 per cent. of the unheated coal, and the mixture is heated at a temperature between 1000° C. and 1400° C. (2) The method of making non-fingery coke out of bituminous coals without using natural coals low in volatile matter; according to which a coal or a mixture of coals is heated as described under (1), and this coal or the mixture of coals thus heated is mixed with the unheated coal or the mixture of unheated coals in the proportion given in the method (1), and heated in the same way.

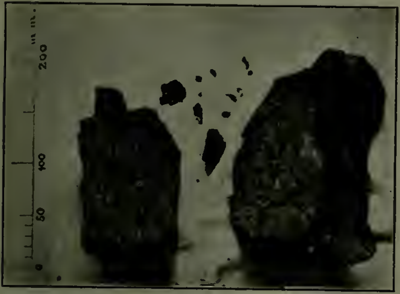

Fig. 3

(3) The method of making non-fingery coke by using coals which had been heated at a suitable temperature to supply the deficiency of the natural coals of low volatile matter; according to which, when the natural coal of low volatile matter is insufficient, that is, when, say, 20 to 35 per cent. is wanting, the balance required is supplied by coal or coals whose volatile matter had been artificially expelled, as described in (1) and (2).

The Japanese Government, after thorough investigation of the patented process, and of the actual working of the plant at Osaka, in view of the paramount importance of the process, has recently granted another term of protection from 1923 to 1930. Fifteen years ago the fuel question had not assumed the importance it has taken to-day. Connected with the recovery of low-temperature carbonisation oils the method of utilising the residue for such a purpose as the manufacture of metallurgical coke is considered by some to be entitled to sympathetic encouragement.

Certain characters of the semi-coal are essential for the successful attainment of the object, among which the amount of volatile matter left is one of great importance. When the semi-coal contains less than 15 per cent. volatile matter, the coke produced will be found to be inferior in quality. When common coke breeze is used, although the fingery condition disappears, the mass obtained is not compact, the particles being loosely cemented together. Another essential qualification is that the particles of semi-coal must have very nearly the same amount of volatile matter. Hence for the practical working on a large scale, the difficulties encountered were found to be somewhat serious. In carrying out the process, an apparatus was designed, bearing in mind the following points:—

(1) Brisk agitation is necessary to prevent the coal from caking in large pieces.

(2) The apparatus is to be provided with the fewest projections or appendages possible, consistent with its proper working, in order to prevent semi-coal from hanging on and accumulating.

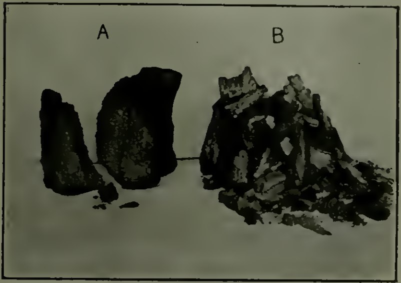

Fig. 4

(3) For evident economic purposes, the operations of feeding and of discharging must be continuous, for which object the agitating and conveying must go together.

(4) Easy access to all the parts of the inside of the retort throughout its entire length without stopping the working is necessary for inspecting and cleaning when needed.

(5) The possibility of easy regulation to suit different kinds of coal. The apparatus, designed so as to meet all the above requirements, was found to work quite smoothly, and the writer is satisfied with the successful practical working on a large scale.

It is quite surprising what a great difference it makes when this semi-coal is used for mixing. It was found that as the quantity of volatile matter decreases below 15 per cent., the compactness of coke decreases, though the cleavages are absent. The photographs in the text illustrate the great difference between the coke made from the mixture, and that from the straight coal.

The coal used for the specimens in the photographs is "Koyaké," one of the two best caking coals found in Japan. It contains 6–7 per cent. of ash, 0·8 per cent. of sulphur and 38–39 per cent. of volatile matter. If heated in beehive ovens, it gives a tolerably good coke, but in by-product ovens its fingery characteristics are quite conspicuous. Fig. 1 is a photograph of the two samples of coke; A is the coke made from the coal mixed with the semi-coal, containing 15–17 per cent. of volatile matter, and B that from the coal unmixed. These are fair samples obtained by coking in Semet-Solvay ovens under equal conditions of heat and duration. The same pieces after being photographed were dropped from a height of 12 feet upon a concrete pavement, and their condition after falling is shown in Fig. 2 and Fig. 3, the photographs being taken from above. Fig. 2 represents the broken pieces of B arranged by size, and Fig. 3, those of A. Fig. 4 is the photograph of the broken pieces of the respective samples, the shattered pieces of B being here shown piled one upon another, and the divided pieces of A standing up. This striking difference is noticed to almost the same extent when the finished products pushed out from the ovens fall on the coke side pavement. In point of hardness, compactness and size of pieces, the coke made from the mixture is found to be equal to the best grade of European coke.

MEXICAN PETROLEUM OUTPUT IN 1922

The petroleum industry in Mexico faced a most critical period in 1922, and the low demand left stocks estimated to be sufficient to supply the world for about six months of 1923. Production started in 1922 with the highest figures yet registered for one month, the output in January reaching 20,641,862 barrels. Afterwards there was a slight decline, but production was maintained almost constant until June, when the output was not less than 179,265,000 barrels, which, although lower than the figure for 1921 (193,397,587 barrels), is still very high. Mexico thus continues to occupy the second place among the petroleum-producing countries, the United States coming first. Up to September, 1922, the latter country had under exploitation 275,000 oil wells, which yielded 1,503,000 barrels daily, an average production of 5·5 barrels per well daily. In Mexico, during the same period, there were in exploitation only 274 wells, which gave an average daily output of 1358 barrels each. This shows that even though some of the large Mexican deposits are rapidly declining, the output was nearly 300 times larger than that of the United States—a fact which not only shows the great importance of Mexico's contribution to the world's oil supply at present, but may also prove of greater significance in the future.

FORTHCOMING EVENTS

June 12. University of London, St. Bartholomew's Hospital Medical College, West Smithfield, E.C. 1, at 5 p.m. "Tropical Hygiene," by Dr. A. Balfour, C.B. Also on June 14, 19 and 21.

June 12 to 14. Institution of Mining Engineers. General Meeting, Royal Technical College, George Street, Glasgow.

June 14. Chemical Society, Burlington House, Piccadilly, W. 1, at 8.30 p.m. "Les Gazes Rares des Sources Thermales, des Grisous et Autres Gazes Naturels," by Prof. Moureu.

June 15. The Royal Institution of Great Britain, 21, Albemarle Street, Piccadilly, W. 1, at 9 p.m. "Life History of an Alpha Particle from Radium," by Sir E. Rutherford, LL.D., D.Sc., F.R.S.

June 16. The Royal Institution of Great Britain, at 3 p.m. "Atomic Projectiles and their Properties," by Sir E. Rutherford.

June 16. Society of Chemical Industry, *Edinburgh and East of Scotland Section.* Excursion to Melrose and Abbotsford, leaving Edinburgh at 1.30 p.m.

June 16 to 20. Meeting of the Union Internationale de la Chimie Pure et Appliquée at Cambridge.

June 20 to 23. Society of Chemical Industry. Annual meeting at Cambridge.

June 28. The Institution of Electrical Engineers. The annual conversazione will be held at the Natural History Museum, South Kensington, S.W., at 8.30 p.m.

SULPHUR INDUSTRY IN CHILE

Chile possesses important sulphur deposits scattered along the chain of the Andes close to the numerous volcanoes of that region. Some deposits, however, are situated at such a high altitude that work is impossible except during summer; others cannot be easily worked because they are in volcanic regions; and a hindrance to the general development is the absence of roads. The most important deposits which have been developed and worked are in the northern zone between the provinces of Tacna and Antofagasta. Production gradually increased up to 1920 owing to the rising demand for sulphur for making powder for the nitrate mines, to the progress in Chilean chemical industry and to increased exportation. The output, however, fell from 13,340 tons in 1920 to 9670 t. in 1921, largely owing to decreased exportation. Future development of the industry depends on progress in Chile's chemical industry and on the provision of improved methods of extraction and transport facilities.—(*U.S. Comm. Rep., May* 7, 1923.)

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

THE MINING EXHIBITION which is being held at the Agricultural Hall provides an opportunity for those who desire to see the latest developments in this industry. I spent an interesting hour looking at the exhibits which have been got together from France, Belgium, Holland, Mexico, Rumania and various other parts of the earth. The Department of Scientific and Industrial Research, the Imperial Mineral Resources Bureau, the Imperial Institute, and the Imperial College of Science and Technology seemed to have vied with each other in producing a number of most interesting exhibits to represent Great Britain's share. I think the most interesting feature is the number of Conferences which have been arranged to take place. There has always been some doubt as to the possibility of getting Conferences of this kind attended by the right people. I see that, apart from those Conferences which relate directly to Mining and Metallurgy, two lectures are to be given, one by Mr. E. I. Lewis, on "The Importance of Fine Chemicals in Industry," and the other by Mr. Edmund White, on "The Purity of Chemical Reagents." These are to be delivered on June 14th, and on the same day there will be a reception for the Société de Chimie Industrielle, and the Union Internationale de la Chimie Pure et Appliquée.

TWO INTERESTING CASES are to come before the Referee under the Safeguarding of Industries Act. It is some time since the last case was heard. The two new cases deal respectively with Formaldehyde and Rochelle Salt, and I suppose we shall witness the usual spectacle of those who desire to import the foreign chemicals bringing forward a number of witnesses who are prepared to give it as their opinion that neither of these chemicals are synthetic organic chemicals or fine chemicals, and on the other side there will be an equal number who will go into the witness chair and endeavour to prove the contrary. I rather thought, as the interval since the last case became longer and longer, that we had had the last of these somewhat dreary proceedings. Apparently it is not so, and we shall soon be back at the old game again. The Formaldehyde case will be heard in the Conference Room of the Board of Trade, on June 15, at 10 a.m.

I THOUGHT PROFESSOR HELE-SHAW'S paper on Monday was very good. He described his stream-line filter to the London Section of our Society and he did this in a manner which was equally pleasing to his audience and himself. He is really quite a highbrow man, full of weird learning of the most abstruse and terrifying kind, but he talked to us with the simplicity—well assumed—of a man with just enough skill to make a few small models and with plenty of spare time which he was not going to misuse by spending on chemical and other problems far beyond his small intellect and limited energy. His pose of handing to the chemists a little toy with which they could do their own dirty work of filtration was maintained until the end and his airy way of offering a few of these filters to chemists on the footing that they would tell him the cases in which they might be useful was a delicate piece of leg-pulling. I cannot remember a more ingenious piece of apparatus nor an explanation framed in such easy and elementary terms. Even an editor could have understood it! The filter is going to be an important instrument in the hands of most chemists and will solve a very large number of difficult problems and in spite of Dr. Hele-Shaw's kind words about sundry competing apparatus it may become an important competitor of some of these. When he next doth read a screed, may I be there to hear!

AT THIS SEASON of the year I have forgotten what the young man's fancy turns to, but the chemist of maturer age has his attention directed towards dinners. On Wednesday this week the Anglo-Batavian Society entertains Professor H. A. Lorentz to dinner in recognition of his work on the refraction of light, his calculation of the respective merits of various formulæ defining it compiled by Gladstone and Dale, Landolt, and L. V. Lorenz, and his investigation of the Zeeman effect. On the 14th the Chemical Club entertains Professor Moureu and his French colleagues to dinner; on the 15th Mr. C. S. Garland, M.P., and some of his colleagues in the House of Commons will entertain the French visitors, who will then be in London. I am told that Lord and Lady Inverforth will be present and some others who are glad to take an opportunity of showing our visitors how welcome they are. After this a number of banquets are arranged at Cambridge, at Northwich and elsewhere. Thick and fast they come at last and more and more and more. I cannot remember what poet wrote this line, but it seems quite familiar.

THE FULLERIAN PROFESSORSHIP of Chemistry at the Royal Institution has, I hear, been filled by the appointment of Sir William Bragg. Sir William has had a very wide experience, having held professorships at Adelaide, Leeds and London, and his research work, chiefly on radio-activity, has brought him recognition in the shape of numerous honorary degrees. I look forward to more of his interesting discourses in the lecture-theatre of the Royal Institution.

SOCIETY OF CHEMICAL INDUSTRY

THE ANNUAL MEETING

CAMBRIDGE. JUNE 20 TO 23, 1923

Addresses. The title of the President's address to be delivered on Thursday, June 21, is "Chemistry and Industry," and that of Dr. Charles Carpenter's address on the following day is "The Evolution of a Chemical Industry."

Accommodation of Members in Colleges. Accommodation will be available for men in various colleges from the afternoon of Wednesday, June 20, to the afternoon of Saturday, June 23. Members who arrive on Wednesday will be charged an inclusive fee of £3, those arriving on Thursday an inclusive fee of £2. These fees include the use of a set of rooms (bedroom and sitting-room), attendance, gratuities to college servants and the following meals: *Wednesday, June* 20.—Tea (if required) and dinner. *Thursday, June* 21.—Breakfast, lunch and dinner. *Friday, June* 22.—Breakfast, lunch and dinner (if required). *Saturday, June* 23.—Breakfast, and lunch (if required). Members will usually take their breakfasts in their rooms. Luncheon and dinner will be served in the halls of colleges. On Thursday and Friday tea will be served at the Vice-Chancellor's reception, and at the Garden Party at Sidney Sussex College respectively. Members who arrive before five o'clock on Wednesday, and who will require tea, are requested to give notice to that effect on a form to be supplied. There will be no extra charge. Members unable to attend the Annual Dinner of the Society on Friday, and desirous of dining in college that evening, may do so without extra charge by giving notice to that effect on the form above referred to. Members who do not make the trip to Ely, and who require luncheon before leaving Cambridge on Saturday, may obtain it in college on that day without extra charge.

It is important to note that alcoholic drinks are not included in the charges specified above, and members requiring such drinks with their meals must sign a chit presented by the waiter at the time of ordering. Payment for such must be made by members at the office of the Society at the Arts School, Bene't Street, on Saturday, before departure. It is the wish of the college authorities that no money shall change hands at table, and it is hoped that members will kindly co-operate in order that this scheme of payment may be a success.

To the list of colleges offering accommodation given on page 491 of *Chemistry and Industry* of 18th May, Corpus Christi is to be added. As previously stated, men requiring accommodation should communicate with Mr. J. E. G. Harris, the University Chemical Laboratory, Downing Street, Cambridge, who will supply any further information and forward a form to be filled up by the member.

Hotel Accommodation. There are still rooms available at The Bull and at The Blue Boar, but the other hotels are more or less full. There is good accommodation to be obtained in boarding houses (college rooms) should the supply of hotel rooms be exhausted.

The Smoking Concert on June 20 will be held in the dining room of the University Arms Hotel.

Group Photograph. A photograph of the members will be taken at the close of the Annual General Meeting on Thursday, June 21.

Tickets. Tickets for the Smoking Concert, the Reception and Dance, the Annual Dinner, and the excursion to Ely with lunch will be handed to members who have paid the inclusive fee when they register at the office in the Arts School, Bene't Street, Cambridge.

Guide to Cambridge. A copy of the illustrated Guide to Cambridge has been forwarded to each member who has purchased his tickets.

News. Further information will be published from week to week in *Chemistry and Industry.*

Members intending to be present at the meetings are asked to send in their forms with the appropriate remittance as soon as possible, if they have not already done so, in order that adequate arrangements may be made for them.

Nominations to Council.—The following have been nominated under By-law 24 to fill four vacancies among the ordinary members of Council: Professor P. Phillips Bedson, Dr. R. T. Colgate, Mr. William Cullen, Professor A. R. Ling, Dr. Joseph Reilly, and Dr. E. W. Smith.

A ballot list has been posted to every member entitled to vote.

J. P. Longstaff,
General Secretary

ADVANCE PROOFS OF PAPERS

Authors of papers which are to be read before local sections or groups, may in some cases desire to have a few advance proofs for distribution among those likely to make useful contributions to the discussion. Any author who requires such advance proofs is requested to hand the manuscript of his paper to the Local Secretary so that it may reach the Editor at least *one month* before the date of the meeting at which it is to be read, in order to allow sufficient time for it to be considered by the Publications Committee and, if approved, set up in type.

PHOTOGRAVURE OF THE PRESIDENT

A photogravure of the President of the Society of Chemical Industry, E. Frankland Armstrong, D.Sc., Ph.D., F.R.S., is sent out with the issue of the Society's *Journal* for June 8 curt.

NEWS FROM THE SECTIONS

LONDON SECTION

On June 4 a meeting was held in the Rooms of the Chemical Society, Burlington House, to hear a paper on "The Stream-Line Filter," by Dr. Hele-Shaw, F.R.S. Mr. E. V. Evans presided.

In presenting his paper, the author said that he had found in the course of experiments with thin films, that it was possible not only to separate the very finest matter in suspension from the fluid, but apparently even to separate two fluids of different densities if the film were sufficiently attenuated. To do this a fibrous or textile material was used that was impervious to the action of the fluid. A form of laboratory filter was demonstrated in which waterproof paper was used; he had found this paper superior to any other kind of paper tested, as it was impervious, not only to water, but even to boiling water, paraffin, oil, petrol, etc. A filter capable of dealing with water at the rate of 150 gallons per hour and a few laboratory filters were demonstrated. The filters were working on coloured water, paraffin, and oil. The coloured water was deprived of its colour in the filter, as would be the case with peat water, an operation which ordinary filter paper could not effect. Paraffin used for cleaning machinery and which was full of suspended dirt was made clear and transparent and of a light straw colour very similar to that of the original material, whereas on passing through ordinary filter paper it was a reddish colour. The filter was not merely experimental, but designed for commercial use as it was able to treat large quantities of fluid within a very moderate bulk and at a moderate cost and weight. Very severe filtration could be effected, involving very attenuated films and therefore high pressure. The process of filtration was continuous and the residue could be removed without opening the filter, whilst the material used did not seem to deteriorate and so far had not required replacing after severe usage. The capacity of the filter depended, *inter alia*, on the viscosity of the fluid, the dimensions of the apertures through which filtration took place, the area of filtering surface, and the amount of hydraulic pressure which could safely be applied to effect the operation.

The essential points of the stream-line filter were the use of one or more packs of impervious material, preferably paper on account of its lightness and cheapness, each pack being held between two ends called "press heads," which enabled the pressure to be controlled according to the filtration required. With a view to economy, the sheets in the pack were rectangular in form, and to obtain as large a filter surface as possible for what could be called *edge* filtration as opposed to *surface* filtration, each sheet was perforated with an identical number of holes in such a way that the holes lay in alternate rows of large and small holes. When the sheets were put together in a pack (the filter shown contained 4000—5000 sheets), the holes formed tubes. If into one row of tubes the liquid to be filtered was forced under pressure, and the opposite ends of the tubes were closed, the liquid could only escape through the interstices of the sheets, leaving behind the suspended matter in the "inlet" tubes, and passing down the smaller or outlet tubes.

It was obvious that the area of filtration was represented by the area of the inner surface of the larger cylindrical tubes and that was why these tubes were made larger. The smaller tubes were quite sufficient to discharge the filtrate. After a time the larger tubes became more or less filled with residue, and could be washed out after opening the filter. If necessary, the process could be reversed, the smaller tubes becoming the pressure tubes and the filtered material then being washed away. As the operation of washing out the residue from the inlet tubes required at most a few seconds, it was possible to have a large number of packs in which a small percentage, probably not more than 1 per cent., was put out of action at a time. Filtration could thus be made continuous, if to the necessary dimensions required for full filtration a very small addition was made, even a fraction of 1 per cent. of the required capacity of the filter, the same mechanism which operated the pump opening and closing alternately the discharge taps for the residue.

Assuming that there were 50 pairs of holes in a sheet and 5000 sheets in the filter, there would be a quarter of a million large inlet and small outlet holes in a pack, the one shown being 2 ft. 6 in. high by 1 ft. square. By putting, say, six packs in four rows one above the other, the whole occupying less than 100 cb. ft., there would be 6 million units. The filter demonstrated discharged at the rate of 150 gallons per hour, so that 100 cb. ft. represented the volume of a filter filtering 3600 gallons per hour.

The pressure required depended entirely on the fineness of filtration and the viscosity of the fluid. If the liquid were water from which colouring matter and possibly even bacteria had to be removed, 100 lb. would be reasonable pressure and less than 4 h.p. would be required for pumping, etc.

In the ensuing discussion, Prof. J. W. Hinchley observed that although the stream-line filter would not replace entirely any existing filters, it would probably prove a most valuable adjunct and would find a great variety of new uses. Mr. J. A. Reavell also pointed out the wide ranges of uses that would be suggested for the new filter, uses that were discussed more in detail by Dr. W. R. Ormandy, Mr. F. H. Carr, Mr. Julian Baker, Mr. W. McNab and others.

MEETINGS OF OTHER SOCIETIES

THE FARADAY SOCIETY

The long postponed symposium on "The Physical Chemistry of the Photographic Process" was held at the Institute of Electrical Engineers on May 28 with Sir R. Robertson in the chair. Amongst the numerous visitors, many of whom had travelled far to be present, were Prof. W. D. Bancroft, of Cornell University, Profs. Luther and Goldberg, of Dresden, Monsieur Clerc, of Paris, and Dr. Errera, of Brussels.

Prof. Bancroft in his opening brief introductory address, divided his remarks into three sub-divisions: The Emulsion, the Latent Image, and Development. A theory of emulsion making, he said, is lacking, and must remain so until the actual makers of the emulsions are prepared to divulge some of their jealously-guarded secrets, and give outside scientific investigators sufficient data to form a working hypothesis and so in this way open up a new point of view. Passing on to plate sensitivity, he showed by eliminating in turn all other possibilities that he was driven to conclude that the sensitivity of a ripened emulsion was due to a complex of silver halide, gelatin, and water. He suggested that the experimental manufacture of an emulsion by dispersing pure silver halide in gelatin would probably give us information as to whether in the complex the gelatin was actually entangled in the crystal lattice. Why gelatin still remained the best sensitising agent for silver halide was still an open question, and little seemed known on this point. Considering grain sensitivity, he dealt with the two main hypotheses put forward to explain it. He disposed of Silberstein's "light dart" theory by quoting W. Clark's work carried out at the British Photographic Research Association Laboratories on the action of sodium arsenite on a photographic plate, in which Clark showed that this action duplicates that of light. He was, therefore, driven to accept the hypothesis that the grains upon a photographic plate made with a ripened emulsion exhibited a range of sensitivity. He considered the question of the formation of the latent image quite settled. The latent image consisted of silver adsorbed by the silver halide, the explanation put forward by Carey Lea many years ago, and afterwards confirmed by the voluminous work of Lüppo-Cramer. The possibility of the formation of a subhalide was dismissed, since no subhalides could be isolated, and the latent image behaved as a phase of continuous varying composition.

In discussing the theory of development, Prof. Bancroft said that no present-day theory faced all the facts. A developer was necessarily a reducing agent, yet all reducing agents were not developers. Reducing agents could be divided into three classes respecting their action upon the photographic plate; the first class, exemplified by formaldehyde, reduced the whole of the silver halide, *i.e.*, both the exposed and unexposed portions of the plate; the second class comprised the ordinary developers, which produced negatives in the usual way, and the third class those substances that produced positives even with short exposures of the plate. It is, therefore, a question of reaction velocity; if the latent image was more rapidly reduced than the unexposed silver halide, a negative was produced; if the latent image, and the unexposed bromide were reduced with equal velocities, we had the conditions of the action of the first class of reducing agents, and finally, if the unexposed halide were more rapidly reduced than the exposed halide, a positive resulted. He postulated, therefore, the existence of selective adsorption of the reducing agent by the exposed and unexposed silver halide. If this adsorption was greater for the exposed than for the unexposed silver bromide, the former would develop more rapidly than the latter, and a negative be produced. The other cases could be explained similarly.

If this explanation was true, selective peptisation should take place, and it should be possible to remove the latent image by washing a plate in a solution of a developer *without alkali*. Preliminary experiments made in the Cornell laboratories had indicated that this was possible: an exposed Seed 23 plate had the whole of the latent image removed by washing with a non-alkaline metol solution.

The subject was now divided into four sections.

Dr. Slater Price, of the British Photographic Research Association, opened Section I with a paper on "Gelatin and Collodion." He pointed out that nothing was known about the sensitising action of gelatin on silver halide, but that many of the physical properties of gelatin had been correlated with the practice of photography.

Dr. Chr. Winther's (Copenhagen) paper, showing no change in the solubility of silver bromide in the presence of gelatin and ammonium bromide, was communicated by Sir R. Robertson. This paper was supplemented by Prof. J. W. McBain, who gave similar details of the solubility of silver chloride, but also added that freshly precipitated silver chloride in the presence of a colloid was approximately 20 per cent. more soluble than when, after a few hours, it had reached a stable state.

Dr. F. C. Toy, of the British Photographic Research Association, opened Section II, and chiefly devoted his attention to the inadequacies of Silberstein's quanta theory of photographic action. He showed from the results of his own investigations that this theory would not in its present form explain the experimental facts; he himself had been forced to assume the presence of some foreign matter on the surface, or inside the grain, to account for the grain sensitivity, the production of which probably took place during the manufacture of the emulsion. This foreign matter after exposure produced development centres on the grains, and the experimental relation between the number of centres, and the wave length of the light used, though contradictory to Silberstein's theory, was that which one would expect when allowance was made for the light absorption of the grains.

Mr. W. Clark, of the British Photographic Research Association, again emphasised the heterogeneity of the grain in the photographic emulsion. He showed that by treatment with dilute chromic acid, the speed of a previously exposed plate was reduced to a low minimum. He claimed to have removed the specially sensitive spots from the halide grain by the chromic acid treatment; moreover, the accompanying increase in the gamma of the treated plate suggested that this treatment had made the sensitivities of the grains more uniform by the removal of the most sensitive points.

Dr. Errera, Brussels, contributed a paper on the sensitivity of asphalt, and Mr. Crowther, of the Kodak Co., gave a brief summary of a paper by E. P. Sheppard, F. A. Elliot, and S. S. Sweet, of the Kodak Research Laboratory, on the photographic chemistry of gelatin.

After the tea interval, it was made clear that the majority of the speakers were antagonistic to Silberstein's quanta theory in its present form. The subject was perhaps best summed up by Prof. Porter, who said that the light-dart theory as it stands was quite impossible, because it had been proved that spatially discrete quanta in the free ether did not exist. It was necessary though to utter a word of warning. If the developability of the grain depended upon electron emission, then some form of the quanta theory would be necessary, but not as regards the *incident* light.

Mr. Bloch, Ilford, opened Section III with a discussion of the methods of plate sensitometry. He pointed out the complete inadequacies of present-day methods of expressing sensitometric properties of plates, and showed that if the object for which a plate was to be used were specified a knowledge of the characteristic curve gave considerable help, otherwise no satisfactory method had been devised for expressing the sensitometric properties of a plate.

Mr. T. Thorne Baker, Imperial Plate Co., considered the characteristic curves produced with filtered X-ray radiation, and showed that they closely resembled the ordinary characteristic curve, but the curve produced with unfiltered heterogeneous X-ray radiations practically consisted of only a long "foot," no straight line portion being apparent.

The meeting then adjourned to dinner, which was held at the Hotel Cecil. After dinner, Prof. Luther continued Section III with a paper on the characteristic curve. He has been able to obtain an equation for the foot of the characteristic curve, after the examination of over 700 typical characteristic curves, and hence to give an explanation of the Watkins system of factorial development.

Prof. Goldberg, of Dresden, gave a summary of the uses of his wedge in photographic investigations, and also a short demonstration of the manufacture of such a wedge. He also showed a new method of measuring halation.

Mr. Pledge, Kodak Co., read a paper by L. A. Jones, of the Kodak Research Laboratory, on some new instruments used in photographic sensitometry. The paper clearly gave a short description of some of the ingenious methods used by the Kodak research workers.

With the time limit drawing near, the meeting concluded with M. Clerc, Paris, reading Lumière and Seyewetz's paper on toning of sulphide prints, in which it was shown that the toned image of a red gold-toned sulphide print probably contained a double sulphide of silver and gold.

It was, perhaps, unfortunate that such a large number of papers had to be dealt with in such a short time. The limited period both for reading of papers and the discussions left a feeling of incompleteness and rush, which would have certainly been emphasised but for the admirable chairmanship of Sir Robert Robertson. It is noteworthy that, although fundamental investigations on this subject were commenced only a few years ago in this country, numerous references were made to this comparatively recent work.

PERSONALIA

On the occasion of the meeting of the International Union for Pure and Applied Chemistry at Cambridge the degree of D.Sc., *honoris causa*, will be conferred upon Prof. W. D. Bancroft, of Cornell University; Prof. E. J. Cohen, of the University of Utrecht; Monsieur A. Haller, President of the Académie des Sciences; Prof. C. Moureu, of the Collège de France; Prof. R. Nasini, of the University of Pisa; Prof. A. Pictet, of the University of Geneva; and Prof. F. Swarts, of the University of Ghent.

Sir William Bragg has been elected Fullerian Professor of Chemistry in the Royal Institution, Director of the Laboratory, Superintendent of the House and Director of the Davy-Faraday Research Laboratory, in succession to the late Sir James Dewar.

* * *

The deaths are announced from Germany of Prof. H. Goldschmidt, a well-known German chemist and the discoverer of thermite; of Prof. W. Roser, director of Meister, Lucius, und Bruning; and of Prof. M. Gary, an authority on the testing of building materials.

CORRESPONDENCE

THE EXISTENCE OF AMMONIUM IN SOLUTION

Sir,—Prof. R. M. Caven, in support of his point of view, quotes from Holleman's Text Book (*Chemistry and Industry*, 1923, p. 449). In this quotation occurs the statement: "We should expect ammonium hydroxide, so far as it is formed, to be extensively ionised, like strong bases, inasmuch as the ammonium salts of strong acids such as the chloride and nitrate react neutral."

Now for N/100 ammonium chloride solution C_H is about $0{\cdot}2 \times 10^{-5}$, which is acid to phenolphthalein and even to litmus. Moreover, it shows that hydrolysis has taken place, a point which is quite obscured by the phrase "reacts neutral." Is it not time the ambiguous use of the word "neutral" was abandoned, unless the indicator used is specified? And is it fair to draw conclusions such as the above, when a solution of ammonium chloride is acid to an indicator with which sodium chloride gives a neutral reaction?

Prof. Caven is, I take it, only using the reference (of which I have only quoted a portion), to show that the order of increasing alkalinity, chloride, carbonate, cyanide, is the same both for salts of ammonium and the alkali metals, and, of course, this is true whatever indicator is used—even for one to which ammonium chloride "reacts neutral"!—I am, Sir, etc.,

Clifton College F. B. Finter
May 26, 1923

"LUCIFER" ON "CALORIFER"

Sir,—Calorifer's oracular "surface criticism" of me and my proceedings, in your issue of May 25 last, leaves my withers unwrung. I suppose it is merely his way of brightening cricket, and we will accept it as such. But surely it is a case of Satan denouncing sin when, immediately after reproving my use of the word "activated," he proceeded to call steam by what I can only describe as "that horrid and un-English word" *hydrone*, which he seems to have invented for it. For such a glaring inconsistency he deserves to be spitted between two of my radiophragms at their fullest incandescence.

I am sorry that apparently he did not enjoy my Royal Institution discourse; but it is impossible to satisfy everybody, and he who tries to do so usually gets nowhere, and often ends by being called a fool for his pains. Perhaps he would have been better pleased had I made out a case for the notion that carbon monoxide never burns except in the presence of dirty hydrone; but I did not. So he laments, in words which somehow have a familiar ring about them, that "it seems impossible for chemists to arrive at any rational conception of chemical change, or to view the phenomena in any consistent comprehensive manner." It seems as though he were croaking from his corner:—

> There ain't no logic, no bloomin' logic in the land,
> Things they 'appen as we cannot understand;
> 'Tis the truth, wot we're gradually arrivin' at,
> 'Arf the time, we dunno wot we're drivin' at,
> For there ain't no logic, no blooming logic in the land.
>
> (*With apologies to Barry Pain for the slight alteration.*)

The only point calling for remark in his rather hasty criticism of our suggestions as to the possible explanation of our discovery of the specific influence of nitrogen in retarding the combustion of carbonic oxide at high pressures is the proof furnished by paragraphs 8 and 9 of his article that he has entirely missed what is surely the cardinal point of our argument. He objects to the view that nitrogen was "activated" in our experiments on the ground that "each of the three kinds of change postulated or possible in the nitrogen molecule, being the effect of heat, should be equally promoted in the isothermic process of combustion with hydrogen."

I thought it had been made perfectly clear, both in our Royal Society paper and in my Royal Institution discourse, that, inasmuch as the experimental results have shown that in hydrogen-air explosions under high initial pressures nitrogen does not play the specific energy-absorbing *rôle* which it undoubtedly does in the corresponding carbon monoxide-air explosions, in the latter it cannot be regarded merely as "an effect of heat," but must be ascribed to some peculiarity of the vibrational energy acquired and manifested by the carbon monoxide during combustion under such conditions.

As a matter of fact, the idea that the observed lag in our experiments may be accounted for by assuming the reversible formation of nitric oxide was considered by us long ago, but discarded in favour of our present views for cogent reasons. Doubtless a part of the "activated" nitrogen primarily formed in our CO-air explosions at high pressures was oxidised in some experiments to nitric oxide, especially when more oxygen was present than sufficed to burn all the carbon monoxide. But an analysis of the actual pressure curves has shown that any such nitric oxide formation was a secondary effect, and that the results as a whole cannot be explained except on the supposition that the lag was primarily due to the "activation" of nitrogen itself. Besides which, even were the "nitric oxide" supposition to be preferable to that of "nitrogen activation" (which it is not), it would still be necessary to explain (*a*) why the said lag was never observed in our hydrogen-air explosions, and (*b*) in the case of our CO-air explosions, why the replacement of a small part only of the carbon-monoxide by its equivalent of hydrogen removed it. To aver (as does Calorifer) that "in hydrogen such action would occur, if at all, to so slight an extent or would be so rapidly reversible that the effect would not be obvious" is surely a mere begging of the question, and no explanation at all. It would seem as though even our critic's logic is not altogether above suspicion.

Our experimental inquiry is still proceeding, and if our critic will possess his soul in patience until some further results of it are published, perhaps I may yet be his Lucifer. For, however hard it may be to illumine the darkness of an old heathen who worships Hydrones, we will not despair of him, but pray that soon he may:

> Accept the blessed Truth, and cast
> His idols all away.

Meanwhile, to those with open minds who wish to judge the evidence for themselves, we would commend a careful study of the results already published in our recent Royal Society memoir. The original photographic pressure records of our experiments, which eloquently speak of nitrogen "activation" by radiation, can be seen by arrangement at South Kensington. Indeed, without a close examination of the actual records, it is hardly possible to appreciate the full weight of the evidence. The subject of gaseous combustion is of such complexity that perhaps only those who are daily in contact with it can realise how dangerous it is to dogmatise, however much they may wish to view it in Calorifer's "consistent comprehensive manner." But if in its pursuit we remain faithful to the scientific method, and employ our theories as tools rather than exalt them into creeds, we may hope in time to get nearer to the truth of things.—I am, Sir, etc.,

William A. Bone

London. June 1, 1923

Note.—With reference to Professor A. J. Allmand's letter of May 25, he is wrong in supposing me to be unaware of Haber's results.

W. A. B.

GASEOUS COMBUSTION

Sir,—With reference to Professor Allmand's and Calorifer's letters on Gaseous Combustion, I should like to inform you that, through Professor Bone's kindness, I have had the opportunity of scrutinising and closely analysing independently the actual pressure-time curves obtained by him and his co-workers (the late Mr. Haward and Messrs. Townend and Newitt), and have come to the conclusions that :—

(*a*) The slowed rate of cooling after attainment of maximum pressure in CO. O_2 and N_2 mixtures at an initial pressure of 50 atmospheres, can in no wise be accounted for on the assumption that it is due to energy released through decomposition of NO formed during combustion.

(*b*) In the combustion of such gaseous mixtures, when exploded at 50 atmospheres, the nitrogen does, in some manner, absorb a considerable part of the energy released by the oxidation of CO to CO_2.

(*c*) Though in all the experiments with such mixtures NO was probably formed in varying small proportions, yet such NO formation was entirely subsidiary to, and occurred only subsequently to, the said peculiar absorption of energy by nitrogen.

(*d*) The delayed rate of cooling after complete combustion, though probably partly due to decomposition of NO, is for much the greater part a result of the energy absorbed by nitrogen during combustion being released.

I have been convinced from my examination of these curves that the interpretation put forward by Professor Bone and his co-workers is entirely warranted by the facts disclosed by the research.

I should like to add that, in my opinion, a detailed examination of the time-pressure curves obtained by Professor Bone and his co-workers is a necessary preliminary to any real criticism or understanding of the results. Reproductions, other than full-scale photographs, do not do justice to the curves, and may, indeed, be actually misleading. I see no reason why nitrogen in the peculiar state where it has absorbed energy as in such explosions should not, for want of a better term, be called "active nitrogen."—I am, Sir, etc.,

G. I. Finch

10, Gainsborough Mansions,
London, W. 14
June 1, 1923

RAPID FILTRATION

Sir,—As makers of filter papers we are constantly testing papers for rapidity of filtering. This is done by passing 10 c.c. of barium sulphate precipitate, made under standard conditions, into a paper fitted into an accurately turned funnel, and observing the time taken to pass 5 c.c. of clear liquid. Generally a particular batch gives fairly constant results, say 45 seconds. After long experience we found that one of our chemists got far more constant results with a considerably shorter period than anyone else. For a considerable time we could not account for this, but have recently discovered that it is due to the amount of pressure exerted on the folds necessary to fit the paper into the funnel. If this is done lightly by a series of small pressures between the forefinger and thumb the results are constant and fast. If, however, the fold is drawn between the finger and thumb, using greater pressure, the results are nothing like as uniform, and not nearly as fast. In some cases the time taken is quite double that of the other method.

We should be very interested to know if any of your readers have experienced this. Is it possibly due to the surface tension of the fibres being altered due to excessive handling ?—We are, Sir, etc.

H. Allnutt & Son
Laurence Green

Maidstone,
June 1, 1923

NEWS AND NOTES

UNITED STATES

Bibliography of Colloid Chemistry

The National Research Council has recently issued a bibliography of colloid chemistry in mimeographed form (pp. 135, price $1·00). The author, Dr. H. N. Holmes, of Oberlin College, chairman of the National Research Council Committee on the Chemistry of Colloids, intends this edition to be preliminary to a more comprehensive one. All the 1800 references on 106 topics are classified and many are accompanied by brief comment as an aid in deciding on their relative importance. Among the classified groups are Adsorption, Asphalt, Baking, Biocolloids, Capillary Analysis, Casein, Cellulose and Cellulose Esters, Cements, Clays and Soils, Cleansing, Coagulation, Dialysis, Emulsions, Filtration, Flotation, Foam, Flour, Fogs, Gels, Gelatin, Glass, Glues, Gold, Gums, Hydration, Indicators, Jellies, Lubricants, Milk, Paints, Rubber, Sewage, Silver, Soap, Sulphides, Surface Tension, Tanning, Ultramicroscopy, Viscosity, and Water Proofing.

Potash in 1921

During 1921 only 25,485 short tons of crude potash (166,834 t. in 1920), containing an average of 39·9 per cent. of K_2O, was produced in the United States by 18 companies operating 20 plants. Of this production, 11,907 t. was from natural brine, 3366 t. from cement mills, 1257 t. from blast furnaces and 8955 t. from molasses distilleries, beet-sugar refineries and wood ashes. No production was reported to the U.S. Geological Survey from alunite, silicate rock, kelp or wool washings. During the year, large quantities of German and French potash were purchased at low prices, and this, coupled with the general trade depression, the disorganisation of the fertiliser business and high freight rates, was the cause of the large reduction in production. The Experiment Station of the Bureau of Mines continued its investigation of the extraction of potash from low-grade alunite, but the experimental kelp potash plant of the Bureau of Soils was sold in March, 1922. Imports of kainite, manure salts, muriate and sulphate totalled 212.752 t. and of other potash salts 37,493 t., making a total of 250,245 t. containing 81,017 t. of K_2O.

BRITISH INDIA

Final Forecast of the Sesamum Crop, 1922-23

The final estimates of the sesamum crop in Burma, Madras and Hyderabad are as follows: Burma area 865,000 acres, yield 50,000 tons; Madras area 735,000 acres, yield 97,000 t. (92.000 t. in 1921-22); Hyderabad area 530,000 acres, yield 36,000 t. (37.000 t. in 1921-22). In Madras the average out-turn for the province is 98 per cent. of the normal as against 89 per cent. in 1921. The prospects of the late-sown crop are very fair.—(*Ind. Tr. J., Apr.* 26, 1923).

SOUTH AFRICA

Mineral Output in 1922

Figures are appended showing the production of minerals in South Africa during 1922:—

		Output	Value £
Gold	Fine oz.	7,009.858	32,189,587
Silver	,, ,,	1,117,649	171,324
Diamonds ..	Carats	652,248	2,266,631
Coal	Tons (sold)	9,725,479	3,467,412
Copper ore and concentrates ..	Tons	705	37.036
Metallic tin and tin concentrates	,,	612	59,393
Other base minerals ..	—	—	202.993

The total value of the output was £38,394,376, a decline of £12,871,125 compared with the previous year. Production declined generally, an increase being shown only by silver and corundum. The chief event during the year was the virtual cessation of production on the Witwatersrand gold mines during the first quarter. World-wide depression, strikes in the collieries and the decline of prices of gold were adverse factors. It is hoped that in 1923 costs will fall and that this and the increasing domestic consumption will provide some compensation for the loss of the gold premium.—(*U.S. Comm. Rep., April* 23, 1923.)

GERMANY

Reported Discovery of Potash

It is announced in *The Times* that extensive deposits of potash have been discovered at Klein Kuhren, on the Elb near Dannenburg in Hanover, during test borings for petroleum. Below the potash deposits oil has also been found, but not in appreciable quantity. The boring operations are being continued.

Building Materials

A second, enlarged edition of Prof. B. Haberstroh's "Science of Building Materials" (Baustoffkunde) has appeared in the *Sammlung Göschen*. To cover all the progress which has been made in this field during the last twenty years the work has been divided into three parts. The first deals with natural stones, some woods, and iron, the second with the remaining woods and metals, and the third with earthworks, railways, bridges, etc. The last contains an appendix dealing with recent Ministerial Regulations concerning iron buildings. The most important repairing materials are dealt with and some attention is given to materials used in dwelling-houses, from the point of view of conduction of heat.

GENERAL

Standard Cast-Iron Steam-Jacketed Pans

The British Engineering Standards Association has recently issued a Specification, No. 186, 1923 (pp. 15, price 1s.) for cast-iron and enamelled cast-iron steam-jacketed pans. The designs for these pans were prepared by a joint committee of the Association of British Chemical

Manufacturers and the British Chemical Plant Manufacturers' Association. The Specification opens with general requirements as to dimensions, enamelling, working pressures, tests, etc., and dimensions are given in tabular form for pans of both shallow and deep type, the capacity of the former ranging from 26 to 100 gallons and of the latter from 10 to 200 galls., the equivalent capacity in litres being also given. Complete key diagrams provided with dimensions are also included. Copies of the specification may be obtained from the British Engineering Standards Association, 28, Victoria Street, London, S.W. 1.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for May* 31)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Brass and copper tubes and sheets	684
Belgium ..	Paint, varnish, enamel	692
British India	Copper wire (tender)..	*
Bulgaria ..	Linseed oil (tender) ..	10754/F.E./C.C./2
,, ..	Lead ingots, sheets and pipes (tender)..	10753/F.E./E.C./2
Canada ..	Litharge	686
,, ..	Steel, copper and brass tubes	688
,, ..	Steel sheets, tinplate ..	689
Denmark ..	Sugar	693
,, ..	Blue vitriol, copperas	694
Egypt ..	Paper (tender) ..	10833/F.E./M.P.
Greece ..	Iron and steel, tinplate, bar tin ..	696
New Zealand	Paper (tender) ..	11404/E.D./M.P.
Rumania ..	Tinplate, galvanised sheets	701
South Africa	Medicinal preparations	690
Spain ..	Paint, tinplate ..	702
Switzerland..	Pig iron, tinplate, steel	706
United States	Steel scrap, pig iron ..	708
,,	Ores, paint, chemicals	709

* Director-General, India Store Department, Branch No. 10, Belvedere Road, London, S.E. 1.

TARIFF CUSTOMS EXCISE

Canada.—Details of the Budget resolution are given in the issue of May 31, together with a list of duties on various goods, including sugar, metals, iron and steel, chemicals, and oils.

Costa Rica.—The list of goods to which no other tax than a wharfage due is applied, now includes pharmaceutical preparations.

France.—The May 31 issue contains information as to the tariff classification of certain goods, among which are included glass, sodium bicarbonate, iron, oil, coal-tar dyes, steel, cadmium, cement, paper, and sulphur.

Germany.—A general export licence has been applied to dyeing materials, mineral oils, soap, cement, artificial silk, leather, rubber, paper, asbestos wares, and electric cables.

Iraq.—Increased import duties are payable on opium, perfumery, artificial silk, and petrol.

South Africa.—It is proposed to reduce the import duty on calf skins and fine leathers. An Act has also been passed prohibiting the sale and manufacture of adulterated leather.

Sweden.—The import duties on iron and steel have been modified.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Reparation Dyes

In reply to various questions, Sir P. Lloyd-Greame said that the Government had taken measures to avoid interruption of delivery of reparation dyes owing to the seizure of dye factories in occupied German territory by the French. A representative of this country visited the factory and the French provided every facility to identify parcels of dyes destined to this country.—(May 29.)

Imports of Dyestuffs

Replying to Mr. Hannon, Sir P. Lloyd-Greame said that imports of coal-tar dyes in 1913 were 18,894·2 tons (£1,892,055), in 1914 10,676·1 t. (£1,291,430), and in 1922 2929·5 t. (£1,326,174). Precise data of the production of coal-tar dyestuffs in the United Kingdom prior to the war were not available, but it was estimated that the output in 1913 did not exceed about 2500 t., largely from imported intermediates, and was valued at less than £200,000. In 1922 the total output, which owing to trade depression was much below capacity, amounted to 9000 t., entirely from home-produced intermediates, and was valued at £3,000,000. These statistics did not include natural indigo or natural dyestuffs.—(May 29.)

World's Output of Cane and Beet Sugar

Sir P. Lloyd-Greame, in answer to Mr. Hannon, said that the world production of cane and beet sugar was as follows :—

	Cane sugar Tons	Beet sugar Tons
1909-1913 (average) ..	9,971,000	8,432,000
1914	11,293,000	8,331,000
1922, latest estimates ..	14,735,000	5,707,000

—(May 29.)

REVIEW

THE CHEMIST'S YEAR BOOK. *Edited by* F. W. ATACK, *M.Sc., D.Sc.*, and L. WHINYATES, *A.M.C.T., A.I.C. Vol. I., pp.* 422; *Vol. II., pp. vii*+684. *Manchester: Sherratt and Hughes*, 1923. *Price* 21*s*.

To review a book so full of minute detail as this is a very difficult task, as only in detail can it be truly criticised, and the space at command does not allow of much detail.

The volumes evidently make two professions: to be a storehouse of numerical data and tables of physical and chemical constants; and to serve as a sort of condensed textbook of analytical chemistry, pure and applied. The first object appeals strongly to the present reviewer. In regard to the second, it seems to him that the parts of the work dealing with the analytical requirements of special industries will be each one superfluous to the specialist in that industry, and likely to be insufficient for those who are only making an acquaintance with it. The continued development of this part of the work, however, seems to indicate that it meets a general want; but the reviewer would like to ask whether the book could not be so arranged that all the mathematical and other tables, and lists of numerical constants and data, should be grouped in one volume, all the analytical work in the other, and the volumes sold separately. The high price of the book is a serious hindrance to one who knows beforehand that half of it, more or less, will be of no use to him. If at the same time additional tables were inserted—specific and latent heats, heat conductivities, thermochemical, electrical and electrochemical data—the usefulness of the book would be further increased.

Accepting the dual object of the book, it is clear that for full usefulness the analytical directions should be full, clear and unambiguous, however concise they may be; and that the tables and data should be accurate, systematic, and in orderly arrangement for quick and easy reference. It is obviously impossible, in any reasonable time, to test the whole book in these respects: all that can be done is to take parts at random and assume that they are typical; and the reviewer has examined parts that happen to be familiar to him.

In the section on Fuel, for example, the directions for sampling coal are altogether insufficient; they could be followed carefully and literally, and yet a sample be obtained not in the least representative of the parcel sampled. If space does not permit of full and detailed directions for such an operation being given, in language which leaves nothing to the imagination of the (as yet) ignorant operator, they should not be given at all. On the same page the statements that coal at 105° C. may increase in weight through absorption of *air*, that to determine ash coal is *carefully heated* in a crucible, and that sulphides are to be oxidised by *a trace* of bromine water: on the next page the use of two differing methods, with differently specified conditions (and different unspecified conditions) for determining the volatile and the non-volatile portions of a coal; and the suggestion on p. 707 that *petroleum ether* could be used to determine the water in a fuel oil: all these are indications of the lack of that precision which is so necessary in such descriptions—a lack which is not made up for by the vague statement that such experiments should be performed "in a standard manner."

In the cement section, the direction, after adding nitric acid to the concentrated filtrate from the lime determination, to *warm gently* to expel ammonium salts, and the omission from the British Standard Specification of the requirements for tensile strength, setting time, and soundness (though those for specific gravity and fineness are given) are similar instances.

Some of the tables exhibit the same features. Looking at the solubilities of gases, for example, in the table of General Properties, we find, in a column headed "Solubility in 100 parts of water at 15° C.":

Ammonia	597 volumes
Chlorine	1:2·6 volumes
Chlorine dioxide ..	20 volumes : 1
Hydrochloric acid ..	82·5/0°C.
Hydrogen	1·93 volumes
Hydrogen sulphide ..	1:3·23 volumes at 15° C.
Sulphur dioxide ..	688

Of all these, the solubility of hydrogen only corresponds with the heading. The ammonia figure is the amount dissolved by 1 volume, not by 100 volumes, of water; the hydrochloric acid figure is given by weight, whilst all the others are by volume; the figures for chlorine, chlorine dioxide, and hydrogen sulphide, do not show whether 1 volume of water dissolves, for instance, 2·6 volumes of chlorine, or 2·6 volumes of water dissolve 1 volume of chlorine; and what the figure for sulphur dioxide means the reviewer has not been able to discover. Could not all these and similar data be put on one basis, or, if treated separately, be so expressed in each case as to be placed beyond ambiguity?

Some of the tables are indeed misleading. On p. 699, for example, "Miscellaneous data concerning fuels," we have coals described as bituminous, anthracite, and *dry*; and the dry coal contains 15 per cent. of oxygen: is this typical of anything? Further, whilst the bituminous coal (presumably typical) contains 4% of ash, the coke below contains 12%. Further still, whilst this coke, with 88% of carbon and 12% of ash, has a calorific value of 8080, the wood charcoal preceding it, containing 5% more carbon and 5% less ash, has a calorific value of only 7500. At the foot of the table we are told that *L* is the "Theoretical quantity of air required in kilos"—for what is not stated, but examination of the figure in the case of coke shows that it is for the complete combustion of

1 kilo. We also learn that G is the "Weight of the products of combustion in kilos"; but how 1 kilo of coke and 10·6 kilos of air manage to form 22 kilos of "Products of combustion" is not easy to see. It is further mystifying that whilst i is said to be the "Coefficient of radiation," there is no i to be found in the table; and the significance of V, the "Increase in volume in c.c.s" is, from the reviewer at least, entirely hidden.

The mischief of this kind of thing is that it destroys confidence in the other parts of the book; and the reviewer earnestly hopes that in future issues there may be careful revision in this respect, and also in respect of arrangement, both in individual tables (see p. 695, where peat and peat derivatives are scattered over the table in three different places, and sawdust briquettes are separated from woods by the whole range of coals, cokes, lignites and peat) and in series of tables, as on p. 716, where a table dealing with liquid fuels is separated from what should be its neighbours, and intercalated between two tables dealing with gases, or as in the early part of the second volume, where "Cryoscopic constants" and "Ebullioscopic constants" are separated from latent heats, and inserted, along with refractive indices, between viscosity and specific gravity.

The reviewer bears willing testimony to the patient labour that has gone to the collection and compilation of such a mass of detail; and in calling attention to what seem to him shortcomings or weaknesses rather than pointing out the excellences of the book, does so in no spirit of fault finding, but with a sincere desire to see the book improved. It challenges comparison, of course, with the "Chemiker Kalender." That is obtainable for 7s. 6d., against the 21s. charged for this. It surpasses this in clearness of type and opacity of paper; and unless the English book can surpass the German one in the accuracy and arrangement of its contents, so as to prove itself superior in ease and convenience of actual use, the patriotism of would-be users will be hard put to it to bear the strain.

J. T. Dunn

NIGERIAN OUTPUT OF TIN

The Mines Department of Nigeria reports that in 1921, 7225 tons of tin ore was won (158 t. less than in 1920), and 7181 t. of tin ore valued at £914,789 was exported. The low price of tin depressed the industry during the year, but total costs have been reduced from £150 to £116 per ton, and some of the companies have amalgamated to reduce overhead charges. The mining industry has been assisted by the grant of special concessions such as a new scale of royalties, reduction of rates, etc., and these have undoubtedly saved many companies from going into liquidation.—(*Ch. Comm. J.*, *May* 4, 1923.)

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The chemical market shows little signs of improvement. The last few weeks have been clouded over by distinct depression in most directions, and as proof of the abnormal conditions of trading may be taken the fact that prices as a consequence of the depression have in very few cases indeed shown any tendency to become easier. Chemicals are evidently being sold at reasonable prices comparable with costs; production or powers of production are sufficient to meet demand, and prices of home-made compounds do not depend as yet on the control of market speculation. Very little forward buying is taking place and as a consequence business is of a hand-to-mouth nature and small in volume.

Acetic Acid, 40% tech...	£24 per ton. Still firm, but rather less inquiry.
Acid Hydrochloric ..	3s. 9d.-5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw. ..	£24 10s. per ton. Quiet.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d.-£8 per ton.
Arsenic (White) ..	£70-£72 per ton. Not much business passing.
Bleaching Powder ..	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Keen competition for orders, especially export.
Bisulphite of Lime ..	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride ..	£5 17s. 6d. per ton d/d. Very quiet.
Copper Sulphate ..	£27 per ton.
Potash Caustic	£32-£34 per ton. Slightly easier, but stocks still light.
Potass. Bichromate ..	5$\frac{3}{4}$d.-6d. per lb. d/d.
Potass. Chlorate ..	3d. per lb. Somewhat firmer but very quiet.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76% ..	£20-£21 per ton. Quieter.
Soda Crystals	£5 10s. per ton carr. paid stations; £5 5s. at certain ports—Home trade.
Sod. Acetate 97/98% ..	£26 per ton.
Sod. Bicarbonate ..	£10 10s. per ton.

Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	2⅞d.-3d. per lb. Small demand.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide, conc.	£16 per ton carr. paid. Little doing. Keen competition for export orders.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£26-£28 per ton according to quantity.
Carbon Black	1s. 5½d. per lb. ex wharf. Still very scarce.
Chromium Oxide	1s. 5d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb. Firmer on advance in price of Rape Seed Oil.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood-distillation products.

Acetate of Lime—	
Brown	£10 15s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 10s. per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 9d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£6 per ton d/d.
Brown Sugar of Lead	£45 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 5d. per lb. Little movement in the market.
Crude 60's	3s. 4d.-3s. 6d. per gall. Not much business.
Acid Cresylic—97/99	2s. 1d.-2s. 5d. per gall. Demand fairly good.
Pale 95%	1s. 10d.-2s. 4d. per gall.
Dark	1s. 10d.-2s. 1d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	9d.-9½d. per gall. Not much demand.
Unstrained	8¾d.-9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8½d. per gall. Business slack, abundant supplies.
Pure	2s.-2s. 2d. per gall.
Toluole—90%	1s. 9d.-2s. per gall. Quiet.
Pure	2s.-2s. 6d. per gall. Not much inquiry.
Xylol	3s.-4s. per gall. according to quality. Good demand.
Creosote—	
Cresylic 20/24%	11¼d.-1s. per gall. Not much business.
Middle Oil	8d.-9½d. per gall. Market steady. Fair demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	9d. per gall.
Solvent 90/160	1s. 7d.-1s. 9d. per gall. Fewer inquiries.
Solvent 90/190	1s. 5d.-1s. 8d. per gall. Market more active.
Naphthalene Crude—	
Drained Creosote Salts	£7-£10 per ton.
Whizzed or hot pressed	£11 10s.-£14 per ton. Plenty of inquiries.
Naphthalene—	
Crystals	£18 per ton.
Flaked	£16 10s. per ton.
Pitch, medium soft	No business for this season. Prices for Autumn delivery 120s.-135s. per ton.
Pyridine—90/140	12s. 6d.-13s. 6d. per gall. Dearer. More inquiry.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Since the beginning of June there has been a decided improvement in business in aniline dyestuffs. There is considerably more inquiry about and orders have improved both in number and weight. There is every likelihood of still further improvement in the near future.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.

Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 9d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works. Good demand.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market has been quiet, and prices weaker in consequence of lack of business.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. 3d.-3s. 4d. per lb. Steady demand. Price well maintained.
Acid, Benzoic	2s.-2s. 9d. per lb. Still very scarce.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8¾d. per lb., less 5%. Less demand owing to cold weather.
Acid, Gallic	3s. per lb. Steady demand.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb.
Acid, Salicylic	2s. 3d. per lb., but 2s. 1d. lb. would buy large quantities.
Acid, Tannic	3s. 3d. per lb. Slightly cheaper.
Acid, Tartaric	1s. 3¾d.-1s. 4d. Demand poor owing to cold weather
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d. per lb. Slow of sale.
Amidopyrin	14s. per lb. Firm.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quality.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. per oz. No inquiry.
Barbitone	20s. per lb. Certain holders are willing to sell at slightly lower figures.
Benzonaphthol	4s. 6d. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Better inquiry. Prices steady. Potass. 8d., Sod. 9d., Ammon. 10d. per lb.
Calcium Lactate	2s. 9d. per lb. for best makes.
Chloral Hydrate	4s. 3d. per lb. Some holders would accept 4s. to clear stocks.
Chloroform	2s. 2d. per lb. for cwt. lots. Slightly weaker.
Creosote Carbonate	10s. per lb.
Formaldehyde 40%	£90-£92 per ton. Very firm.
Guiacol Carbonate	8s. 6d. per lb.
Hexamine	4s. per lb. would now be accepted by most holders.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Market good with considerable inquiry.
Magnesium Carbonate—	
Light Commercial	£37-£38 per ton net, according to quantity.
Magnesium Oxide—	
Light Commercial	£85 per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	1s. 9d.-2s. per lb. Good demand.
Menthol	35s. per lb. spot.
Methyl Salicylate	2s. 6d. per lb. for carboys. No considerable demand.
Methyl Sulphonal	15s. per lb. Still neglected.
Mercurials	Unchanged. Market rather firmer.
Paraformaldehyde	3s. 6d. per lb. Weak.
Paraldehyde	1s. 7d. per lb. A lower rate wanted for forward delivery.
Phenacetin	6s. 6d. per lb. spot value. Very steady.
Phenazone	7s. 6d. per lb. Very firm.
Phenolphthalein	6s. per lb. now wanted by most holders.
Potass. Bitartrate—99/100% (Cream of Tartar)	96s.-98s. per cwt., less 2½%.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. Demand still continues good.
Potass. Permanganate	10d. per lb. for large quantities. Forward market very much firmer.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	6s. per lb. still quoted on a weak market.
Salol	2s. 9d. per lb. Not quite so firm.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 9d. per lb. now wanted by holders. Still in short supply, fresh stocks being quickly absorbed.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality.
Sod. Hyposulphite—Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	80s.-82s. per cwt. net.
Sod. Salicylate	Demand not so good. Powder is slightly weaker at 2s. 8d. per lb., with crystal at 2s. 10d. per lb.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. per ton, according to quantity for home trade, 1-cwt. packages included.

Sulphonal	15s. per lb.	
Tartar Emetic	1s. 2d.-1s. 4d. per lb.	
Thymol	17s. per lb.	for genuine white.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.	
Aubepine	14s. ,, ,,	
Amyl Acetate	3s. ,, ,,	
Amyl Butyrate	7s. ,, ,,	
Amyl Salicylate	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	2s. 9d. ,, ,,	
Benzyl Benzoate	3s. 3d. ,, ,,	
Cinnamic Aldehyde	14s. 9d. ,, ,,	
Coumarin	18s. 6d. ,, ,,	Considerably dearer.
Citronellol	19s. 6d. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate	15s. ,, ,,	
Ethyl Phthalate	4s. 3d. ,, ,,	
Eugenol	11s. 6d. ,, ,,	
Geraniol (Palmarosa)	30s. ,, ,,	
Geraniol	5s. 6d.-12s. 6d. per lb.	
Heliotropine	8s. per lb.	
Iso Eugenol	16s. 6d. per lb.	
Linalol ex Bois de Rose	21s. ,, ,,	
Linalyl Acetate	25s. 6d. ,, ,,	
Methyl Anthranilate	6s. ,, ,,	
Methyl Benzoate	8s. 6d. ,, ,,	
Musk Xylol	9s. 6d. ,, ,,	
Phenyl Ethyl Acetate	10s. ,, ,,	
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,	
Rhodinol	45s. ,, ,,	
Safrol	2s. 3d. ,, ,,	
Terpineol	3s. 1d. ,, ,,	
Vanillin	23s.-24s. per lb.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.	
Anise Oil	2s. ,, ,,	
Bergamot Oil	12s. 6d. ,, ,,	spot.
Bourbon Geranium Oil	31s. 6d. ,, ,,	
Cananga Oil, Java	9s. ,, ,,	
Cinnamon Oil, Leaf	4½d. per oz.	
Cassia Oil 80/85%	8s. 6d. per lb.	
Citronella Oil—		
Java 85/90%	4s. 2d. ,, ,,	
Ceylon	3s. 4d. ,, ,,	
Clove Oil	8s.-8s. 6d. per lb.	
Eucalyptus Oil 70/75%	1s. 9d. per lb.	
Lavender Oil, Mont Blanc 38/40%	13s. ,, ,,	
Lemon Oil	3s. 1d. ,, ,,	
Lemongrass Oil	2¾d. per oz.	
Orange Oil, Sweet	12s. 6d. per lb.	Advanced.
Otto of Rose Oil—		
Anatolian	24s. per oz.	
Bulgarian	30s. per oz.	
Palma Rosa Oil	17s. 6d. per lb.	
Peppermint Oil—		
English	80s. ,, ,,	
Wayne County	13s. ,, ,,	
Japanese	6s. 4½d. ,, ,,	
Petitgrain Oil	7s. 9d. ,, ,,	Lower.

TRADE NOTE

Imports of Chemicals into the United States

The statistics of the imports of chemicals in 1922 show that $63,126,200 of duty free, and $37,477,500 of dutiable chemicals were imported, the aggregate gain being 24 per cent., whereas the export trade increased only by 1·4 per cent. Amongst particular groups, imports of explosives increased by 11 per cent., paint, pigments and varnish by 55 per cent., and fertilisers by 47 per cent. An increase of 28 per cent. was shown by perfumery, etc. and of 23 per cent. by medicinal and pharmaceutical preparations. Imports of coal-tar products were valued at $11,012,800, a decline of 3 per cent., decreases occurring particularly in naphthalene, creosote oil and benzene. Imports of coal-tar intermediates, however, increased from 867,300 lb. in 1921 to 2,136,670 lb. in 1922; the smaller imports of indigo and coal-tar medicinal chemicals were compensated for by increases in the alizarin and coal-tar dyes imported. Amongst general heavy chemicals, imports of the following showed gains as compared with the previous year: oxalic acid (3 per cent.), arsenic compounds, glycerin (30 per cent.), citrate of lime (1000 per cent.), sodium compounds (90 per cent.), varnish (55 per cent.).—(*U.S. Com. Rep., Apr.* 23, 1923.)

PUBLICATIONS RECEIVED

WORSTED DRAWING AND SPINNING CALCULATIONS. A PRACTICAL GUIDE FOR STUDENTS, APPRENTICES, FOREMEN, AND OTHERS OF THE WORSTED TEXTILE TRADE. *By* G. H. DAVIES. *Pp. x*+167. *London: Charles Griffin & Co., Ltd.*, 1923. *Price 7s. 6d.*

DIE AUTOMATISCH REGISTRIERENDE SEDIMENTIERVORRICHTUNG UND IHRE ANWENDUNG AUF EINIGE KOLLOIDCHEMISCHE PROBLEME. *By* DR. SVEN ODÉN. *Reprint from the Kolloid-Zeitschrift. Vol. XXVI., Part* 3, 1920.

PUBLICATIONS OF THE UNITED STATES BUREAU OF MINES. *Department of the Interior, Washington: Government Printing Office*, 1923:—

ACCIDENTS AT METALLURGICAL WORKS IN THE UNITED STATES DURING 1921. *By* W. W. ADAMS. *Technical Paper* 327. *Pp.* 31. *Price* 5 *cents.*

PROPOSED METHOD FOR REDUCING MINERAL WASTE IN THE WISCONSIN ZINC DISTRICT, WISCONSIN. *By* W. H. COGHILL *and* C. O. ANDERSON. *Technical Paper* 301. *Pp. iv*+66. *Price* 10 *cents.*

PROSPECTING AND TESTING FOR OIL AND GAS. *By* R. E. COLLOM. *Bulletin* 201. *Pp. vii*+169. *Price* 25 *cents.*

METAL-MINE FIRES. *By* D. HARRINGTON, B. O. PICKARD *and* H. M. WOLFIN. *Technical Paper* 314. *Price* 10 *cents.*

QUARRY ACCIDENTS IN THE UNITED STATES DURING 1921. *By* W. W. ADAMS. *Technical Paper* 329. *Price* 10 *cents.*

SPECIFICATIONS FOR PETROLEUM PRODUCTS AND METHODS FOR TESTING. *Federal Specifications Board, Standard Specification No.* 2., *Technical Paper* 323. *Pp. viii*+88. *Price* 10 *cents.*

THE TECHNOLOGY OF SLATE. *By* O. BOWLES. *Bulletin* 218. *Pp. viii*+132. *Price* 20 *cents.*

	747 0 7		Stock	123 0 0	
		673 0 0	South Eastern Railway 4½% Preference Stock	582 2 10	
	5000 0 0	5,194 0 10	War Loan 5% Stock 1929/47	5194 9 10	19,708 7 10
	£23,145 9 3		,, Office Furniture	410 14 0	
	(Depreciation = 14·85% on cost).		*Less:* Depreciation	100 0 0	310 14 0
£24,253 13 7					£24,253 13 7

"MESSEL FUND."

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31st DECEMBER, 1922.

EXPENDITURE.	£ s. d.	INCOME.	£ s. d.
To Chemical Engineering Group	100 0 0	By Dividends	994 17 8
,, Messel Memorial Lecture	52 10 0	,, Income Tax Refund (1921/22)	80 4 6
,, Balance, carried to Balance Sheet	926 10 8	,, Bank Interest	3 18 6
	£1079 0 8		£1079 0 8

BALANCE SHEET AS AT 31st DECEMBER, 1922.

LIABILITIES.		£ s. d.
Capital Account		18,076 13 0
Income and Expenditure Account—		
Balance, as per last account	863 16 0	
Excess of Income over Expenditure for the year 1922	926 10 8	1790 7 5
		£19,867 1 2

ASSETS.			£ s. d.	£ s. d.
By Cash on Deposit at London Joint City & Midland Bank				111 13 7
,, Investments at value at date of transfer, or at Cost—				
	£400 0 0	Birkenhead Corporation 5% 1924/34	350 0 0	
	1200 0 0	Exchequer Bonds 3% due 28/1/30	972 0 0	
	1580 0 0	Metropolitan Water Board, Staines Reservoir Guaranteed Debenture Stock	760 0 0	
	1000 0 0	Metropolitan Water Board, Grand Junction Water Works 3½% Debenture Stock	535 0 0	
	720 0 0	London Electric Railway 4% Debenture Stock	435 12 0	
	200 0 0	London & North Western Railway 4½% Red. Preference Stock	179 0 0	
	600 0 0	North Eastern Railway Guaranteed 4% Stock	381 0 0	
	16,725 4 10	War Loan 5% 1929/47	14,886 9 7	
	2264 13 11	Conversion Loan 3½%	1450 0 0	
		(Market value 31st December, 1922, £22,867 9s. 4d.).		19,755 7 7
				£19,867 1 2

To the Members of the Society of Chemical Industry.

We have audited the above Balance Sheet, dated 31st December, 1922, as also that of the Messel Fund, with the Books and Vouchers of the Society, and have verified the investments, and we are of the opinion that such Balance Sheets correctly set forth the financial position of the Society and of the Fund at 31st December, 1922.

3 Frederick's Place, Old Jewry, London, E.C. 2.

25th April, 1923.

PRICE WATERHOUSE & CO.,
Chartered Accountants.

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THE SOCIETY OF CHEMICAL INDUSTRY.

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31st DECEMBER, 1922.

Corresponding figures for 1921. £ s. d.	£ s. d.	EXPENDITURE.	£ s. d.	£ s. d.	£ s. d.
		To Journal—Editorial and Sundry Expenses—			
1160 0 0		Editor's and Assistants' Salaries	1223 15 0		
75 1 1		" Expenses	75 18 9		
875 3 6		Abstractors	987 10 0		
33 1 8		Foreign and Sundry Journals	41 4 1		
145 0 3		Insurance of Stock	9 6 10		
1060 10 0		Review Editor's and Assistants' Salaries	1045 10 0		
65 0 7		" " Expenses	71 8 3		
301 5 4		" Contributors	310 10 3		
. . .		Chemistry and Industry Editor's Salary	81 5 0		
. . .	3705 2 5	" " " Expenses	3 3 7		
				3849 13 6	
		,, Advertisement Department Expenses—	£ s. d.		
1618 2 10		Salaries and Commission	1427 3 9		
163 11 10		Sundry Expenses	291 0 8		
435 0 11	2216 15 7	Manager's Travelling Expenses	102 15 2	1820 10 7	
		,, Publishing Expenses—			
11,397 4 4		General	11,082 13 11		
4159 14 6		Paper	2086 10 0		
1618 10 4	17,175 9 2	Postages	1626 13 0		
				15,395 16 11	21,066 10 0
	23,097 7 2				
		,, Annual Reports on Applied Chemistry—			
971 1 4		Expenses	802 0 10		
844 10 2	126 11 2	*Less:* Sales and Stock	763 11 9		38 18 1
		,, Sectional Expenses—			
200 0 0		London	200 0 0		
30 0 0		Bristol	66 0 0		
31 0 7		Yorkshire	35 0 0		
70 9 6		Glasgow	125 0 0		
50 0 0		Liverpool	100 0 0		
42 0 6		Nottingham	92 7 8		
175 6 0		Manchester	260 0 0		
60 0 0		Birmingham	30 0 0		
55 0 0		Edinburgh	70 0 0		
. . .		South Wales	46 9 5		
. . .		Toronto	100 0 0		
212 16 0		New York	223 15 0		
15 0 0		Shawinigan Falls	. . .		
70 0 0		Newcastle	. . .		
20 0 0		Sydney	. . .		
75 0 0		Montreal	60 0 0		
25 0 0		Ottowa	15 0 0		
. . .		Local Representatives' Expenses to Council Meetings	28 15 4		
256 0 0	1381 0 7	Chemical Engineering Group	300 0 0		1685 7 5
		,, Subscriptions and Donations to other Societies—			
100 0 0		Chemical Society Library	100 0 0		
. . .		Federal Council	100 0 0		
. . .		Nottingham Technical Library	5 0 0		
5 5 0		Conjoint Board of Scientific Societies	5 5 0		
. . .		Pasteur Memorial Fund	21 0 0		
3 3 0	108 8 0	London Chamber of Commerce	3 3 0		234 8 0
	449 12 0	,, Annual General Meeting Expenses			345 18 1
	. . .	,, Overseas Propaganda			32 1 6
	. . .	,, Income Tax Schedule "D" (*re* Journal)			26 13 9
		,, Working Expenses—			
1543 13 4		Salaries	1034 0 0		
539 7 10		Rent, Lighting and Cleaning	537 15 8		
225 0 7		Stationery, Binding and Library	177 18 7		
615 6 8		Postages, Telephone and Sundry Expenses	582 3 5		
35 4 10		Bank Charges	38 16 10		
100 0 0	3658 13 5	Depreciation of Furniture	100 0 0		3070 14 6
	3747 11 0	Balance, being excess of Income over Expenditure			586 1 6
	£31,969 3 2				£27,086 12 10

Corresponding figures for 1921. £ s. d.	INCOME.	£ s. d.	£ s. d.
11,967 0 3	By Annual Subscriptions		11,492 13 4
370 13 0	,, Entrance Fees		260 8 0
186 17 6	,, Life Composition Fees		24 3 9
14,616 3 10	,, Journal Advertisements	9832 11 11	
4355 16 1	,, ,, Subscriptions and Sales	4318 4 1	14,150 16 0
472 0 0	,, Dividends and Interest on Investments		747 15 7
. . .	,, Income Tax refunded—April 1920/21 and 1921/22		404 16 2
£31,969 3 2			£27,080 12 10

BALANCE SHEET, 31st DECEMBER, 1922.

LIABILITIES.	£ s. d.	£ s. d.	£ s. d.
To Sundry Creditors			1968 1 4
,, Subscriptions and Entrance Fees to the Society and Journal paid in advance			3652 10 11
,, Lotham Research Prize Fund			196 5 8
,, To Bank Overdraft against Security			1089 18 6
,, Accumulated Fund—			
Balance 31st December, 1921		15,391 0 8	
Add: Surplus of Income over Expenditure for 1922	586 1 8		
Increase in value of Investments at this date	1975 6 0		
		2555 7 6	17,946 17 2
			£24,253 13 7

Cost. £ s. d.	ASSETS.	£ s. d.	£ s. d.	£ s. d.
	By Sundry Debtors, for Advertisements, etc.			2301 14 4
	,, Stock of Journal Paper			342 3 6
	,, ,, ,, Journals—nominal value	100 0 0		
	,, ,, ,, Annual Reports, Vols. I., II., III., IV. V. and VI., as estimated by the Secretary	471 10 0		571 10 0
	,, Subscriptions in Arrears, estimated to produce			100 0 0
	,, Payments in Advance			295 16 8
	,, Cash in Hand (Secretary, Editors, and Advertisement Manager)			90 3 0
	,, Cash at National City Bank, New York			336 18 7
	,, Cash on Deposit, Latham Research Prize Fund			196 5 8
	,, Investments at market value, viz.:—			
1051 1 6	£1050 0 0 4% Funding Loan 1960/90	963 0 0		
700 0 0	724 8 0 India 3½% Stock	456 7 5		
700 0 0	834 9 2 India 3% Stock	458 19 0		
2327 1 7	2502 13 11 Metropolitan 3% Consolidated Stock	1927 15 10		
1122 3 1	1277 4 8 New South Wales 3% 1935	998 4 10		
870 0 0	1000 0 0 New Zealand 3% 1945	730 0 0		
661 0 2	700 0 0 War Loan Stock 1925/28 3½%	668 16 0		
1700 18 5	1800 0 0 War Loan Bonds 5% 1929/47	1800 0 0		
507 0 0	600 0 0 Gas Light & Coke Co. 3% Deb. Stock	363 0 0		
1629 14 5	1509 0 0 Great Eastern Railway Co. 4% Irredeemable Guaranteed Stock	1109 13 1		
696 0 0	800 0 0 Great Northern Railway Co. 3% Debenture Stock	496 0 0		
922 10 0	1000 0 0 Metropolitan Water Board "B" Debenture Stock	650 0 0		
1187 4 0	960 0 0 Midland Railway 2½% Guaranteed Preference Stock 736 0 0 Midland Railway Consolidated 2½% Perp. Preference Stock	489 12 0 368 0 0		
1762 10 0	1250 0 0 Great Western Railway 5% Guaranteed Stock	1268 15 0		
900 5 6	1084 13 4 North British Railway 3% Consolidated Stock	661 13 0		
495 0 0	450 0 0 Nottingham and Grantham Railway and Canal Co. Consolidated Stock	371 5 0		
166 0 0	200 0 0 Nottingham Joint Station 3% Stock	123 0 0		
747 0 7	973 0 0 South Eastern Railway 4½% Preference Stock	682 2 10		
5000 0 0	5,194 9 10 War Loan 5% Stock 1929/47	5194 9 10		19,708 7 10
£23,146 0 3	,, Office Furniture	410 14 0		
(Depreciation = 14·85% on cost).	*Less:* Depreciation	100 0 0		310 14 0
				£24,253 13 7

"MESSEL FUND."

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31st DECEMBER, 1922.

EXPENDITURE.	£ s. d.
To Chemical Engineering Group	100 0 0
,, Messel Memorial Lecture	52 10 0
,, Balance, carried to Balance Sheet	926 10 8
	£1079 0 8

INCOME.	£ s. d.
By Dividends	994 17 8
,, Income Tax Refund (1921/22)	80 4 6
,, Bank Interest	3 18 6
	£1079 0 8

BALANCE SHEET AS AT 31st DECEMBER, 1922.

LIABILITIES.	£ s. d.	£ s. d.
Capital Account		18,070 13 9
Income and Expenditure Account—		
Balance, as per last account	863 16 10	
Excess of Income over Expenditure for the year 1922	926 10 8	1790 7 6
		£19,861 1 3

ASSETS.	£ s. d.	£ s. d.
By Cash on Deposit at London Joint City & Midland Bank		111 13 7
,, Investments at value at date of transfer, or at Cost—		
£400 0 0 Birkenhead Corporation 5% 1924/34	350 0 0	
1200 0 0 Exchequer Bonds 3% due 28/1/30	972 0 0	
1580 0 0 Metropolitan Water Board, Staines Reservoir Guaranteed Debenture Stock	706 0 0	
1000 0 0 Metropolitan Water Board, Grand Junction Water Works 3½% Debenture Stock	535 0 0	
720 0 0 London Electric Railway 4% Debenture Stock	435 12 0	
200 0 0 London & North Western Railway 4½% Red. Preference Stock	170 0 0	
600 0 0 North Eastern Railway Guaranteed 4% Stock	381 0 0	
16,725 4 10 War Loan 5% 1929/47	14,086 9 7	
2204 13 11 Conversion Loan 3½%	1450 0 0	
(Market value 31st December, 1922, £22,807 0s. 4d.).		19,755 7 7
		£19,861 1 3

To the Members of the Society of Chemical Industry.

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3 Frederick's Place, Old Jewry, London, E.C. 2.

26th April, 1923.

PRICE WATERHOUSE & CO.,
Chartered Accountants.

JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

Official Organ of the Federal Council for Pure and Applied Chemistry

Vol. 42 NEW SERIES LONDON, JUNE 15, 1923 No. 24

EDITORIAL

THE perusal of certain remarks, which appear in another part of this number, on electric accumulators and a faint recollection of some recent articles on co-ordination, tautomerism and kindred topics suggested that the modern ideas as to chemical combination might be suitable for editorial comment. An article is sometimes instructive to the reader, but unless the writer is well acquainted with the subject he gets far more instruction than do the readers. It always affords us amusement in our editorial sanctum to find—by writing—how little of exact and elementary knowledge on most subjects is readily accessible in the text-books at hand. Rough approximations suffice for a while in science, but as knowledge becomes more precise these become inadequate and the complex idea takes its place, yielding in due course to a further scheme of a further order of complexity. The simple action of sulphuric acid on a mass of lead oxide seems to involve a whole set of mutually interacting forces as complicated as the various forces which keep the solar system smooth and comfortable. Formerly the good old rule, the simple plan, sufficed, that hydrogen, carbon and nitrogen combined to make prussic acid, one atom of each element being required. Then some dissatisfied chemist, some Paul Pry, hoping he or she does not intrude, wants to know how the three atoms fit into each other. Is the hydrogen atom attached to the carbon or the nitrogen or both ? Or does it like Captain Macheath, sip each flower and change every hour ? We gather that Miss Usherwood is of opinion that it does. In what we used to call prussic acid the hydrogen is sometimes attached —not very firmly—to the carbon, in which case the real name of the compound is formonitrile; sometimes the hydrogen has a liaison with the nitrogen and in this case the compound is carbylamine. But one of these substances readily changes into the other and while you are measuring some specific property which enables you to identify the exact position of the little wanderer it has changed its quarters and incidentally the chemical properties of the substance. *Dum loquimur fugerit invida.*

* * *

It seems that most of the discussions at Cambridge next week will involve a consideration of those minute particles and minute forces which build up atoms or molecules. The study of soap solutions involves knowledge of colloids, a study of infinitesimals ; the discussion on catalysis requires a phraseology founded on the theory that a surface of some metal may collect and incorporate in it some few molecules or atoms of another substance. We need not be surprised that modern pure chemistry is mainly concerned with particles, which lie on the very border line of visibility, ponderability and credibility. We have outlived the period when a successful chemical experiment was recognised by a flash, a bang, a stink. We gather from Mr. Holmyard's article that the chemist in olden days was not merely organic, but sometimes even aromatic. This is really off the main line of the argument. We began with prussic acid, a compound known to every novelist and to some poets. She drank prussic acid without any water and died like a Duke or a Duchess's daughter, so we were told in our youth. But what we have not yet been told is whether prussic acid without any water is an active compound, even is it an acid and is it the formo-nitrile or the carbylamine which has acidic properties ? We fancy while the full dress discussions are taking place some of us may argue in a timid and private manner some of these simpler topics, but if Calorifer and Lucifer are to have a bout there may be some pretty sword play and we will come and watch. Lucifer—we mean the first bearer of the name—was the morning star ; by what species of degradation did the name become attached to the prince of darkness ? Perhaps some reader can give us this little history of a change of meaning. Has the photographer who has not yet taken Holy Orders reached this stage in his study of divinity? We hesitate to appeal to our clerical contributor himself, as he complains of advancing years and even this slight trouble, this grasshopper, may become a a burden to him.

* * *

The Anglo-Batavian Society entertained Prof. H. A. Lorentz, F.R.S., to dinner at the Langham Hotel, London, on Wednesday, June 6, as a mark of the distinguished services which he has rendered to science. The chair was taken by Sir Walter Townley, who a few years ago was the British Ambassador at the Hague. Among those present were Lord Haldane, Prof. Donnan, Sir Frank Dyson and Lady Dyson, Sir Richard Glazebrook and Lady Glazebrook, Profs. Forsyth and Whitehead, Sir W. Napier Shaw and Lady Shaw, and several others well-known in the world of physics or as being interested in the promotion of cordial relations between the English and Dutch. Speeches were made by Sir Walter Townley, Prof. Lorentz, Lord Haldane, Sir Frederick Mott, Prof. G. N. Lewis, of California, and Sir William Bragg, and it was evident that those present were delighted to meet Prof. and Mrs. Lorentz and renew old friendships.

Some species of exchange of ideas between England and Holland, so far as science is concerned has been organised, and Prof. Lorentz has been in England now for some little time, and has delivered a series of lectures, and lectures by British physicists are taking place in Holland. It is very important that this sort of exchange of views should take place. In Chemistry, Monsieur Kestner a few years ago came over here to lecture before the Society of Chemical Industry. How important and valuable his visit has been! The following year Prof. Louis and Sir William Pope delivered addresses in Paris, and now the chemists from over a score of countries are meeting in friendly conclave at Cambridge. Some sciences are particularly suitable for such international co-operation, and, as Lord Haldane said, science has no frontiers and knows nothing of provincialism. There are some difficulties in cordial gatherings of chemists from all countries which do not, fortunately, exist in physics and mathematics, and the Anglo-Batavian Society has been singularly fortunate in choosing so genial and accomplished a man as Prof. Lorentz to assist in these sciences. In both these he is distinguished, in mathematics he is in the front rank, and in physics he suggested a formula for the refraction of light which has been supported by a good deal of experimental evidence. As professor of physics at Leyden he has not only worked himself, but also trained up others to work at the alteration of lines in spectra when placed in a magnetic field, at long-wave radiation from hot bodies, on the Michelson-Morley experiment and its relation to the hypothesis of Einstein.

THOMAS NORTON, AN ALCHEMIST OF BRISTOL

By E. J. HOLMYARD

Head of the Science Department, Clifton College

We have been told that "*la chimie est une science française*," but we may take comfort in the thought that the honour of having introduced chemistry to Christian Europe must be given to England. On February 11, in the year 1182 of the Spanish era, that is 1144 A.D., the Englishman, Robert of Chester, finished the first translation from the Arabic of a book on chemistry, the *Book of the Composition of Alchemy*, ascribed to the Monk Morienus, teacher of Khālid ibn Yazīd. In the preface to his translation Robert says: "*quoniam quid sit Alchymia, et quae sit sua compositio, nondum vestra cognovit latinitas, in praesenti sermone elucidabo.*" This interesting passage enables us to fix the origin of European chemistry and also indicates that the word *alchemy* was used not merely, and perhaps not mainly as the name of a science, but also as the name of a *substance*, to wit the philosopher's stone.

The seed thus sown by Robert of Chester fell upon fertile ground and quickly germinated. In the next century there lived Roger Bacon, who, if he did not (as some assert) invent gunpowder, was at least the first to mention it and to describe its preparation, and who seems to have had a better conception of scientific method than any other man prior to his great namesake of the seventeenth century. The widespread interest in alchemy in England in the next hundred years, is witnessed by Chaucer's *Tale of the Chanon's Yeoman*, which shows that the art had obtained so great a hold upon the country that it could be made the subject of a popular poem. The unfortunate yeoman describes his woes as laboratory assistant to the "chanon" with a taste for research and admits that his intelligence is not sufficient to cope with the technical language:—

> "There is alsoe full many another thing
> That is to our Craft apertayning:
> Though I by ordre hem ne reherce can,
> Bycause that I am a leud man.
> Yet wol I tellen hem as they come to mynde,
> Though I ne can sette hem in her kynde,
> As bole Armonyake, Verdegreece, Boras."

As for alchemists the yeoman says that:—

> ". . . . evermore where that ever they gone
> Men may hem ken by smell of Brimstone:
> For al the world they stynken as a Gote."

Some fifteen years after Chaucer's death, was born George Ripley [1415(?)-1490], who belonged to the Abbey of St. Augustine in Bridlington, and there pursued the study of chemistry with such ardour that at last the abbot and other monks grew weary of him, upon which he joined the Carmelite fraternity at Boston. He was a remarkable man in many ways, not the least being that, according to the *Biographie Médicale*, (Paris, 1820-25), he was the uncle of Roger Bacon, who predeceased him by two hundred years!

Among Ripley's disciples in the "Divine Science" was Thomas Norton. The Nortons were one of the chief families at Bristol, and lived in a large house on the site now occupied by St. Peter's Hospital. Thomas Norton's father, or at least the Norton who was probably his father, was sheriff of Bristol in 1401 and mayor in 1413; he was also M.P. for Bristol for many years. Thomas Norton himself was a privy councillor and seems to have been a man of substance, deriving his wealth from commercial undertakings the exact nature of which is not stated. He began to study chemistry at an early age, and, according to his own account, arrived at a knowledge of the method of preparing the Elixir of Gold at the age of 28. He acquired a great reputation, and, according to Ashmole (quoting from earlier writers), he was "*Alchymista suo tempore peritissimus*, and much more curious in the studies of *Philosophy* than others, yet they passe some undecent and abusive *Censures* upon him, with reference to this *vaine and frivolous Science*, as they are pleased to tearme it. . . . Indeed, every one that is educated a *Scholler*, is not borne to affect or be happy in every *Art*, some love one, some another, but few *All*. . . . Commonly, what either a man does not *affect*, or *know*, he *despises* or *condemnes*, yet seldome with any shew of *Reason*. But it is no good *Conclusion* for *Blinde men* to affirme the *Sun* has no *light*, because they were never so happy as to see it."—(*Theat. Chem. Brit.*, pp. 437, 438.)

Norton's chemical knowledge he exposed in three works, the *Ordinall of Alkimy*, the *De transmutatione Metallorum* and the *De Lapide Philosophico*. Of these, the only one that has been published is the first, which is included in Ashmole's *Theatrum Chemicum Britannicum*, (1652), and, in Latin, in Maier's *Tripus Aureus* (1618), and Manget's *Bibliotheca Chemica Curiosa* (1702). Ashmole transcribed his versions he tells us, from a very fine manuscript. "In the search I have made after authentique manuscripts to compleate this worke, a private Gentleman lent me a very fair one of Norton's *Ordinall*, which I have chiefly followed; yet not omitting to compare it with fourteen other copies. It was written in Velame and in an auntient sett Hand, very exact and exceeding neate, the Figures . . . being also most neatly and exquisitely lym'd, and better work than that which was Henry the Seventh's own Booke, (as I am informed by those that have seene both)."

The authorship of the *Ordinall* is revealed in a curious way. "From the first word of the Proeme," says Ashmole, "and the initiall letters of six following chapters (discovered by *Acromonosyllabiques* and *Sillabique Acrostiques*) we may collect the author's Name and place of Residence: For those letters, (together with the first line of the seventh chapter) speak thus:

Tomais Norton of Briseto,
A parfet Master ye maie him call trowe.

"Such like Fancies were the results of the wisdome and humility of the Auncient Philosophers, who (when they intended not an absolute concealment of Persons, Names, Misteries, etc.), were wont to hide them by *Transpositions*, *Acrostiques*, *Isogrammatiques*, *Symphoniaques*, and the lyke, (which the searching Sons of Arte might possibly unriddle, but) with designe to continue them to others as concealed things."

The poem opens with the "Proheme," in which Norton explains his reason for writing the book, and laments the foolishness of both "clerks and laymen," in attempting to follow the enigmas and dark sayings of his predecessors. Alchemy seems to have been as popular a fashion in the fifteenth century as spiritualism is in the twentieth. Even:—

" . . . common workemen will not be out-laste,
For as well as Lords they love this noble crafte;
As Gouldsmithes whom we shulde lest repreve
For sights in their Craft moveth them to beleeve:
But wonder it is that Wevers deale with such warks,
Free Masons and Tanners with poore Parish Clerks;
Tailors and Glasiers will not thereof cease,
And eke sely Tinkers will put them in the prease
With greate presumption."

As masters of the Art, Norton mentions "Hermes, Rasis, Geber, Avicen, Merlin, Hortolan, Democrit, Morien, Bacon and Raimond," but complains that, to use his own delightful expression, "their Cloudy Clauses dulled many men." His advice to the novice is not to trust these men and their books, but to "give Credence to this booke and mee," and "to lerne well this Clause, Nothing is wrought but by his proper Cause." He also solemnly warns his readers (doubtless with tongue in cheek) never to slide into falsehood, "but stedfastly your minde must be set Fals Colloured Metall never to counterfett." He modestly describes his *Ordinall* as "a Boke of incomparable price, whose trewth shall never be defiled," and, having given a summary of the contents of the seven following chapters, closes his "Proheme" with a prayer to the Almighty.

In the first chapter Norton sets out to explain what manner of people may hope to acquire a knowledge of the secrets of alchemy, and why this science is called blessed and holy. With a naïve belief in the ancient accounts of transmutation he mingles some shrewd observations which, if it were our custom to hang texts in our laboratories, might still have a salutary effect so used:—

"Blessed is he that maketh due proofe."

"With due proofe and with discreet assaye,
Wise men may learne new things every day."

Those who do not make due proofe:—

" . . . lewdly believe every Conclusion,
Be it never so false an elusion:
If it in boke written they may finde,
Thei weene it trewe, thei be so lewde of minde."

Chapter II deals with the "nice Joyes of alchemy, with the great paine" as well. It contains some autobiographical information, from which we gather that Norton rode over a hundred miles to meet his master, and stayed with him forty days, in which time he learned all the secrets of alchemy. Having returned to Bristol, he put his newly-acquired knowledge to the test of experience and succeeded in preparing the great Elixir of Gold, only to have it stolen from him by a dishonest servant. He was so discouraged by this reverse of fortune, that he would have "noe more of Alkimy," but turned his attention to the Elixir of Life. Here again, he was unlucky, for after he had made it, it was stolen from him by a merchant's wife, who is generally said, on inadequate grounds, to have been the wife of William Canynges. Canynges rebuilt the church of St. Mary Redcliffe in Bristol, and had a master-mason whose name was Norton, but there is, as far as I am aware, no evidence that the mason was also the alchemist.

Norton's third misfortune was the theft of his *Quintessens* :—

"Which sinfull people tooke me fro,
To my greate paine and much more woe."

Whether Thomas Norton was a conscious impostor or not is hard to decide, but it seems likely that he was. His tales of his adventures with the elixirs are rather more than suspicious, and, in spite of his repeated promises to speak "in homely wise," it is quite impossible to make anything out of his tenebrous instructions. The *Ordinall* furnishes us with additional evidence of the parlous state of chemistry between the days of Roger Bacon and Paracelsus. In spite of the fact that the mineral acids had become known to the Western world about the year 1300 A.D., and chemists were, therefore, provided with the essential factors for incalculable progress, astonishingly little advance was made. In chemical theory it is not far from the truth to say there was no advance whatever. It is difficult to discover the reason for this stagnation. Probably the theory of transmutation had become an obsession and had stifled the growth of new ideas; at the same time it must have been partially discredited by intellectual men aware of the ever-recurrent failures of attempts at transmutation, and the time was not yet ripe for another generalisation of sufficient stimulus. The comatose state of chemistry at the end of the fifteenth century is shown by the ease with which Paracelsus made it the handmaid of medicine, and the utter lack of realisation that it was an independent science.

Norton's poem enables us to obtain a conspectus of chemistry as it was just before the birth of Iatrochemistry, and its sprightly style makes it easy to read; but as a serious contribution to the science it is negligible. Underneath Norton's chemical theory is the inevitable substratum of Aristotelianism. He says :—

". . . . of Alkimy the trew foundation,
Is in Composition by wise graduation
Of Heate and Cold, of Moist and of Drye,
Knowing other Qualities ingendered thereby;
As hard and soft, heavy and light,
Rough and smoothe, by ponders right,
With Number and Measure wisely sought."

The influence of the stars he admitted, and the whole system of thought is confused, illogical and puerile. Yet there are redeeming features. Norton insists upon the necessity of employing all the senses, as well as the intelligence, in the study of alchemy. Smell, for example, is not to be despised, for it may reveal facts otherwise imperceptible. And this because odours have definite causes—causes which appear humorous to us, but which Norton describes with the utmost gravity :—

"The cause of Odours to know if you delight,
Foure things thereto be requisite.
First that suttill matter be Obedient
To the working of Heate, for to present
By a fume the liknes of the same thing,
From whome that fume had his beginninge.

* * * *

Heat maketh Odours, Cold shrinketh, by reason
Dunghills in Summer stink more than in Winter
season.
Pleasant Odours ingendered be shall
Of cleane and Pure substance and fumigale,
As it appeareth in Amber, Narde, and Mirrhe,
Good for a Woman, such things pleaseth her."

The various kinds of smells arise from the action of great or lesser heat upon more or less pure material :—

"But of Pure substance with a Meane heate,
Be temperate Odours, as in the Violet;
Of a meane heate with substance impure,
Is Odours misliking, as Aloes and Sulphure:
But when Naturall heate beginneth to spill,
Then thereof ariseth heavie smell.

* * * *

Stinch is a Vapour, a resolved fumositie
Of things which of Evil Complexions be."

Taste, again, is a useful servant, but substances must be tested with caution, especially the Elixirs. For :—

"A lewde Mañ late that served this Arte,
Tasted of our *White Stone* a parte,
Trusting thereby to find releefe,
Of all sickness and of all greefe,
Whereby the Wretch was sodenly,
Smitt with a strong Paralisie;
Whom my *Master* with great Engine,
Cured with *Bezoars* of the Mine."

Moreover :—

". . . Manie things be of good Smell,
Which to Tast be found full ill:
For they maie be abhominable sower,
Over-sharpe, too bitter, or of great horrour."

Norton goes to some length in describing the apparatus necessary for the operations of alchemy. Each process has its own instruments without which it may be impossible to bring it to a successful completion. Thus :—

". . . workes of Division and Seperation
Have small Vessells for their Operation;
But Vessells broade for Humectation,
And some deale broad for Circulation;
But longe Vessells for Precipitation.

* * * *

Of Vessells, some be made of Leade,
And some of Clay both quick and deade ;
Dead clay is called such a thinge,
As hath suffered greate roastinge ;
Such medled in powder with good raw Claye,
Will Fier abide and not goe away."

The furnaces too, must be carefully made, and different forms of them are required for different operations. Norton tells us that he himself had invented several new varieties :—

" In this Boke portraied finde ye shall.
One Furnace by me is found of newe . . .
Threescore degrees divers ye maie gett,
For threescore warkes, and everie-ech of divers Heate,
Within that Furnace, to serve your desire,
And all this served with one little Fier,
Which of a Foote square onlie shalbe,
Yet everie-ech of the threescore as greate space as he."

The sixth chapter ends with a warning against geomancy, negromancy, and, within limits, astrology : " Trust not in Geomantie, that superstitous Arte ; " " Trust not, ne love not Negromancy."

The final chapter deals with the regimen of fire, which Norton declares to be of the utmost importance. Indeed, he who knows this matter strongly is to be considered a perfect master of the Art. As the ancients said, *Totum consistit in ignis regimine*, a solitary rule, through the neglect of which :—

". . . manie of *Gebar's Cookes*
Deceived were though thei be wise in Bookes."

With this discussion the book ends. What are we to think of fifteenth century chemistry if such a farrago of nonsense is typical ? In the first place it seems clear that as an intellectual science, chemistry in those days was practically non-existent. Europe had not properly appreciated her great legacy from Islam, and the philosophy of chemistry had withered. But through the dark years the life of the science had been preserved in the technical traditions in the secrets of the craftsmen, which could not fail to become more numerous and more extensive as generation succeeded generation. It is here that we must look for the real progress of chemistry in mediæval Europe. With the invention and spread of printing, and with the new mental activity of the Renaissance, conditions changed. After a century of assimilation and re-assimilation of ancient learning, a more vigorous spirit was born, and the mass of facts accumulated during preceding centuries was quickened to vigorous life.

It is, indeed, a sorry picture which Norton's *Ordinall* presents to us. When we think of the state of the natural sciences in Islam in the seventh to the twelfth centuries, we cannot fail to be depressed by the retrograde movement which occurred in Europe afterwards. Charles the Hammer's defeat of the Arabs at Tours was a defeat also for Science ; a defeat from which she did not completely recover for some six hundred years.

Nevertheless, the *Ordinall* has its amusing side, and we may with good will accede to its author's parting request :—

" All that hath pleasure in this Boke to reade,
Pray for my Soule, and for all both quick and deade."

FREE SULPHUR IN MOTOR FUELS

By E. C. CRAVEN, M.Inst.Pet.Tech., F.C.S.

The corrosion of copper, and to a very much smaller extent its alloys, by hydrocarbon spirits, is well known to tar and petroleum distillers. Most motorists also have at some time been troubled by the blackening and scaling of copper gauzes, tubing or the like.

This effect has been traced to the presence of sulphur in a free state, which occurs to a greater or less extent in all the motor spirits now on the market. Hitherto there have been qualitative methods only for the determination of this free sulphur. Usually a vessel or strip of copper is exposed to the action of the spirit under certain conditions of heating and time of contact. The amount of blackening due to copper sulphide formation gives an idea of the amount of free sulphur present in the spirit.

Some recent work[*] carried out in the laboratory of Dr. W. R. Ormandy has led to a simple quantitative method for determining the amount of free sulphur in motor fuels. A measured volume of the fuel is shaken with mercury until the whole of the sulphur is converted into mercury sulphide. This is filtered off on a wet asbestos plug, oxidised to mercuric sulphate, and the sulphur determined by barium chloride in the usual manner.

The results of the application of this method to spirits on the market have shown that amounts of free sulphur up to 6 mg. per 100 c.c. are common in petrol. Samples of benzol of English manufacture compare very favourably with imported samples. Alcohol fuels are practically free from sulphur.

The method has been compared against a copper strip test, in which a strip of electrolytic copper foil is present in the distilling flask during the carrying out of complete Engler distillation. The amounts of sulphur corresponding to the appearance of the copper strip at the finish of distillation are as follows :—

Appearance, etc., of copper strip	Free sulphur mg. per 100 c.c.
Peacock or brown tints	Up to 0·5
Black but no scaling	Up to 1·0
Black, scaling on bending	Up to 1·5
Scaling before end of distillation ..	Above 1·5

The fact that a qualitative method now exists for the determination of that sulphur which is so deleterious to copper may result in greater attention being paid to the presence of this particular impurity by producers and refiners.

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[*] J. Inst. Pet. Tech, IX, 36, p. 133—139

THE ALKALINITY OF AMMONIA

By A. E. CLARENCE SMITH

Professor Caven (*Chem. & Ind.*, p. 449) quotes with entire agreement an argument by Holleman to the effect that ammonium hydroxide must be a strong base since ammonium chloride is inappreciably hydrolysed in solution; the feeble basicity of ammonia solutions thus being really due to the great tendency of ammonium hydroxide to split up into ammonia and water.

But surely a little consideration will serve to show that Holleman's argument is in fact misconceived: ammonium hydroxide may possibly be a strong base, but this cannot be established by considering the p_H of ammonium chloride solutions. On either view we have the successive equilibria:—

$$NH_3 + H_2O \rightleftarrows NH_4OH \rightleftarrows NH_4^+ + OH^-.$$

If we assume the concentration of uncombined ammonia to be negligible, we can easily obtain, from conductivity or otherwise, a dissociation constant for ammonium hydroxide. This has been done by Bredig and others, and it may be taken that its value, K, does not differ very very much from 2×10^{-5}, thus making the base a weak one.

If, on the other hand, the base is to be strong, we must assume the presence of a large quantity of uncombined ammonia, so that K will be merely an "apparent" dissociation constant. In this case we must consider separately the two successive equilibria shown above, assigning to them equilibrium constants k_2 and k_1 respectively. There is no reason why the "true" dissociation constant, k_1, should not be large, provided we make k_2 correspondingly small; but it is clear that there must be a close relation between these two hypothetical numbers and the value of K, which is experimental.

This relation appears at once when the equations of equilibrium are written out, and, as was first remarked by Kauffman in 1904, has the form:—

$$K = \frac{k_1 k_2}{1 + k_2}.$$

Given k_1 and k_2, we can of course calculate the hydrogen-ion concentration in any ammonium chloride solution in the usual way; and we find that k_1 and k_2 can, by means of the above equation, be eliminated from the resulting expression, K appearing instead. It follows, therefore, that the degree of acidity is determinable with reference to K alone, and will be just as great with the double equilibrium and large value for k_1 assumed by Holleman, as with the simpler state of affairs assumed in Bredig's value for K.

A verbal semi-quantitative elucidation may be given as follows:—When ammonium chloride is dissolved in water and ionised, combination will begin between its cations and the hydroxyl ions of the water. On the view that ammonium hydroxide is a weak base, this combination, and the consequent upsetting of the dissociation equilibrium of the water, will proceed to some length, causing at equilibrium an excess hydrion concentration, the magnitude of which will depend on the relation between the dissociation constants of water and ammonium hydroxide.

On Holleman's view that the base is a strong one, there will be very much less *tendency* for the ammonium and hydroxyl ions to combine; but since the ammonium hydroxide thus produced is now assumed to be almost entirely removed as ammonia and water, the combination will proceed as far as on the other view.

Why, then, is ammonium chloride solution practically neutral, as remarked by Holleman? The answer is that Holleman's apparent expectation of the degree of hydrolysis is an exaggerated one. In a chloride where the base has a dissociation constant of 2×10^{-5}, the "fraction hydrolysed," to use the customary but very objectionable term, will, in normal solution, be only about 3 parts in 100,000, producing an almost negligible degree of acidity.

It may be pointed out that Bredig's value for the dissociation constant of ammonium hydroxide is almost exactly the same as that of acetic acid, so that ammonium chloride solutions would be expected to be only as acid as sodium acetate ones are alkaline.

Furthermore, the acidity of ammonium chloride solutions, small though it is, has been measured by Denham (*Trans. Chem. Soc.*, 1908), by means of the hydrogen electrode. By this method he found the hydrolytic constant to be about 3×10^{-10}, whereas that deducible from Bredig's dissociation constant of ammonium hydroxide is about 5×10^{-10}. These figures are in quite sufficiently close agreement, especially as Denham considered that his values for this substance were not very accurate.

Denham also found, as one would expect, that the passage of plain hydrogen through the electrode continually carried off ammonia produced by the hydrolysis.

Enough has been said to show that, although it is quite possible, by assuming the presence of much uncombined ammonia in ammonia solutions, to formulate a mechanism whereby the true dissociation constant of ammonium hydroxide may be increased from its apparent value of 2×10^{-5} to that of a strong base, yet the observed degree of hydrolysis of ammonium salts does not throw any light on the problem.

A reference is desirable to the intermediate position adopted by Professor Moore (*Chem. & Ind.*, p. 343), who is led by thermodynamical and other considerations to assign to k_2 and k_1 the respective values of 1·15 and $3{\cdot}41 \times 10^{-8}$ These are seen to fulfil the Kauffman relation when it is noted that the second is expressed in c.c. units, and in litre units becomes $3{\cdot}41 \times 10^{-5}$.

Physico-Chemical Laboratory,
University College of Southampton,
May 15th, 1923

REFLECTIONS ON PATENTS*

By HOWARD CHEETHAM

Some year or more ago Prof. F. Soddy remarked that scientific discoverers were not observed to amass great fortunes and rarely founded families, whereas the originators of the industrial application of a discovery frequently did, and from this foundation he proceeded to erect the super-structure that consequently there was no occasion for the scientific worker to fear any adverse results from any social revolution. I do not propose to discuss the conclusion or to examine the arguments leading to it, but simply to take more or less as a fact the initial statement that scientific work is less renumerative than its industrial application. In the nature of things quite apart from legislative action this tends to be so. As soon as a discovery is made known it ceases to belong to the discoverer and becomes as much the property of any one able to appreciate its nature and bearing. The same thing is true precisely of an industrial invention so far as its inherent nature goes; the only natural hindrances to the general dissemination of industrial inventions and their adoption forthwith by everyone interested are the common reluctance to change and that the inventors may conceivably be already in the industry directly concerned and so get a start or for a time preserve some sort of secret.

The Patent law has modified the natural law as regards industrial invention, but has not so far done much towards interfering with natural conditions as they concern scientific discovery.

In this country it seems to me probable that the restriction of patent rights to "the sole working or making of any manner of new manufacture within this realm to the true and first inventor or inventors of such manufactures, which others, at the time of making such Letters Patents and grants shall not use, so as also they be not contrary to the law nor mischievous to the State by raising prices of commodities at home or restraint of trade or generally inconvenient," was due to the intense realisation of the iniquity of the capricious grant of monopolies over articles of ordinary consumption, rather than to deliberate decision that scientific discovery did not merit reward.

Although three hundred years have gone by since the Statute of Monopolies was passed, the merest suggestion that any concern is or may be a monopoly raises righteous indignation and so it is easy to imagine that those just freeing themselves from the shackles of real monopolies, when all patents were looked upon with the gravest suspicion and as grievances, were not in the best circumstances in which to frame a statute intended to promote progress.

It is obvious from the words of the statute that "any manner of new manufacture" within the realm was the thing visualised as important, and it is quite conceivable that closer attention to the question of who were the first inventors of new manufactures might have led the legislators to discover—it could be fairly called discovery—the fact that scientific discovery sooner or later resulted in new manufacture. It is probable that in 1623 the interval between a purely scientific discovery and its industrial application was much longer than it is now, although to take a comparatively recent example the interval between the fundamental discoveries on which all electrical practice and their extensive industrial application essentially rest was not much less than half of last century and so it would hardly be fair to blame our predecessors for being insufficiently impressed by the apparently idle suggestions of supposedly unpractical philosophers. It has also to be recognised that in one way and another by rule of thumb and the skill or observation of untold generations of craftsmen, industrial applications had already made advances which still command our wonder and respect even though their scientific basis had more or less yet to be discovered. It still sometimes happens that the scientific explanation is subsequent to industrial application, the ordinary steam injector being an instance. For those who do not know the story I may make a digression and mention briefly that Giffard was a rather prolific inventor and not always too keen on industrial application. He was working out a steam pump essentially involving a wheel to form the rotor of a turbine to be driven by a steam jet and being revolved to serve as a pump to feed a boiler. One day the experimental apparatus worked better than ever and Giffard found the rotor had been left out. He reported the result that steam drawn from a boiler would force water into it to a French Patent Agent, who said, "You have told us many wonderful things, but this passes belief." Giffard, however, proving his statement well founded, the patent agent paid the expense of sending him over to Messrs. Sharp, Stewart and Co. here, and the industrial application preceded sound statement of the theory.

Even if the framers of the Statute failed to see there was such a thing as discovery or need to encourage it, it may reasonably be allowed that in their circumstances the limits laid down for the grant of patents were fairly wide, if sufficient weight had been given to the full meanings and implications of "new manufacture" and "first inventor or inventors." Unfortunately, however, the hatred of the word monopoly persisting after the Statute, has continually influenced public and judicial opinion and though there has been a gradual widening of the judicial interpretation of patentable matter to include applied principles and new results with an indication that eventually products themselves might be held patentable, it has been dogged continually by atavistic reminiscences and sentiment, based partly on the ancient antipathy to monopoly, which has materially added to the essential difficulties of decision in conflicts between the interests of patentees and those of the public. To cite case after case in support of this view would be possible, but each case having been decided largely on its own merits and, therefore, with complications interfering with classification as indicating tendencies to broaden and to narrow, I prefer to state the view broadly as a matter of observation. The case of Heath *v.* Unwin, mentioned by Dr. Erhardt in his paper of January (*cf. Chem. & Ind.*, p. 314) and the earlier cases of the same name and the slightly later case of Heath *v.* Smith might be cited as a collection of conflicting opinions favourable and unfavourable to inventors or discovers, although judging from the records it might be said the patentee was responsible for some of his own troubles in so far as having said, " I do not claim this or that, but only the use of carburet of manganese in any process for the conversion of iron into steel," he proceeded to say in so many words, " I claim, fourth, the employment of carburet of manganese in preparing an improved cast steel," and then soon after filing his specification proceeded to put on the market a much cheaper substitute in the shape of coal tar and manganese dioxide (read Judge's remarks in Goodeve's Patent Cases, p. 234-238). There is here rather a variety of conflicting opinions ending in the contradictory conclusion that what did not infringe the patent because it was not an equivalent invalidated the patent because it was previously used and would serve as an equivalent. We may suppose Heath had some reason for not patenting the tar and manganese dioxide mixture, possibly the cost, but it would be interesting to know it.

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* Read at a meeting of the Manchester Section on May 4, 1923.

The ebb and flow in judicial opinion might be expected to result in gradual realisation of the need to reward by remuneration or otherwise those to whom progress is essentially due. With recognition of this fact, and that there was eventual new manufacture, the statutory mechanism would not be difficult to evolve.

One can hardly affirm that public opinion, even when fairly well instructed, has a very wide outlook, the old prejudice against any supposed monopoly being still rampant and combined in some of us with a less worthy motion that anyone seeing an attractive thing has necessarily the right freely to participate in it, for example, unauthorised " listening-in." Other examples of the effect of this are the present statutory escape from damages provided for the supposed ignorant or innocent infringer and the possible result indicated by Dr. Erhardt in the paper mentioned above, that all patents for products and processes are in jeopardy, which is, perhaps, one way of removing Prof. Soddy's grievance, by restoring industrial inventors to the unrewarded state of scientific discoverers. In my view the desirable end is the greatest possible reward to every one to whom progress is due and concurrently the greatest possible dissemination of the advantages to the community. This principle is clearly indicated in the provisions regarding licences of right in the present Patents Act and the gist of my contention is " let us go further in that direction."

In England the ruling out of pure scientific work from protection by patents has been by judicial interpretation of the statute. In France the reverse was the case, scientific work as such being explicitly excluded, both in the commendation of the statute before its passage and also in the terms of the statute itself.

This clear statutory statement seemingly has stimulated French opinion and led to very eloquent expression of the needs and claims of scientific and inventive workers and the formulation of a scheme of statutory revision of the French law (given in an appendix) by the Union of French Inventors and the French Society of Chemical Industry and others (*La Propriété Industrielle*, 1922, p. 85), and also in the creation and organisation by decree of a National Office of Scientific and Industrial Research and of Inventions.

This paper is of a contentious rather than conclusive character, but if it should suggest any useful consideration of the matter it may not be useless.

Extract from " Proposition de Loi "

Article 1.—Toute nouvelle découverte ou invention, de quelque nature qu'elle soit, confère à son auteur, sous les conditions et pour le temps ci-après déterminé, le droit d'exiger une redevance de tous ceux qui en tirent un profit industriel.

Art. 2.—Si l'auteur de l'invention n'a pas accompli les formalités de l'article 3 de la présente loi, la redevance n'est due qu'à partir du jour de sa demande.

Art. 3.—L'auteur d'une invention ou découverte non susceptible d'être brevetée aux termes des articles 1^er^, 3 et 30 de la loi du 5 juillet, 1844, peut faire constater son droit au moyen d'un brevet de corps ou de principe, délivré dans les conditions du titre II de ladite loi. En ce cas, le droit de la redevance existe à partir du jour de la demande du brevet.

Art. 4.—Le brevet de corps ou de principe ne confère pas à son titulaire le droit exclusif d'exploiter à son profit la découverte ou l'invention, mais seulement le droit de délivrer des licences obligatoires pour l'exploitation de ladite découverte ou invention.

Art. 5.—La propriété scientifique, constatée ou non par brevet, dure pendant toute la vie de l'auteur et, après son décès, 50 ans, dans les conditions prévues par l'article 1^er^ de la loi du 14 juillet, 1866.

Art. 6.—Le taux de la redevance est déterminé par l'accord des parties et à défaut par le tribunal.

Art. 7.—A l'expiration, pour une cause quelconque, du brevet d'invention délivré conformément à la loi du 5 juillet, 1844, l'auteur de l'invention précédemment brevetée reçoit sur sa demande un brevet d'auteur qui lui confère les avantages prévus dans les articles précédents.—(*La Propriété Industrielle*, June 30, 1923, p. 87.)

PASTEUR CENTENARY CELEBRATIONS

From our Special Correspondent

In view of the known dangers of Paris life, the return of Sir William Pope and the other members of the select body of British chemical delegates to the Pasteur celebrations in Paris and Strasbourg, May 23-31, is to be chronicled with satisfaction. The strain of French hospitality has been very great, it appears ; yet such is the strength of the English constitution that it has been able to withstand the test : Paris is poorer, perhaps, by many *demis* but the *ambassade* returns home with the happiest impressions and recollections, satisfied that real service has been rendered in strengthening the rapidly growing bonds of sympathy and friendship uniting French with English chemists.

Commencing on Thursday evening with a most brilliant reception by the President of the Republic at the *Élysée*, the proceedings next day included a visit to the Pasteur Institute and the tomb of Pasteur in its crypt, followed by a crowded meeting, presided over by the President, in the great hall of the Sorbonne—which will seat 5000 persons—at which addresses were presented and much doubtful French was spoken by delegates coming from all over the world. Before this, a most graceful appeal to British sympathies had been made, by unveiling, in the presence of the British delegates, an inscription commemorating the historic meeting of Pasteur and Lister, on December 27, 1892. The British Ambassador, Lord Crewe, made suitable acknowledgment of the compliment. In remembrance of the occasion, the Association "France-Grande Bretagne" gave those present a photograph of the large picture by Rixens representing Lister advancing to embrace Pasteur as the latter arrived upon the platform of the great hall of the Sorbonne. It is worth noting that, amidst the display of academic colour at the Sorbonne cermony, the Chinese delegates were pre-eminent in magnificent most becoming gowns of gold and black.

On the Saturday, a special visit was paid to the *École Normale* and to Pasteur's laboratory there ; on this occasion, a most interesting letter was read, recently discovered in the State Archives, from Pasteur, at an early period of his career, to the Minister of Instruction, pointing out the directions in which inquiry into vital problems might be made with advantage, in striking anticipation of his own later achievements.

In the afternoon, the Municipality of Paris received delegates at the Hotel de Ville. Sunday was devoted to private inquiries, of course of a scientific nature ; but relief was afforded, in the evening, by gala performances at the Opera and the Comédie Francaise. Monday was spent in a visit to Versailles, where a luncheon was given in the great *Salle de Batailles*. On Tuesday afternoon, a visit was paid to Chantilly, not to the Races but to a garden party given by the Institut de France, to whom the Palace with its Art Treasures was bequeathed by the Duc d'Aumale. British chemists were here specially at home, as the party was received by the veteran French chemist, Mons. Haller, the President of the Academy, well known in this country as a visitor to British Association meetings. Visitors were tea'd to the tune of hunting horns in the cyclopean stables in the grounds of the Palace.

Wednesday was spent in travelling to Strasbourg. Thursday there was a full day, commencing with the unveiling of the Pasteur monument by the President of the Republic. Then came a great luncheon ; this was followed by a visit to the Palais du Rhin, to witness a striking march-past of representatives from the surrounding districts in their special costumes, many of great beauty, after which a Pasteur Museum and a Hygienic Exhibition were formally opened, though both were in an embryonic state. At night, the Mayor gave a reception at the Hotel de Ville. Particularly in the evening, Strasbourg was *en fête* and enthusiastic in its reception of the President and especially of Mons. Poincaré, who spoke with admirable effect of Pasteur in the afternoon. Prior to reaching Strasbourg, the President and a select party had visited Dole, Pasteur's birth-place, also several other places with which his name is associated.

Taken generally, the proceedings were very striking and illuminating. They were not without political purpose, especially at the close ; but no such official recognition of the value of scientific effort as the French have given to Pasteur could possibly be made in this country. The press has been full of notices of his life and work. Mons. Millerand and Mons. Poincaré both laid special emphasis, in their speeches, not merely upon the value of his discoveries but upon the great example he had set as a man, by his disinterested and always exact method of working and by his declared devotion to his country. Everything was done, in fact, to bring home to the public the force and truth of the great Frenchman's own words :

> "*Au point où nous sommes arrivés de ce qu'on appelle la civilisation moderne, la culture des sciences dans leur expression la plus élevée est peut-être plus nécessaire encore à l'état moral d'une nation qu'à sa prospérité matérielle.*"

Sunday, May 27, was a Pasteur Flag Day throughout France. In Paris and the suburbs, over 600,000 francs were collected in the streets and theatres. As the day was wet, collections were made again on the following Sunday. The proceeds of the theatres on the 27th are also to be given to the fund, which eventually is to be devoted to French scientific laboratories, for which at present poor provision is made. Noteworthy is the issue of three special Pasteur stamps to mark the celebrations. Clearly, in French opinion, Mons. Millerand was justified in saying :—

"*Si l'on mesure à la valeur et à l'étendue de ses bienfaits la grandeur d'un homme, celui dont nous honorons le centenaire ne le cède à nul autre et le siècle où il a vécu méritera, dans la reconnaissance des générations, de s'appeler : le siècle de Pasteur.*"

As to the monument at Strasbourg, the cost of which is to be met by international subscriptions, the British contribution being £800, the general opinion appears to be that it is a failure and it is to be removed to a less public position than that which it now occupies in face of the University buildings. It may well be compared with the Egyptian monoliths upon which events are recorded in hieroglyphs ; a well-meant attempt has been made, with which scientific workers must sympathise, to represent the outstanding features of Pasteur's career in chronological order upon the four sides of the obelisk, which is of a reddish stone of peculiar hue—commencing with his crystallographic work, typified by a girdle of crystals at the base, terminating with Rabies, typified by dogs. Probably the general public will have as much difficulty in reading the story as the masses in Egypt had, in the past, in interpreting their hieroglyphs ; test-tubes and a 500 c.c. measuring-cylinder graven upon stone are not objects to appeal to the man in the street to-day. Unfortunately the execution, especially of the animal figures, is poor and lacking in expression, the monument itself being squat and of unsatisfying form and proportions. Perhaps the the artist unwittingly pays science a compliment, in being overcome in his attempt to render its victories obvious. To use Pasteur's words :—

"*Il est salutaire de rappeler aux cités qui l'oublient qu'elles ne vivent à travers les âges que par le génie ou la vaillance de quelques-uns de leurs enfants.*"

It is well that we should be reminded how great were his victories by realising how impossible it is to translate them into any ordinary means of expression.

The real value of the visit to most of the delegates probably lay in the opportunities it afforded for private intercourse with French colleagues. The infinite charm of French society is well known—it has a quality and distinction entirely its own. The chemists were peculiarly fortunate in being entertained at a most perfect dinner at the invitation of Dr. Roux and the Pasteur Institute, the evening being under the special charge of the Professors of Chemistry, MM. Bertrand and Fourneau, as Dr. Roux unfortunately was unable to attend. It was certainly the red-letter event of the week and not without special significance. We have to remember that Pasteur was trained as a chemist and achieved his success in virtue of this training —his attitude throughout was that of the chemist. On account of his discovery of molecular asymmetry and his insistence upon the asymmetric character of the phenomena of life, he may well be regarded as the founder of Organic Chemistry proper—the chemistry of life. The day may not be far distant when this is regarded as his prime discovery, certainly that upon which all his later discoveries were based, the key whereby the gates to the now closed passages of life will be unlocked and control no longer permitted to empirical observers. The world awaits a new Pasteur strictly armed with the weapon of scientific method and gifted with the power to use it ; at present we do little more than blunder on in the paths he marked out.

At Strasbourg, the question arose what was the leading industry and at once came the answer : *Foie Gras.* Then followed the question : How would this be placed by the august body in the U.S.A., including the six (unnamed) scientists eminent in the field of Organic Chemistry ? Clearly, it is a *Synthetic Organic Chemical*, under the terms of their Olympian declaration : a *chemical*, since it contains a preponderating quantity of an individual substance ; *organic*, because it contains carbon (obvious if only as truffle) ; *synthetic*, because it is made by a controlled process, not only changed in chemical identity but converted into a material which is not merely a scientific product but a great work of art, which even Mr. Wells's *Men Like Gods* will hold in reverence ; it may even lead to their accumulation in Strasbourg and, let us hope, their extinction by a sudden Rhine flood. That it was to be reckoned among Fine Chemicals, all agreed : no specious Colefaxian rhetoric nor Board of Trade Referee's unreasonable decision can ever rate it otherwise. Another inquiry was undertaken across the Rhine bridge in Kehl, where a Beer garden was discovered without Beer and our delegates had the sensation of their lives in paying 19,000 marks for a more than thin imperial pint of vinous lubricant. A burette, in a shop window, was farcically priced 28,000 marks and there were many other such signs of the depths to which Germans are being brought by the bad faith of those who control their fortunes. The conclusion come to was that the French are probably right in their attempt to force them to behave as if they were gentlemen and meet their obligations.

NOTES FROM HEATHFIELD IV

By the Rector, REV. B. V. WHITE

Dear Mr. Editor,—A few days ago I had the mortification of discovering an omission of which I have been guilty. My wife said to me, " Basil, did you not promise to write an account of our electric lighting ? I have not seen your article in the journal yet." Incited by this and some other observations which followed my answer to the question, I lost no time in preparing this further letter to you.

Here and in the top of Ribblesdale and in some other places in the Dales the hamlets and villages are supplied by electric light by means of power derived from the streams which are very plentiful. Our geological formation includes in these places an alternation of hard and comparatively soft strata which are nearly horizontal; the rivers and streams therefore flow over a succession of these, and as the softer strata wear away quicker than the harder ones the surface of the land tends to become terraced by the outcrops of the harder rocks, and where streams flow over these waterfalls are produced, varying from the noble fall of the Tees at High Force to the graceful one at Hardraw Scar and the many small waterfalls in other places. In my parish we make use of a fall hard by to turn a Pelton wheel or turbine which drives a dynamo and generates an electric current. We store this up in accumulators which consist of a number of plates of lead of which each alternate plate is connected to one wire and the remaining plates are connected to another wire. The plates are covered with a mixture of oxides of lead, the exact composition of which is not easy to specify, for the fine particles which compose the mixture are probably not uniform. The inside of the particle may be one form of oxide and the outside another; thus one may obtain what on chemical analysis appears to be a gradual gradation from lead metal to a dioxide of lead. You may consider some of these as compounds if your fancy so chooses and many of these mixtures have separate names, but to what extent these are definite chemical compounds or merely intimate mixtures with specific physical properties is to me merely a matter of conjecture. But be this as it may, the plates are placed in dilute sulphuric acid and the current from the dynamo passes through from one set of plates to the other. Now there is obviously some sort of equilibrium which will be attained depending on the quantities of the lead, oxygen, water, sulphuric acid and other circumstances. This equilibrium means that certain proportions of lead peroxide, lead sulphate and so on are present, and if you pass an electric current through this accumulator you will tend to form lead peroxide on one plate and metallic lead on the opposite and more free sulphuric acid, and you can do this during the day, and then when night comes disconnect your dynamo and connect the accumulator on to your electric wires, when the sulphuric acid acts on the lead, lead oxides and lead peroxide to form sulphate of lead and water, the plates return to their original state at the same time giving an electric current which flows through the accumulator sufficient to light up the whole village. At about five minutes to ten of the clock the man in charge of the plant disconnects the wires and retires to his rest; this tends to peace and quietness in the whole village. Of course, in the summer it is unnecessary to have any artificial light at all, and indeed on moonlight nights both in the spring and autumn we are able to save the expense of this luxury.

Trinity Bridge

I frequently look forward with considerable animation to the concourse of chemists at Cambridge, where some forty years ago I spent three happy years. Cambridge can never alter; some antique towers may decay and new buildings rise up here and there, but in all its essential features the town itself, the colleges, the life continue the same.

Clare and King's Colleges

Long may it so remain ! For a few years after I went down I kept in touch with the University, read of the discoveries of Liveing and of Dewar, heard of the notable work of Heycock on metallic alloys and rumours reached me of the very ingenious educational methods of Griffith, who had a plan for teaching Divinity which probably is now considered unorthodox. Dewar has gone from us ; a great man, he accomplished much. He was, moreover, a personality, he had force, charm, a love of art and an appreciation of much that is good in this world. Of the work done at Cambridge during recent years, I know little ; long journeys fatigue me more than formerly. Time was when I could take my place at Fenner's, or witch the world with noble horsemanship. But now how things are changed ! My sportive strength is ended, my vaunted strength expended :—

Sir W. J. Pope, K.B.E., F.R.S.

I feel my steep decline ;
The pleasures of my youthful days
Forsake my age, which now betrays
Desire for rest and warmth and wine.

It is some satisfaction that the bracing air of this remote spot in the dales does preserve a good appetite. When I read of the banquet in the Hall of Trinity, my mind went back to my undergraduate days, and I thought of what the poet wrote of the bell which announces the due repast :—

O blessed Bell ! Thou bringest beef and beer,
Thou bringest good things more than tongue may tell.
Seared is, of course, my heart—but unsubdued
Is, and shall be, my appetite for food.

I shall see and hear some distinguished men at Cambridge. Professor Moureu, I know, has worked much on the occurrence of helium in the natural gases and springs. Professors Bancroft and Lewis I know only by name, but years ago I was presented to Monsieur Kestner in Paris, and I have a vague recollection of hearing of the researches of Professor Nasini and Senator Paterno. As to Sir William Pope, I know of his work on optically active substances, on photographic sensitisers and desensitisers, on mustard gas and other subjects, but it would be folly for me to mention facts about him which are far better known to your readers than they are to me. He is a very various man, learned in his own subject, and so far as I can judge from meeting him at the British Association a few times, I should consider him to be a man of the world, shrewd and even worldly in business, and probably able to appreciate that post-prandial refreshment which prevails among the fellows at our ancient seat of learning. Herein he but pursues the same path as the austere Cato—*Narratur et prisci Catonis, Soepe mero caluisse virtus.* Thy fame, O worthy knight, will spread and thy reputation increase

Till Granta's sons from all her sacred bowers
With grateful hand shall weave Pierian flowers
To twine a fragrant chaplet round thy brow.

Professor Lowry I know only from the papers he has contributed to your journal. I think he and I have contributed more articles to it than anyone else ; but I am not sure, for there is one writer who thinly disguises himself under such titles as "Wanderer in Society," "Calorifer," and "Scarifier"—I quote from memory—the name he adopts varies, but there is a pungency, a vigour—what the *Yorkshire Post* calls a Kruschen feeling—about him, if I may use the expression, which marks him for his own. I have almost drop't into his own parenthetical style of writing myself.

My Dear Sir, although I have done such poor justice to the subject, I am able to adorn your pages with some excellent photographs taken by a young friend of mine who has not yet taken Holy Orders.

Ely Cathedral and Norman Monastery

I anticipate a lively pleasure in meeting, for the first time, your distinguished President, your amiable contributor Professor Baly, and your indulgent self, and am, with all respect and kindly wishes, etc., etc.

SOCIETY OF CHEMICAL INDUSTRY

THE ANNUAL MEETING

CAMBRIDGE. JUNE 20 TO 23, 1923

Members intending to be present at the meetings are asked to send in their forms with the appropriate remittance at once, if they have not already done so, in order that the necessary arrangements may be made for them.

Addresses. The title of the President's address to be delivered on Thursday, June 21, is "Chemistry and Industry," and that of Dr. Charles Carpenter's address on the following day is "The Evolution of a Chemical Industry."

Accommodation of Members in Colleges. Accommodation will be available for men in various colleges from the afternoon of Wednesday, June 20, to the afternoon of Saturday, June 23. Members who arrive on Wednesday will be charged an inclusive fee of £3, those arriving on Thursday an inclusive fee of £2. These fees include the use of a set of rooms (bedroom and sitting-room), attendance, gratuities to college servants and the following meals: *Wednesday, June* 20.—Tea (if required) and dinner. *Thursday, June* 21.—Breakfast, lunch and dinner. *Friday, June* 22.—Breakfast, lunch and dinner (if required). *Saturday, June* 23.—Breakfast, and lunch (if required). Members will usually take their breakfasts in their rooms. Luncheon and dinner will be served in the halls of colleges. On Thursday and Friday tea will be served at the Vice-Chancellor's reception, and at the Garden Party at Sidney Sussex College respectively. Members who arrive before five o'clock on Wednesday, and who will require tea, are requested to give notice to that effect on a form to be supplied. There will be no extra charge. Members unable to attend the Annual Dinner of the Society on Friday, and desirous of dining in college that evening, may do so without extra charge by giving notice to that effect on the form above referred to. Members who do not make the trip to Ely, and who require luncheon before leaving Cambridge on Saturday, may obtain it in college on that day without extra charge.

It is important to note that alcoholic drinks are not included in the charges specified above, and members requiring such drinks with their meals must sign a chit presented by the waiter at the time of ordering. Payment for such must be made by members at the office of the Society at the Arts School, Bene't Street, on Saturday, before departure. It is the wish of the college authorities that no money shall change hands at table, and it is hoped that members will kindly co-operate in order that this scheme of payment may be a success.

To the list of colleges offering accommodation given on page 491 of *Chemistry and Industry* of 18th May, Corpus Christi is to be added. As previously stated, men requiring accommodation should communicate with Mr. J. E. G. Harris, the University Chemical Laboratory, Downing Street, Cambridge, who will supply any further information and forward a form to be filled up by the member.

Hotel Accommodation.—The hotels are now more or less full, but there is good accommodation to be obtained in boarding houses (college rooms) should the supply of hotel rooms be exhausted.

The Smoking Concert on June 20 will be held in the dining room of the University Arms Hotel.

Group Photograph. A photograph of the members will be taken at the close of the Annual General Meeting on Thursday, June 21.

Tickets. Tickets for the Smoking Concert, the Reception and Dance, the Annual Dinner, and the excursion to Ely with lunch will be handed to members who have paid the inclusive fee when they register at the office in the Arts School, Bene't Street, Cambridge.

Guide to Cambridge. A copy of the illustrated Guide to Cambridge has been forwarded to each member who has purchased his tickets.

Nominations to Council.—The following have been nominated under By-law 24 to fill four vacancies among the ordinary members of Council: Professor P. Phillips Bedson, Dr. R. T. Colgate, Mr. William Cullen, Professor A. R. Ling, Dr. Joseph Reilly, and Dr. E. W. Smith.

A ballot list has been posted to every member entitled to vote.

J. P. Longstaff,
General Secretary

ADVANCE PROOFS OF PAPERS

Authors of papers which are to be read before local sections or groups, may in some cases desire to have a few advance proofs for distribution among those likely to make useful contributions to the discussion. Any author who requires such advance proofs is requested to hand the manuscript of his paper to the Local Secretary so that it may reach the Editor at least *one month* before the date of the meeting at which it is to be read, in order to allow sufficient time for it to be considered by the Publications Committee and, if approved, set up in type.

ANNUAL REPORTS

Vol. VII. is now ready and can be obtained by members at the price of 7s. 6d., post free, from the offices of the Society.

INSTITUTION OF CHEMICAL ENGINEERS

The first annual corporate meeting of the Institution of Chemical Engineers was held at the Engineers' Club, London, on June 8, under the presidency of Sir Arthur Duckham. In the absence of the hon. secretary (Prof. J. W. Hinchley) through indisposition, the report of the Provisional Council was presented by Mr. C. S. Garland. The report gave a brief account of the formation of the Institution and stated that 205 applications had been received for membership, of which 114 had been accepted by the Council. Mr. W. J. U. Woolcock had been elected the first honorary member of the Institution in recognition of his work on behalf of the chemical industry of this country and especially in the formation of the Institution. The Council had decided that the Institution should take part in the British Empire Exhibition, 1924, and that the sum of £25 should be allocated as a donation towards the chemical section of the Exhibition. The statement of accounts showed the finances of the Institution to be in a sound condition, the liabilities on June 8 being £371, cash at bankers and in hand on the same date being £822.

The President said that although the position was good now, the members would have to know what it was going to cost to run the Institution. So far the work of the Institution had been done largely on a voluntary basis, but henceforth they would have to consider how much assistance they could afford in the future to run the Institution properly. They would have to have definite paid assistance in the form of a Registrar or some person to act as manager of the Institution. The membership of the Institution was, of course, sufficient for the present expenditure, but it was not sufficient to enable them to appoint the type of man they wanted as Registrar.

As the result of a ballot for members of Council the following were declared elected: H. Talbot, J. Arthur Reavell, C. S. Garland, W. B. Davidson, Sir A. Gibb, W. Macnab, Col. Sir F. L. Nathan, J. MacGregor, and W. Newton-Drew. The Associate members of Council elected were R. C. Browning, A. L. Booth and E. C. Randall. The honorary officers were elected as follows: President, Sir Arthur Duckham, K.C.B.; vice-presidents, Dr. C. Carpenter and K. B. Quinan; hon. treasurer, F. H. Rogers; hon. secretary, Prof. J. W. Hinchley.

The President said that Mr. Garland had very generously offered to act as Registrar for the Institution until other arrangements could be made. Mr. Garland had done an enormous amount of work for the Institution since the beginning, he was closely in touch with the work of the Institution, and his assistance would be of the very greatest value. The hearty thanks of the Institution were accorded to Mr. Garland for his offer.

Mr. T. C. Finlayson then read a paper entitled "Industrial Oxygen," an investigation into the possibilities of obtaining cheap oxygen. The author stated that the work had been undertaken under the auspices of Messrs. Woodall-Duckham Vertical Retort and Oven Construction Co. (1920), Ltd., to see if industrial oxygen, which would be of fundamental importance to the gas industry, could be manufactured at a price not exceeding 1s. per 1000 cubic feet, in a plant which would not involve a large capital expenditure.

Starting with a brief review of the various processes which have been invented for the manufacture of oxygen, the speaker subdivided them into: (1) Chemical, (2) physical, and (3) electrolytic processes. It was found that most chemical processes, being conducted at high temperatures, were thermally inefficient, the cost of the oxygen produced being between 7s. and 12s. per 1000 cb. ft. Of the low temperature process the Bergfeld seemed to offer the greatest possibility of producing cheap oxygen, but presented a difficulty in the isolation of oxygen produced when the reaction was reversed.

The physical processes were further subdivided into two groups, viz., solution processes and liquefaction processes. Brief descriptions were given of the Mallet, Helouis, and Belbie processes, which belong to the former group, and fuller descriptions of the Linde, Claude, and Norton processes belonging to the latter section. Here again the cost of oxygen production by liquefaction was very much in excess of the figure aimed at, being with continuous working 19s. per 1000 cb. ft. for small plants and 4s. 6d. per 1000 cb. ft. for large plants. For intermittent working of the plants these figures would be about 27s. per 1000 cb. ft. and 6s. 3d. per 1000 cb. ft., respectively.

Mr. Finlayson then described various cells used in the electrolytic processes and stated that with this type of process the cost of oxygen if the hydrogen was wasted would amount to 56s. per 1000 cb. ft. If, however, both hydrogen and oxygen were utilised the cost would be 28s. per 1000 cb. ft. for oxygen and 14s. per 1000 cb. ft. for hydrogen. Electrolytic processes therefore were only used when small quantities of oxygen were required for certain industrial purposes.

The second part of the paper was devoted to the physical chemistry of metallic oxidation, and of hæmoglobin, the solution of gases in liquids, the adsorption of gases by solid absorbents and the separation of gases by dialysis. As a result of these investigations the author concluded that the adsorption of oxygen by hæmoglobin might give a workable process, but that large plants using hæmoglobin as an adjunct to gas-making would not be considered an attractive proposition. It seemed therefore that cheap oxygen could best be obtained by separation of oxygen and nitrogen by solution methods. With this object in view experimental plant was designed and experiments made on the rate of solution and rate of evolution of air from solutions of water, Diesel Oil, light fuel oil, methylated spirit and paraffin. The effect of agitation and temperature on these rates was also determined. From the information thus obtained a plant capable of producing 1000 cb. ft. of 100 per cent. oxygen per hour was designed. This consisted of two cylindrical vessels each of 660 gallons capacity, provided with an efficient means of agitation and openings for the introduction of air and solvent and the withdrawal of gas and solvent, as well as a device to keep the vessels filled with oil whilst the gas was passing off from the vessel with the stirrer in motion. In working the plant air was pumped into the first cylinder until a pressure of 135 lbs. per sq. in. was attained and then the pressure was raised to 150 lbs. per sq. in. by pumping in blow-back gas. After thorough washing the pressure was allowed to fall rapidly to 75 lbs. per sq. in., the energy contained in this being utilised in driving the high-pressure air blower, after which it passed into the atmosphere. The pressure inside the washer was now allowed to fall to 36 lbs. per sq. in. The gas evolved was used to drive the low-pressure blower during its passage to the atmosphere. During a further fall in pressure to 20 lbs. per sq. in., the gas evolved, containing about 25 per cent. of oxygen, was pumped into washer No. 2, and constituted the "blow-back gas" mentioned above. In this way the oxygen content of the washer was raised to about 22 per cent. The pressure in No. 1 washer was then reduced to 1 lb. absolute when the gas evolved would contain an average of 40 per cent. of oxygen. The results of these experiments made it appear that a supply of 40 per cent. oxygen could possibly be obtained by this pressure-fractionation process more cheaply than by any of the existing methods. As, however, the percentage of oxygen increased, say, to between 60 and 70 per cent., the process became much less efficient. The experimental work showed that ordinary paraffin oil was the best of the solvents tried. Another plant was designed to work under pressures at or below atmospheric. Here the oil was agitated in contact with air at atmospheric pressure and then after saturation the pressure was reduced to 6·5 lbs. per sq. in. absolute, a gas containing an average of 23 per cent. oxygen then being evolved. The pressure was again further reduced to as near zero as possible, when the gas evolved would contain nearly 40 per cent. oxygen. This second method had the advantage over the first in that power was not required for compression, but had the disadvantage that the much larger quantities of oil required give rise to the difficulty of intimate mixing with the air. The saving in power used for compression seemed to be more than counterbalanced by the increased capital outlay and the necessary treatment of much larger quantities of solvents.

The concluding portion of the paper dealt with the uses of oxygen in industry. The author stated that 50 per cent. of the oxygen used in industry was employed in metal cutting, a further 25 per cent. in oxy-acetylene welding, the remainder being used in lead burning and in the production of high temperatures for special purposes. Oxygen has also been used in Germany in the manufacture of nitric and acetic acids, but otherwise its use is not very general in the chemical industry. If cheap oxygen could be obtained and used in the gas industry it probably would not alter materially the carbonisation process, but would, however, permit of a more efficient gasification process being carried out in which both the "run" and the "blow" would give a gas of satisfactory calorific value. By using oxygen in gas manufacture greater internal heat would be generated thus permitting the introduction of more steam, which would make for an increased yield of gas per ton of coal charged. In the author's opinion, whilst the use of oxygen in blast furnace work would be a decided advantage the size and cost of a plant built on the designs outlined above would render its adoption uneconomical.

In the evening, Sir A. Duckham again presided at an informal dinner, which was followed by a short discussion on the training of the chemical engineer. Mr. Donald said that the time has come for some action, and suggested that a committee should be appointed to consider the preparation of a curriculum with the educational authorities of the country. Sir A. Duckham made it clear that the new council considered that one of its first and most important tasks was to confer with the university and other authorities with a view to drawing up an agreed curriculum and he expressed the belief that a scheme of this nature would be ready by the time the next annual meeting was held. During the discussion of the lines upon which training should take place, the sandwich system was recommended by Mr. Garland and severely condemned by several other speakers, and the desirability that British industrialists should assist in training chemical engineers in this country was commented upon. The President first raised the point as arising out of his recent experiences in America, where chemical engineering firms were closely in touch with the teaching institutions and in many cases sent their research work to the institutions to carry out. This or some equivalent method would have to be adopted in this country. Mr. C. S. Garland said that not only would industrialists in this country have to work in close co-operation with the training institutions, but their works managers and others would have to go to the universities and give lectures and say what industry required. Another matter of interest raised was the class of man to be appointed as professors of chemical engineering.

MEETINGS OF OTHER SOCIETIES

SOCIETY OF GLASS TECHNOLOGY

The sixty-second meeting was held in University College, London, on May 16, Prof. W. E. S. Turner, D.Sc., presiding.

Two sessions were held. At the first session two papers were presented. The first, "On the Refractive Index Changes in Optical Glass occasioned by Chilling and Tempering," was by F. Twyman, F.Inst.P., and F. Simeons, B.Sc., F.Inst.P. In presenting this paper Mr. Simeons defined "chilling" as rapid cooling from a high temperature, as opposed to the controlled cooling from a medium temperature known as "annealing." Considerable "chilling" could be effected by allowing glass to cool in air from a temperature within or above the annealing range. In tempering a metal, part of the properties introduced in the preceding operation was removed by heating to a temperature much lower than that attained for "chilling," and allowing the metal to cool slowly. The term "tempering" was applied to the analogous partial recovery of the properties of glass in the annealed state on heating to a medium temperature. "Annealing temperature" was the temperature at which internal stresses existing in a glass were reduced to one-twentieth of their original amount in 0·26 minute. On chilling dense barium crown and borosilicate crown glasses the refractive index might be lowered by as much as 0·004 and 0·0013, respectively. This lowering of refractive index was avoided by heating to a definite temperature and for a definite time.

Mr. V. Stott, B.A., F.Inst.P., then gave a paper entitled, "Notes on Burettes," in which he showed that a burette which emptied rapidly had a very high drainage factor, the draining continuing over a very long period; using a 50 c.c. burette emptying in 20 seconds the drainage was not complete in 30 minutes. But a burette with a long emptying time had a very small drainage, which was practically complete after a comparatively short time. Accurate readings could thus be obtained much more quickly by using a long emptying time and a short drainage, than by using a short emptying time and a correspondingly longer drainage time. Errors due to using a burette calibrated for a certain delivery time with a jet which gave different delivery time were discussed, and it was shown that such errors were, in specified instances, too large to be negligible.

At the second session the President referred to the death of Sir Albert J. Hobson, one of the first members of the Society. He also intimated that the visit to Paris, which had been postponed, would take place some time in July. Two papers were then read. The first was entitled, "A New Method of Glass Melting," by A. Ferguson, who claimed that by means of the method tank bottle-glasses could be melted with 30 tons of coal to 100 t. of glass, including a margin of 60 per cent. safety. The process utilised a cone or column of whirling gases at 1800° C., into the vortex of which batch ground to 60-mesh was dribbled at the rate of two lb. per second, the carbon dioxide of the limespar and soda having been first driven off in a preheater so that the furnace had only to raise the temperature from 850° to 1350° instead of from 20° C. The particles of finely divided batch exposed to the heat a surface which was over 6000 times that of batch "spread on" and the permeation of the particles was 2000 times easier. All reactions necessary to form glass molecules took place in a gas at least two million times less viscous than tank metal, so that affinities could reach each other, collide and react millions of times per second, instead of all the energy of the atom being required for hours to find the waiting affinity somewhere in a tank, and when not encountered resulting in seed, striæ and unequal strain in the glass. All preheating was done by waste heat; the coal was retorted, the hydrocarbons saved, air and batch preheated and freed from carbon dioxide. The process was entirely automatic from coal and batch bin to warehouse counter. The batch, instantly melted and refined, flowed through a stream-line tank to a periphery gatherer in a firehearth.

The second paper was entitled, "Natural Sillimanite as a Glass Refractory," by S. English, M.Sc., who gave results of tests, which showed that this material possessed properties of great value to glass makers. Test pieces were made up by mixing 100 parts of sieved sillimanite with 10 parts of finely ground clay; such a mixture could be made into slabs and pressed into crucibles if care were taken in working it. These slabs and crucibles were examined for the properties which were the chief causes of trouble to glass makers when using ordinary clay refractories, and the results showed:—(1) The drying and firing shrinkages of the sillimanite mixture were very much less than the corresponding contractions of pot-clay mixtures, in fact sillimanite slabs that were completely air-dried showed practically no further shrinkage on firing to 1400°. (2) The porosity of the fired sillimanite slabs was rather less than the porosity of pot-clay slabs fired to the same temperature. (3) Sillimanite crucibles were attacked very much less by molten glass at 1400—1420° C. than were similar size pot-clay crucibles.

In the evening the annual dinner was held in the Hotel Cecil, the president being in the chair. Among those present were Sir F. W. Dyson, F.R.S., Astronomer Royal; H. J. C. Johnston, Esq., President of the Institute of Clayworkers; Frank Wood, C.B.E., B.Sc., and Dr. M. W. Travers, F.R.S., past presidents of the Society; A. R. Upjohn, Esq., LL.B., Master of the Glaziers' Company; R. L. Frink, Director of the Glass Research Association; and Mons. Courty, of Paris.

CHEMICAL SOCIETY

A formidable array of papers was announced for presentation at the meeting of the Chemical Society on June 7. Prof. Wynne presided, each of the seven papers on the list being dealt with.

(1) "Investigations on the dependence of rotatory power on chemical constitution. Part XX. The rational study of optical properties: Refraction a constitutive property," by H. Hunter. Dr. R. H. Pickard, F.R.S., who communicated the paper on behalf of the author, pointed out the aim of following up refractive dispersion so as to connect it with rotatory dispersion. The Pulfrich refractometer was used for measurement and even with this accurate instrument reliability could only be taken to the fourth decimal place, whereas in the literature on the subject it was quite usual to record the fifth place. Refraction was largely constitutive—*e.g.*, using Eisenhohe's recalculation of Conradi's figures for atomic refractivities it was necessary to ascribe to oxygen six different values.

(2) "Researches on indium. Part I. Diphenyl indium chloride and phenyl indium oxide," by A. E. Goddard. It was stated that indium formed compounds similar to thallium of the types R_2InCl and $RInO$. The compounds discussed were those in which the radical R was phenyl. These were obtained as powders.

(3) "The properties of ammonium nitrate. Part VI. The reciprocal salt pair, ammonium nitrate and potassium sulphate," by E. P. Perman and W. J. Howells. Dr. Perman submitted curves showing the formation of compounds, mixtures and mixed crystals when ammonium nitrate and potassium sulphate were the components.

(4) "Ring-chain tautomerism. Part VI. The mechanism of the keto-cyclol change in the propane series," by E. W. Lanfear and J. F. Thorpe. Prof. Thorpe showed how stability was conferred on one or other of the two tautomeric forms each with the wandering hydrogen atom—*i.e.*, the keto acid or the hydroxy-ring acid by different kinds of substitution or alteration, on his hypothesis of the tetrahedral angle.

It would be of interest to correlate or contrast Prof. Thorpe's view of tautomeric change with those of G. N. Lewis based on the arrangement of electrons within the various molecules.

The other papers were:—

(5) "The reversibility of additive reactions. Part I. The aldol reaction," by E. H. Usherwood.

(6) Mechanism of the pinacone-pinacoline and Wagner-Meerwein transformations," by C. K. Ingold.

(7) "Researches on antimony. Part I. Tri-*m*-xylylstibene and its derivatives," by A. E. Goddard.

PHYSICAL SOCIETY

At the meeting held on May 25 at the Imperial College of Science, Dr. A. Russell, M.A., in the chair, a paper on "The Effect of Torsion on the Thermal and Electric Conductivities of Metals," by Prof. C. H. Lees, F.R.S., and J. E. Calthrop, B.A., B.Sc., was read by Prof. Lees. A method was described which enabled measurement to be made of the effect of twisting a wire on its thermal conductivity. In each of the steel, aluminium, copper, and lead wires tested the twist decreased the conductivity along the wire by a small amount, approximately proportional to the square of the twist per unit length. The change of electrical conductivity was found to be in general less than the change of thermal conductivity, but was also approximately proportional to the square of the twist per unit length. In reply to the discussion, Prof. Lees said the wires were soft and not annealed; the object of the experiments was to test the electron theory of conduction.

Mr. C. R. Darling, F.Inst.P., F.I.C., read a paper entitled "An Experiment on the Production of an Intermittent Pressure by Boiling Water." If a glass tube, open at both ends, and of about 5 mm. bore, were placed in a beaker of briskly boiling water so as to rest on the bottom of the beaker, steam bubbles would form at the point of contact, causing the water to rise to a definite height in the tube. The column of water thus raised sunk after a time and then rose again, the rising and falling occurred at regular intervals. If the tube were narrowed to a bore of about 1 mm. near the top of the water, and widened out considerably just above the water surface, the phenomenon then became regular in action. After rising to the height of about 3 cm. in the widened part, the water discharged back into the beaker, and after a short interval again rose and was discharged, the cycle being repeated indefinitely. The water was apparently superheated at the points of contact of the tube and beaker, so that the steam produced could sustain a higher pressure of water. When the water reached the widened part, however, it was cooled and increased in density until the extra steam pressure at the bottom of the tube was overcome, when it discharged completely. The capillary bore slowed down the rate of flow in both directions, and thus steadied the movements.

Dr. F. E. Breithut has been appointed Chemical Trade Commissioner on the staff of the United States Commercial Attachée at Berlin. Dr. Breithut was attached to the United States Chemical Warfare Service and later has been engaged in industrial chemical work. He is a member of this and other societies.

PERSONALIA

Professor H. Louis, D.Sc., has been appointed a member of the Royal Commission on subsidence caused by mining operations, of which the Right Hon. the Viscount Chelmsford is chairman.

At a recent meeting of the Court of the Leeds University it was decided to confer the honorary degree of Doctor of Literature on Sir E. Brotherton, Bart., and of Doctor of Science on Professor A. Smithells.

Sir R. Hadfield, F.R.S., has been elected a corresponding member of the Académie des Sciences, Paris.

Dr. E. P. Hyde has resigned from the directorate of research of the National Lamp Works of the General Electric Co., U.S.A.

Dr. W. A. Caldecott, industrial adviser and metallurgist to the New Consolidated Goldfields, Ltd., has accepted the post of Director of Industries in the Department of Mines and Industries, South Africa.

Monsieur Richard, professor of chemistry at the University of Bordeaux, has been appointed Director of the School of Chemistry of that University, in place of the late Prof. Dubourg.

Prof. J. R. Withrow has been nominated Chairman of the United States National Research Council Committee on the use of sodium compounds as substitutes for potassium compounds in scientific and industrial work.

Monsieur H. Gabelle, Director of the Conservatoire National des Arts et Métiers at Paris, has been confirmed in his post for a further eight years.

Messrs. J. H. T. Roberts, J. H. G. Monypenny, R. C. Richards and G. C. Simpson have been elected Fellows of the Institute of Physics, and Messrs. A. Adderley, W. T. Astbury, F. G. C. Bratt, P. A. Curry, G. A. R. Foster, A. E. Owen and J. H. Smith have been elected Associates.

Mr. H. M. Lancaster, who is an active member of the Canadian Section of the Society of Chemical Industry, has been appointed Director of the Laboratories of the Dominion Department of Health, Canada.

Major B. J. Eaton, O.B.E., Agricultural Chemist of the Federated Malay States, has been selected to represent the Governments of the Federated Malay States and Straits Settlements (British Malaya) at the Pan Pacific Scientific Congress to be held in Sydney and Melbourne from August 13 to September 3, 1923.

Dr. E. W. Schwartze, of the U.S. Bureau of Chemistry, has received a Fellowship from the National Research Council for a year's study in the laboratory of Sir W. M. Bayliss in University College, London.

From the United States the death is announced of E. C. Klipstein, a member of the firm of that name which was the first to market sulphur black and to manufacture synthetic tannins in the United States. Mr. Klipstein, who was a well-known authority in textile and leather chemistry, has been a member of this Society since 1902.

The death is announced of Prof. P. N. Arata, a well-known Argentine pharmacist and professor of chemistry in the University of Buenos Ayres. Prof. Arata was the founder of the Argentine National Chemical Bureau, and the author of numerous technical treatises.

From Germany the death is announced of Dr. F. Isernhehn, chemist of F. Bayer and Co., of Leverkusen.

FORTHCOMING EVENTS

June 16.	The Royal Institution of Great Britain. at 3 p.m. "Atomic Projectiles and their Properties," by Sir E. Rutherford.
June 16.	Society of Chemical Industry, *Edinburgh and East of Scotland Section.* Excursion to Melrose and Abbotsford, leaving Edinburgh at 1.30 p.m.
June 16 to 20.	Meeting of the Union Internationale de la Chimie Pure et Appliquée at Cambridge.
June 20 to 23.	Society of Chemical Industry. Annual meeting at Cambridge.
June 21.	The Royal Society. The Croonian Lecture will be delivered at Burlington House, Piccadilly, W. 1, at 4.30 p.m.. on "Plant Respiration as a Catalytic Process," by Dr. F. F. Blackman, F.R.S.
June 21.	The Chemical Society, Burlington House, Piccadilly, W. 1. Ordinary Scientific Meeting at 8 p.m. (1) "The Constitution of the Higher Oxide of Nickel," by O. R. Howell; (2) "The Relationship of the Tautomeric Hydrogen Theory to the Theory of Induced Alternate Polarities," by F. Allsop and J. Kenner. (3) "Electron Valency Theories and Stereochemistry," by S. Sugden. (4) "The Relative Influences of Water Vapour and Hydrogen upon the Combustion of Carbon Monoxide—Air Mixtures at High Temperatures," by W. A. Bone, D. M. Newitt, D. T. A. Townend. (5) "Metallic Hydroxy-Acid Complexes. Part I. Cuprilactates," by I. W. Wark. (6) "Metallic Hydroxy-Acid Complexes, Part II. Cuprimalates, their Formation, Properties and Composition," by I. W. Wark. (7) "Cholesterol and its Role in the Organism," by S. Minovici.
June 28.	The Institution of Electrical Engineers. The annual conversazione will be held at the Natural History Museum, South Kensington, S.W., at 8.30 p.m.

CORRESPONDENCE

A BURNING QUESTION AND A CONTENTIOUS BONE

SIR,—Nine-tenths of the luciferous letter in your issue of June 8 is pure bluff, the rest merely specious, loose logic. To deal with the complex issues of combustion with levity is useless waste of your space and a bad example to your sensitive readers. It is not the treatment I should have expected from one bred in the bosom of a stern faith. My mentor has named himself with unconscious humour. I asked for light, not for darkness. It were meet that I keep company with angels, not walk out with the fallen, as my friends imply that the partial pressure of my respectability is low, whatever its differential coefficient, particularly that my hydrogen-ion-concentration should on no account be raised.

To make experiments is an easy task to many; to make use of the results is beyond most. That this is so is clear from the fact that, from Davy onwards, we have an endless series of observations but are still without the vestige of an acknowledged "theory" of the process of combustion in our text-books. Nevertheless, we rate ourselves scientific—in reality, we just muddle through, like ordinary people; yet should we be careful that our conceit be not found out ere long The funds for research work must soon come to an end, if we do not now experiment with clear purpose and greater effect than heretofore: only to this end can the use of public money be justified.

The dispute between Lucifer and me hinges upon the interpretation of the difference between a hydrogen-air and a carbonic-oxide-air mixture. Lucifer has upon his brain the "activation" of nitrogen by some mysterious, sympathetic vibration process: he regards it as a mere carbonic oxide buffer which takes up the shock; I would leave all such speculation to the Liverpool School and remain true to what is called by Jacques Loeb "classical chemistry" —a discipline little favoured by the luciferous school, it seems. Writing in Derby week, I may say shortly that I am backing Nitric Oxide.

Says Lucifer :—

> Doubtless a part of the "activated" nitrogen primarily formed in our CO-air explosions at high pressures was oxidised in some experiments to nitric oxide, especially when more oxygen was present than sufficed to burn all the carbon monoxide. But an analysis of the actual pressure curves has shown that any such nitric oxide formation was a secondary effect, and that the results as a whole cannot be explained except on the supposition that the lag was primarily due to "activation" of nitrogen itself. Besides which, even were the "nitric oxide" supposition to be preferable to that of "nitrogen activation" (which it is not), it would still be necessary to explain (*a*) why the said lag was never observed in our hydrogen-air explosions, and (*b*) in the case of our CO-air explosions why the replacement of a small part only of the carbon-monoxide by its equivalent of hydrogen removed it.

To which I reply: (1) There is not the slightest proof that any special form of "activated nitrogen" is primarily formed or reason to suppose that it ever is: everything becomes "active" at high temperatures. (2) As to the analysis—what analysis? I fail to find any in the Royal Society paper, after reading this carefully several times. How any analysis can show that the formation of nitric oxide was a secondary effect, I fail to see; nor that the lag cannot be explained except on the supposition of an activated nitrogen. (3) As to the (*a*) and (*b*) besides, Lucifer fails to realise that in hydrogen alone and even in presence of a small proportion of the gas the conditions are entirely different from those in carbonic oxide. In presence of the large amount of moisture formed—I will not harrow his majesty's feelings by writing the melodious, well-formed word I would substitute for it—the rate of change would be much more rapid than in the simple carbonic oxide mixture. As an appreciable amount of nitric oxide is present in the cold gases, the proportion formed at a high temperature may be very considerable, and this would revert but slowly in the dry atmosphere; in the wet hydrogen atmosphere, possibly there would be less nitric oxide formed initially and what was formed would be more readily unburnt, so that little would persist.

I do not think I have missed any point in the argument, let alone a cardinal one.

There is nothing new in the observation that nitric oxide is produced in gaseous explosions—I fancy a chapter is devoted to the subject in the Government Nitrogen Report. Those of us who are interested in such matters have long had the problem under notice. As to the effect of living with a bomb—familiarity has been known to breed contempt. I am not so anxious for more inquiry as I am for light on the records already before us. Messrs. Bone and Co. have given us a long series of trustworthy data, but it may well happen that the reapers will be other than the sowers; in any case the harvest is yet to be properly garnered.

CALORIFER

P.S.—The behaviour of nitrated explosives is worth noticing in connexion with the question at issue. They may be regarded as potentially nitric oxide personified, yet the gas is scarcely present in the products, even when they are exploded under conditions giving rise to very high pressures and presumably correspondingly high temperatures. Doubtless it is all "over burnt." Reference may be recommended to Sir R. Robertson's recent Royal Society paper. It is very kind of Mr. Finch to tell me of his visit to South Kensington. If it becomes the fashion for visitors to laboratories to deliver such *obiter dicta*, you will have no need to invite scientific communications to your columns, and your *Journal* will be quite a chatty organ. I already hear it spoken of as "readable." In time we may learn the quality of the afternoon teas—now a want felt with great regularity in all laboratories—and so be able to make our selection among them. As to his conclusions: *b* is a self-evident proposition, *a*, *c* and *d* are just assertions, such deductions are not to be made from any scrutiny of continuous curves, which merely show rise and fall of pressure. They are but the dictated interpretations of Lucifer.

GOLD OUTPUT IN WESTERN AUSTRALIA

Sir,—I beg to advise you that the Honourable the Premier of Western Australia draws attention to a paragraph on page 242 of *Chemistry and Industry* of March 9, which purports to give particulars of the gold production in Australia for the year 1922.

The figures given in the *Board of Trade Journal* of March 1, 1923, page 274, from which your paragraph is taken, relate to the State of New South Wales only. The output for the *whole* of Australia for 1921 was 767,194 fine ounces, valued at £3,258,832, and for that year the output for Western Australia was 553,731 fine ounces, valued at £2,352,098. For the year 1922 the output for Western Australia was 538,246 fine ounces, valued at £2,286,325, but I have not the complete figures for the other States.

The Agent-General will be glad if you will make the necessary correction in the next issue of your Journal.—I am, Sir, etc.,

C. B. Bannister,
Secretary to the Agent-General
for Western Australia
Savoy House, W.C. 2
June 7, 1923

THE ORIGIN OF TWADDELL'S HYDROMETER

Sir,—Mr. H. A. Auden's letter on the above subject, which appeared in the issue for May 18 last, does not seem to have elicited any response, so perhaps the few notes upon the genesis of the instrument which follow may be of value.

In the memoir of Charles Macintosh, of india-rubber fame, compiled by his son George Macintosh (privately printed in Glasgow, 1847), there is given a list of the inventions to which Mr. Macintosh laid claim, one of these being the improved Baumé's hydrometer, and on page 49 of the same memoir it is stated that: "Mr. Macintosh was also the inventor of the hydrometer or aerometer which has been named Twaddel's hydrometer, from the last-named mechanician having constructed them according to Mr. Macintosh's directions. This instrument was first used for the purpose of determining the specific gravity of the alum liquors, and seems to have been a modification of the hydrometer of Fahrenheit (or rather of Baumé)." The date of this invention was about the year 1809, when Macintosh was busy with the manufacture of alum from shale near Glasgow.

In 1805, Wm. Twaddel, described as a "Glass-spirit proof maker," had a shop at 76, Saltmarket, in Glasgow. In 1810 he had removed to the High Street of that city, and he carried on his business at various addresses until 1839-40, when his name disappears from the directory, and in 1840-41 is succeeded by Thomas Twaddell (with two l's) at his last address, and shortly after the name becomes Thomas Twaddell and Co., and so continues for some years. What relation Thomas Twaddell was to William Twaddel is not evident, perhaps son or nephew, but it is clear that William Twaddel was the maker (but not the inventor) of the instrument known by his name; regarding the spelling of the name there is ground for spelling it either with one "l" or with two, but the earlier form has only one, and is, I think, to be preferred. The Tyneside story of the origin of the instrument is, I make bold to say, a pure myth.—I am, Sir, etc.,

Edward Rodger
1, Clairmont Gardens, Glasgow, W.
June 9, 1923

BRITISH CHEMISTRY AND GERMAN PUBLICATIONS

Sir,—With reference to some remarks in last week's editorial of *Chemistry and Industry*, that some doubt has been felt as to the reason why references to the work of British chemists have been left out in many of the recent German publications, may I, as one who recently had the opportunity of mixing and speaking with quite a number of research workers in Germany, give my impressions in this matter?

Nowadays it is absolutely impossible for a German chemist to subscribe to any foreign journal. The pay of the highest paid professors a couple of months ago was four pounds monthly at the then exchange rate.

Only very few libraries can now afford to take in foreign papers; even the biggest Universities in Germany have been forced to stop their subscriptions to almost all foreign periodicals, because the value of the mark is so low.

With the exception of Austrian publications and occasional gifts of stray numbers of Scandinavian and Dutch journals, hardly any other scientific papers reach the German Universities.

When I was in Germany last time more than a dozen people went to the extent of copying down the whole of the British journals I received. Even then the expense of buying sheets of writing-paper for this purpose was considered as a very heavy one!

I hope you will agree with me that the reason for which recent work of British as well as other foreign chemists is not acknowledged is surely not one of deliberate intention; it is the desperate economic situation which has prevented the majority of the German chemists from getting at the foreign literature. What seems to me most surprising is that there can be any scientific work done in Germany of to-day—the conditions there are appalling.—I am, Sir, etc.,

Ion

Geneva,
June 7, 1923

THE "STREAM-LINE" FILTER

Sir,—At the last meeting of the London Section of the Society of Chemical Industry, Prof. Hele-Shaw gave an exceedingly attractive demonstration and interesting paper on his new "Stream-line Filter."

The experiments and description of the working of the filter raised hopes for its successful application in varied fields of industry and research—*e.g.*, in colloidal chemistry, biochemistry, bacteriology, etc. It is therefore rather surprising that figures, apart from the rate of filtration, have not been given to indicate its capabilities. As the strength of a chain is that of its weakest link, so one factor of the efficiency of a filter is the size of the smallest particle it will with certainty retain or separate from the liquid to be filtered. The only definite statement of measure, apart from the experiments shown with coloured liquids, was that the filter was capable of retaining or separating particles that were small enough to pass through the best analytical filter paper. There are, however, numerous ultra-filters made from solutions of collodion of different concentration or of collodion with other substances which can be made to effect varying degrees of filtration, and by comparison it ought not to be difficult to state the capabilities of the new filter in terms of μ or $\mu\mu$.

The way the filter works seems to be all-important for future development. Is the selective filtration the same under similar conditions of pressure, etc., when different liquids are used as the dispersion medium? How does the filter behave with dialysed ferric hydroxide, congo red, night blue, etc.? Is the mechanism in the case of colloids really one of filtration or straining (the word "filter" being akin to felt), or does it bring about separation by adsorption of the disperse phase?

One is led to inquire whether measurements have been made in differences of electrical potential.

Lastly, the paper used appears to be made from un-treated or partially treated wood pulp, and yet it is claimed as waterproof. How does its composition, especially its inorganic constituents, affect the working? Is there any possibility of ignition when volatile liquids of low flash-point are filtered?—I am, Sir, etc.,

W. H. Patterson

University of London Club
June 9, 1923

NEWS AND NOTES

UNITED STATES

Phosphate Rock in 1921

The phosphate rock industry was very depressed during 1921, probably owing to over-production in the previous year, and sales declined by nearly 50 per cent. in quantity and 50 per cent. in value to 2,064,025 long tons valued at $12,270,070. Production ceased entirely in S. Carolina, fell by 90 per cent. in the Western States, by nearly one-half in Tennessee and Kentucky, and more than one-third in Florida. Exports of phosphate rock fell from 31,461 t. in 1920 to 6,293 t. in 1921.

FRANCE

Mineral Output in 1922

Provisional figures for the production of minerals in France during 1922 are given in the following table:—

	1922 Metric tons
Salt	1,048,614
Potash:—	
Crude salts (12 to 16% K_2O)	320,975
Fertilising salts (20 to 22% K_2O)	337,318
Fertilising salts (30 to 40% K_2O)	59,608
Potassium chloride (over 50% K_2O)	126,866
Total contents of K_2O	207,123
Mineral oil	63,377
Asphalt	37,320
Bauxite	139,176
Iron pyrites	175,066
Ores:—	
Antimony	3,280
Arsenic	941
Gold-bearing	46,175
Copper	364
Iron ore	20,831,993
Lead	10,470
Zinc	2,404
Manganese	684

GENERAL

The Isotopes of Germanium

In a letter to *Nature* of June 9, Dr. F. W. Aston announces that, using the improved method of accelerated anode rays, he has succeeded in obtaining the mass-spectrum of germanium. The effects were feeble, but satisfactory evidence of three isotopes was obtained. Their mass-lines were at 70, 72 and 74, and appeared to be whole numbers, though the accuracy of measurement was not as high as usual. The intensities were roughly in the proportion of 2 : 4 : 5, which agreed reasonably well with the value 72·5 for the chemical atomic weight now in use. Dr. F. W. Aston further pointed out that these values conformed to the general rule connecting even atomic number with even atomic weight, and that it appears that Ge^{70} is isobaric with the weakest and heaviest component of zinc discovered by Dempster, and Ge^{74} isobaric with the lightest and weakest isotopes of selenium announced in 1922 in *Nature* (Nov. 18, p. 664).

The Output of Copper Sulphate in Italy

Italy, which is the chief consumer of copper sulphate, is also an important producer, the production amounting to 75,000 metric tons, which is in excess of the requirements, and compares with an output of 50,000 t. in 1918 and 20,000 t. in 1914. The factories that produce copper sulphate are scattered throughout the country, but are most numerous in the North.—(*U.S. Comm. Rep., Apr.* 23, 1923.)

Bulgarian Beet-sugar Crop

H.M. Commercial Secretary, Sofia, states that the Bulgarian beet crop in 1922 was 100,000 tons, which yielded 15,000 tons of sugar. This amount is insufficient to meet local requirements, estimated at 35,000 to 45,000 tons per annum, and the balance required is imported from Czechoslovakia, Germany and the United States. For the sugar factories to work at full capacity at least 250,000 hectares (hectare = 2·47 acres) should be cultivated with beet, whereas in 1922 only 90,000 hectares was under the crop.—(*Bd. of Trade J., Apr.* 19, 1923.)

The Greek Emery Industry

It is reported that the Greek Government has decided to construct works at Naxos, at a cost of £30,000, to facilitate the mining and transport of emery ore. The works will, it is estimated, be complete within a year and should result in increasing the annual production to roughly 20,000 tons.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for June* 7)

TARIFF CUSTOMS EXCISE

Australia.—A dumping duty has been levied on aluminium and enamelled ware, various industrial and pharmaceutical chemicals and certain glass apparatus of German and Czechoslovakian origin.

Bolivia.—The export duty on silver has now been cancelled. The importation of alcohol has been prohibited.

British India.—A revised export duty has been applied to raw hides and skins.

Cyprus.—The import duty on matches has been revised.

Egypt.—Sugar is now free from excise duty.

New Zealand.—The embargo on the importation of German and Austrian goods is to be discontinued.

Poland.—A translation is given of a list of goods which are subject to a surtax of 899,900 per cent. All goods that are not included in this list are subject to a surtax of 599,900 per cent.

South Africa.—The Food, Drugs and Disinfectants Bill has been postponed.

South Africa (*Cape of Good Hope*).—Notice is given of standards regulating the content of milk solids and of preservatives in milk and foodstuffs.

Sweden.—Bills have been passed to raise the malt tax, regulate the manufacture, sale and importation of beer and increase the duty on malt. The regulations regarding the control of platinum wares have also been revised.

Tanganyika.—Restrictions have been placed upon the importation of opium, morphine, heroin, cocaine, and articles containing such drugs.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Stoneware, cast-iron pipes	7425/F.L./E.C./2
Australia	Brass and copper sheets and rods	712
Austria, Hungary, Czecho-slovakia	Chemicals, drugs, tanning materials, oils, fats	718
Canada	Paint	715
”	Scrap leather	11361/E.D./M.C.
France	Oils, fats, acid oils, tinplate, copper sulphate	722
Germany	Waste fats	F.W. 18905
Greece	Pharmaceutical products	726
Netherlands	Corrugated and galvanised sheets, pickled plates, lead foil, forgings	728, 731, 732
Panama	Paper	745
Poland	Glass, glassware	225/78/F.G./M.C.
United States	Pottery	742

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Dried Milk

Lord E. Percy informed Mr. Lamb that regulations were under consideration to provide for the proper labelling of dried milks.—(May 31.)

Dyestuffs

Viscount Wolmer, replying to Mr. Darbishire, said he had no reason to suppose that the high prices of dyestuffs in this country were the main cause of British goods being sent abroad to be dyed. In cases when licences to import foreign dyestuffs had been refused the Licensing Committee had no doubt given full weight to all relevant considerations. As regards the allegation that on many occasions the prices of reparation dyes exceeded the prices at which they could be obtained from Germany under licence, an Advisory Committee on prices had been formed, two of the four members representing the Colour-Users' Association.—(June 4.)

Sir P. Lloyd-Greame, replying to Mr. H. H. Spencer, said he was aware that the export of grey cotton cloth increased by 50 per cent., and that of printed and coloured woven cloth decreased by 38 per cent. in 1922 as compared with 1920. He did not agree that this was due mainly to the prices of dyestuffs. But for the action taken to promote the dye-making industry, the British textile trades would now be very greatly embarrassed.—(June 5.)

Patent Fees

Replying to Mr. Hannon, Sir P. Lloyd-Greame said that although British patents covering a population of about 45,000,000, cost £131 in fees for 16 years, and that patents in the United States covering a population of 110,000,000 for 17 years cost only about £7 10s., there was no fair basis of comparison between these fees owing to differences in the permissible scope of single patents and other considerations. It was not practicable to reduce the British fees at present.—(June 5.)

Carbon Monoxide in Gas

Answering various questions Sir P. Lloyd-Greame said that he was informed that the gas produced by the Tully plant contained 37 per cent. of carbon monoxide, but it was claimed that by means of a new converter, the carbon monoxide contained could be reduced to a negligible quantity. The matter was being carefully watched by the Government departments concerned.—(June 5.)

Safeguarding of Industries Act

In a written answer Sir P. Lloyd-Greame informed Mr. Hannon that the basis on which depreciated currency duty was levied under the Safeguarding of Industries Act was defined in the Act, and could not be varied in accordance with the tariff system in operation in Spain and other countries without legislation.—(June 5.)

Replying to Major Entwistle, Sir P. Lloyd-Greame said that the export from Germany to this country of fabric gloves, enamel, aluminium, gas mantles, and glassware was controlled, but he could not confirm the statement that invoices in sterling were insisted upon. H.M. Customs, however, required an invoice in sterling.—(June 7.)

REVIEWS

LEHRBUCH DER CHEMIE. *By* PROF. MAX TRAUTZ. VOL. I. STOFFE. *Pp. xxviii*+534. *Berlin and Leipzig: Vereinigung Wissenschaftlicher Verleger,* 1922. *Price* 22*s.* 6*d.*

This is Volume I. of an attempt to treat the whole of chemistry in three volumes, in such a way as to give the student of chemistry the real essentials of the subject, and the connexion between it and related subjects (physics, mathematics, etc.), without demanding any considerable previous knowledge.

The present volume deals with Stoichiometry, Electrochemistry and Thermochemistry. The arrangement of the numerous sub-divisions of these main branches in the table of contents is somewhat difficult to follow.

Stoichiometry occupies 236 pages and in its first sub-section (" Quantity of Matter," 10 pp.), deals with the definition of mass, its measurement by weighing, the precautions which must be observed in accurate weighing and a discussion of the Law of the Conservation of Mass. The second sub-section (50 pp.) is entitled, " Homogeneity and Volume of Matter," and includes a short discussion of the nature of pure substances and mixtures and the methods of separating the constituents of mixtures, a brief introduction to the molecular theory, the gas laws and Avogadro's law. Then follows an introduction to preparative chemistry in which the preparation and properties of oxygen, hydrogen and water are briefly described, and the nature of aqueous solutions is indicated. The laws of combination and the methods of determining atomic weights are then discussed, brief mention being made of such subjects as isotopes, the absolute size and mass of atoms and molecules, and Avogadro's number. The third sub-section (" Kinds of Matter and the Multiplicity of its Compounds," 168 pp.), treats of the atmosphere and its constituents; ozone and the halogens (in connexion with their occurrence in the atmosphere); metals and non-metals, crystallography; non-metallic elements according to their groups in the periodic system; valency; then, according to groups in the periodic system, the hydrides, oxides, hydroxides, oxygen acids, sulphides, hydrosulphides, halogen compounds, azides and cyanides of the elements. Then follows a collection of the more important metallic salts of the oxygen acids, arranged according to the groups of metals in the periodic system.

In Electrochemistry, Part I., 20 pages are occupied in explaining the fundamental laws of electricity, 40 pages in dealing with the elements of electrochemistry and 10 pages are devoted to a discussion of complex salts. This is followed by analytical and preparative electrochemistry (52 pp.). In the former, volumetric analysis, electroanalysis and qualitative analysis are dealt with, whilst the latter treats briefly of the technical preparation of metals, alkalis, salts, halogens, etc. by electrolysis.

Part III., Thermochemistry, (130 pp.), discusses the laws of thermodynamics and their application to chemical and electrochemical processes (56 pp.). The remainder of the book discusses the production and application of high temperatures, including such varied topics as qualitative dry tests, gaseous liquid and solid fuels, and electrical heating; the preparation of substances by electrothermic methods; the Goldschmidt processes; metallurgy; glass and ceramics; and a host of miscellaneous preparations and descriptions of furnaces.

It is difficult to imagine the type of student for whom this book is intended. Certainly it is not suitable for the British student. Even as a work of reference its scope is limited by the meagre treatment of important substances in systematic chemistry, a treatment which is no fuller and in many cases not so full as in our own best text-books. The lack of references to original literature also rules it out for this purpose. The arrangement, too, is difficult to follow and the student who tries to teach himself chemistry with the help of this volume will probably find himself suffering from a severe attack of chemical indigestion.

Much of the matter is well done, expecially the physico-chemical part, but even this is spoiled by unnecessary introductions, physical and mathematical. Everything is worked up from the very beginnings, and the reader is evidently presumed to have no previous knowledge of either physics or chemistry.

Many of the very numerous illustrations are quite unnecessary, such as the various catalogue pictures of the commonest pieces of apparatus —even a spatula is represented. Pages 124 to 127 are mainly taken up with diagrams of the various varieties of Gæde pumps, with no word of explanation in the letterpress, and similar instances are not lacking. The book is provided with a good index—and it is needed.

Joseph Knox

The Destructive Distillation of Wood. *By* H. M. Bunbury, M.Sc. *Pp. xx*+320. *London: Benn Brothers, Ltd.*, 1923. *Price* 35*s*.

It is a curious fact that, in spite of the importance of the wood-distillation industry in America and Canada, no text-book on the subject has appeared hitherto from the pen of an English or American author. For a comparatively long period about one-half the world's supply of wood-distillation products has been derived from America, but scientific investigations on the nature of the process, as well as refinements in the design of the necessary plant, are largely of German, French and Scandinavian origin; in fact, it is only in the last decade that any considerable volume of literature, chiefly in the form of contributions to scientific journals, Forest Service Bulletins, etc., has appeared from American sources. In Great Britain the recent rise of the industry from the very modest position it had long occupied—since followed, it must be confessed, by a fall to the old position—was purely an outcome of the war. Nevertheless, in that brief period much useful work on the process was accomplished in this country, and since the war the attention of chemists and technologists has been attracted by the possibilities of extension and development of wood-distillation, more particularly in those parts of the Empire where, unlike Great Britain, raw material is plentiful and cheap. Mr. Bunbury has rendered considerable service, therefore, in producing for the use of English readers a volume in which the process of wood-distillation receives very comprehensive treatment both in its theoretical and practical aspects.

After a brief historical introduction and a description of the varieties of wood employed in the process, the author deals at some length with the physical properties and the chemistry of wood, including an account of the most recent views on the constitution of the cellulose and lignin molecules. Considerable space is devoted to the thermal decomposition of wood, the reactions which it involves, and the yields of commercial products which result. This section, occupying nearly one-half of the book, is largely composed of matter that is likely to appeal more strongly to the chemist than to the manufacturer. It includes, however, certain information of practical importance, more especially a summary of the recent work of Palmer and others on the influence of temperature and of moisture-content on the course of the process and the yields of products.

On the subject of yields the author has collected a large mass of data—chiefly the results of small-scale investigations—for American, European, Australian as well as Indian species of wood, and, in addition, for certain waste materials such as coconut shells, myrobalam kernels and gold mohur husks. Unfortunately, this chapter, dealing with one of the most important aspects of the process from the commercial point of view, is very confusing for the reader owing to the fact that the figures in the various tables are often based on different units. The author refers to the fallacy of using the cord, which may vary widely in weight, as a unit when comparing the yields from different species of wood; therefore, it might have been expected that, wherever possible, he would have recalculated the figures in the various tables to a common unit. For example, comparison between New South Wales woods and Indian woods is difficult, since the yields from the former are stated in gallons and cwts. per ton and the moisture-content is omitted, whereas, the figures for the latter represent percentages of the original weight of wood containing 15 per cent. of moisture. Further, the figures included in the three tables referring to the distillation of softwood are based on the cord, on 25 kilos, and on the ton, respectively. Apart from their bearing on the commercial prospects of the process, certain data in this chapter suggest that an interesting field of research is open to chemists who are prepared to investigate the reasons for the marked differences in yields from European and American hardwoods on the one hand, and tropical and sub-tropical hardwoods on the other.

The second half of the book deals with wood distillation on a commercial scale, and includes descriptions of the lay-out of a factory and the types of plant employed at the different stages of the process, as well as a detailed account of the various operations which the process involves. This section is well arranged; the introduction of flow-sheets showing the course of the process renders the subject-matter easy to follow, and the illustrations and drawings are usually well chosen and exceptionally clear. Practically every modern method of distilling wood and working up the distillate receives attention from the author, and it is probable that some of the information—for example, details of the construction and operation of the recently developed Swedish " blowing ovens " —is quite new to English and possibly American wood distillers. A chapter is also devoted to the distillation of wood-waste, and an interesting and excellently illustrated account is given of the various processes for the production of illuminating- and power-gas from wood, a subject of increasing importance in industry. In view of the labour which the author has expended on this portion of the book, it is unfortunate that, in many instances, he has omitted any criticism or advice in regard to the various types of plant and systems of operation described. In this connexion some consideration of relative costs and relative advantages and disadvantages would have added greatly to the value of the book. For example, it would be interesting to know whether the direct treatment of calcium acetate liquor in a continuous still for the removal of naphtha can really be regarded as sounder practice generally, than preliminary treatment in a lime-lees still and subsequent concentration of the naphtha in a continuous still. The author mentions the main difficulty attaching to the former process, viz., the tendency for tarry matter to deposit on the plates and the necessity for its removal periodically; hence, it is rather surprising that, in view of his acquaintance with this difficulty, he has selected a particularly unsuitable design of three-column still (Fig. 83) for purposes of illustration. In this still the only method of gaining access to the plates of the boiling column is to remove each section separately; and in the rectifying column the majority of the plates are rivetted to the walls and are quite inaccessible without removing the rivets.

The precise function of a tar-separator is not always made quite clear, and it is not possible to agree altogether with Mr. Bunbury that smoke-hoods over the discharge-ends of the retorts are a luxury—at any rate, if the top of the setting is used as an acetate drying floor.

The chapter dealing with the destructive distillation of wood waste does not, unfortunately, give us very much information as to the real position and prospects of this branch of the industry. Various forms of plant are described, of which certain, it is to be feared, have not progressed very far beyond the blueprint stage. How far these recent developments are likely to overcome the inherent difficulties of treating this class of raw material still remains to be demonstrated. A short description of the chain-and-scraper type of mechanical retort might have found a place in the book. Though by no means perfect, it does represent a form of mechanical plant which has received a thorough trial on a manufacturing scale, especially in Great Britain, and is capable in certain conditions of yielding reasonably successful results.

The chapter on analytical methods is scarcely worthy of the book. In some cases the method of analysis is only very briefly described, and in others several alternative methods are given, without any attempt to indicate their relative values; for example, four different methods of determining acetone in wood alcohol. A reproduction of the British Government specification for denaturing wood-naphtha, which is almost invariably the form of naphtha produced by the British wood-distiller, and some information concerning the examination of pure methyl alcohol intended for the manufacture of dyestuffs, etc., would have proved useful.

The book concludes with a series of statistical data, which indicate the magnitude of the industry in various countries.

This volume must be regarded as a distinct contribution to the literature on the subject of wood-distillation; but, in the event of a further edition becoming necessary, the author might perhaps consider the advisability of curtailing his treatment of the more theoretical aspects of the subject, and devoting greater attention to the problems of wood-distillation as a commercial undertaking. The book would then be likely to appeal more strongly to numerous individuals in various parts of the world, who, having large quantities of wood-waste at their disposal, are attracted by the possibilities of distillation and are anxious to know what it will involve in capital expenditure, operating costs, labour, etc., and particularly to be guided in the choice of plant suited to the conditions in which the process will be carried out.

Alex. Rule

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

There has been a slightly better demand during last week, but general improvement is not by any means decided. Both home trade and export business are more promising and prices all round are well maintained.

Acetic Acid, 40% tech.	£24 per ton. Still firm, but rather less inquiry.
Acid Hydrochloric	3s. 9d.-5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw.	£24 10s. per ton. Quiet.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Demand steady, export inquiry good.
Arsenic (White)	£71-£74 per ton. Somewhat easier.
Bleaching Powder	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Business much below normal.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand.
Copper Sulphate	£27 per ton.
Potash Caustic	£33-£34 per ton. Little moving.
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Potass. Chlorate	3d.-4d. per lb. Very dull.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76%	£20-£21 per ton. Steady demand.
Soda Crystals	£5 5s.-£5 10s. per ton ex railway depots or ports.
Sod. Acetate 97/98%	£26 per ton. Very scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	2¾d.-3¼d. per lb. Very dull.
Sod. Nitrate refd. 96%	£13 5s.-£13 10s. per ton ex Liverpool.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	£15-£16 per ton carr. paid. Very quiet.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£26-£28 per ton according to quantity.
Carbon Black	1s. 5½d. per lb. ex wharf. Still very scarce.
Chromium Oxide	1s. 5d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb. Firmer on advance in price of Rape Seed Oil.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood-distillation products.

Acetate of Lime—	
Brown	£10 15s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 10s. per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 9d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£6 per ton d/d.
Brown Sugar of Lead	£45 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 4½d.-1s. 5d. per lb. A better demand at these prices.
Crude 60's	3s. 4d.-3s. 6d. per gall. Not much business.
Acid Cresylic—97/99	2s. 0d.-2s. 5d. per gall. Demand fairly good.
Pale 95%	1s. 10d.-2s. 4d. per gall.
Dark	1s. 10d.-2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	9d.-11d. per gall. Not much demand.
Unstrained	8¼d.-9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1¼d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.
Pure	2s.-2s. 2d. per gall. No business.
Toluole—90%	1s. 9d.-2s. per gall. Quiet.
Pure	2s.-2s. 6d. per gall. Not much inquiry.
Xylol	3s.-4s. per gall. according to quality. Good demand.

Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil	8d.-9¾d. per gall. Market steady. Good demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.-10½d. per gall.
Solvent 90/160	1s. 6d.-1s. 9d. per gall. Market quiet.
Solvent 90/190	1s. 5d.-1s. 7½d. per gall. Market moderately active.
Naphthalene Crude—	
Drained Creosote Salts	£6-£8 per ton. Fair demand. Supply short.
Whizzed or hot pressed	£11-£14 per ton. Plenty of inquiries.
Naphthalene—	
Crystals	£18 per ton.
Flaked	£16 10s. per ton.
Pitch, medium soft	No business for this season. Prices for Autumn delivery 100s.-110s. per ton. f.a.s. Manchester.
Pyridine—90/140	13s. 6d.-16s. 9d. per gall. Dearer. Demand still good.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Since the beginning of June there has been a decided improvement in business in aniline dyestuffs. There is considerably more inquiry about and orders have improved both in number and weight. There is every likelihood of still further improvement in the near future.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 9d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works Good demand.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market has been quiet, and prices weaker in consequence of lack of business.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. 3d.-3s. 4d. per lb. Steady demand. Price well maintained.
Acid, Benzoic	2s.-2s. 9d. per lb. Still very scarce.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8¾d. per lb., less 5%.
Acid, Gallic	3s. per lb. Steady demand.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d.-2s. 3d. per lb. Weaker.
Acid, Tannic	3s. 3d. per lb.
Acid, Tartaric	1s. 4d. per lb. Demand improved. Also more demand from the Continent.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d. per lb. Slow of sale.
Amidopyrin	14s. per lb.
Ammon. Benzoate	3s. 3d.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. per oz.
Barbitone	20s. per lb., but difficult to find spot supplies at this figure.
Benzonaphthol	4s. 6d. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Potass. 8d., Sod. 9d., Ammon. 10d. per lb.. Slightly weaker in some holders' hands.
Calcium Lactate	2s. 9d. per lb. for best makes.
Chloral Hydrate	4s. per lb.
Chloroform	2s. 2d. per lb. for cwt. lots.
Creosote Carbonate	9s. lb. Demand negligible.
Formaldehyde 40%	£90-£92 per ton. Very firm.
Guiacol Carbonate	8s. 6d. per lb.
Hexamine	4s. per lb. down to 3s. 10d. for ½ ton lots.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Market good with considerable inquiry.
Magnesium Carbonate—	
Light Commercial	£37-£38 per ton net, according to quantity.

Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	1s. 9d.-2s. per lb. Good demand.
Menthol	35s. per lb. spot.
Methyl Salicylate	2s. 6d. per lb. for carboys. In slightly better demand.
Methyl Sulphonal	15s. per lb.
Mercurials	Market weaker.
Paraformaldehyde	3s. 6d. per lb. Weak.
Paraldehyde	1s. 6d. per lb. accepted for large orders.
Phenacetin	6s. 6d. per lb. spot value. Very steady.
Phenazone	7s. 6d. per lb. Very firm.
Phenolphthalein	6s. 6d. per lb. now wanted by most holders. Considerable advance in view of shortage.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	96s.-98s. per cwt., less 2½%.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. Demand still continues good.
Potass. Permanganate	10d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	6s. per lb. still quoted.
Salol	2s. 9d. per lb.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 9d. per lb. now wanted by holders. Still in short supply, fresh stocks being quickly absorbed.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality.
Sod. Hyposulphite—	
Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	80s.-82s. per cwt. net.
Sod. Salicylate	Demand not so good. Powder is slightly weaker at 2s. 8d. per lb., with crystal at 2s. 10d. per lb.
Sod. Sulphite, anhydrous	£27 10s.-£28 10s. per ton, according to quantity for home trade, 1-cwt. packages included.
Sulphonal	15s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.
Thymol	17s. per lb. for genuine white.

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Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	2s. 9d. per lb.
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Cinnamic Aldehyde	14s. 9d. ,, ,,
Coumarin	18s. 6d. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	15s. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. 6d. ,, ,,
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Geraniol	5s. 6d.-12s. 6d. per lb.
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Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	25s. 6d. ,, ,,
Methyl Anthranilate	6s. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Xylol	10s. 6d. ,, ,, Dearor.
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	2s. 3d. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	23s.-24s. per lb. Market well maintained. Demand is brisker.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
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Bourbon Geranium Oil	31s. 6d. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4½d. per oz.
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Citronella Oil—	
Java 85/90%	4s. 2d. ,, ,,
Ceylon	3s. 7d. ,, ,, Dearer.
Clove Oil	8s.-8s. 6d. per lb.
Eucalyptus Oil 70/75%	1s. 10d. per lb. Dearer.
Lavender Oil, Mont Blanc 38/40%	13s. ,, ,,
Lemon Oil	3s. 1d. ,, ,,
Lemongrass Oil	2¾d. per oz.
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Anatolian	24s. per oz.
Bulgarian	30s. per oz.
Palma Rosa Oil	17s. 6d. per lb.
Peppermint Oil—	
English	80s. ,, ,,
Wayne County	13s. ,, ,,
Japanese	6s. 7½d. ,, ,, Advanced.
Petitgrain Oil	7s. 6d. ,, ,, Lower.

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JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

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EDITORIAL

CHEMISTRY, both Pure and Applied, is receiving considerable attention this week in Cambridge. The Union Internationale, notwithstanding its title, is mainly concerned with Pure Chemistry; all the discussions held under its auspices this week related to theoretical chemistry and were interesting chiefly to those whose knowledge of the science is both general and profound. The Society of Chemical Industry's meeting begins as we go to press and seems likely to be a very successful one. Cambridge is an ideal place for such congresses. The foreign delegates are much interested in the college life and, as many of them are living in the colleges and lunching and dining in the ancient halls, they have a very good opportunity of acquiring something of the spirit of the place and a knowledge of the circumstances in which our young men receive their University education. So far as the International Union is concerned, this is the largest gathering ever held, and there are many more ladies than have hitherto attended one of its meetings; the social side of the meeting has been very pleasant in spite of cold and cheerless weather. On Tuesday night the banquet in the great hall of Trinity was a magnificent occasion; the antique solemnity of the building, the rich colours of the academic robes and the ladies' dresses, the excellence and brevity of the speeches and the considerable number of distinguished people, made a wonderful impression. The Vice-Chancellor and the heads of half-a-dozen colleges were there, Cambridge physics was represented by Sir J. J. Thomson, Sir Ernest Rutherford and Dr. Aston, though the latter does indeed stand on the very border of the blest promised land; chemistry was represented very worthily, and among the foreign names which occur are such widely known ones as Professors Haller, Moureu, and Lindet from France, Paterno and Nasini from Italy, Bancroft and Lewis from the States, Cohen and Kruyt from Holland, Swartz from Belgium, Pictet from Switzerland and among the many distinguished men outside the academic circles may be mentioned Prince Ginori Conti, Monsieur Kestner, and so on. The British delegation was a strong one and, on the whole, fully representative of all branches of the science, but it was a pity that the President of the Chemical Society was unable to be present.

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So far as can be judged by this meeting, the most valuable part of these congresses is the opportunity afforded of talking over chemical topics with chemists from other countries; not merely making the acquaintance of a man whose work has perhaps long been familiar, but the discussion of this with him and the presentation of the subject from a new point of view. The four formal discussions were interesting and probably of value to those who, with incessant care, devote themselves to such hobbies as oxidation and tautomerism. On the other hand, a good deal of the committee work appears to us to be not worth the time and expense involved. Three or four hours of rather casual talk by a body of men selected in a somewhat fortuitous manner, on such subjects as industrial hygiene, solid combustibles, or international patents, leads nowhere, and the subsequent expenditure of about the same amount of time in drawing up and revising a report to be formally presented and adopted, too often leads only to a suggestion that the committee continues its labours for another year. The committee on the elements does valuable work, but then the members of it are selected with some care, not chosen because they happen to be at Brussels or Lyons at a particular time. The committee on the elements, moreover, carries on its work by correspondence in the intervals of its meetings. If this committee continues its activities, and perhaps two other committees were formed on similar lines, and the rest of the committees allowed to die a painless death, we are of opinion the usefulness of the Union would be increased and the pleasure of its meetings not diminished.

A different set of circumstances affects the Annual Meeting of the Society of Chemical Industry. This Society does not have a chrysalis state which terminates each summer and changes into a short and intensely active life for which the previous months are merely a preparation. The Society of Chemical Industry during the autumn, winter and spring is hard at work collecting and disseminating information of value to those who are concerned in applied chemistry. Its meeting in the summer has, at least this year, a twofold character, and its importance must be considered both from the point of view of the public and of its own members. From the external or public point of view it affords an opportunity of making widely known to all classes of the community the importance of chemistry to the manufactures and commerce of the country, its powerful influence in promoting the arts which form so large a part of our modern civilisation and the supreme necessity of maintaining our science in a state of efficiency second to none in the world. Incidentally, it should be a means of enabling the Society to show how much its members have contributed towards these very objects and how the public may feel confident that their interests, so far as applied chemistry is concerned, are in safe hands. As to the internal or social side, the annual meeting is of the greatest value in enabling us all to know each other better. It was suggested to a committee of divines who began their report, "Conscious as we are of our infirmities," that this might be altered so as to read, "Conscious as we are of each other's infirmities." At such meetings we find out that the other man's infirmities, when we come to know him, are less than we imagined, and that the brusque remarks we read in his contributions are accompanied by a smile or a twinkle of the eye which deprives them of all offence. The weighty observations of Dr. Armstrong in his Presidential Address on the relationship between science and industry and on the relation between this Society and the public will be widely read and deserve the closest attention. We have few spokesmen who appeal to the public; we have few Fellows of the Royal Society who can speak to plain business men; we have few chemists who not only attain to distinction in their own subject, but are willing to devote their spare time to that public work of organisation which is so necessary. Dr. Armstrong is all these, and we are confident that the remarks he has made with so much authority will not only receive the attention they deserve, but will also stimulate a large number of chemists to put their shoulders to the wheel and help to make notable progress.

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It was significant that, at the first corporate meeting of the Institution of Chemical Engineers, a discussion should have been held on the question of the training of the chemical engineer. Hardly any question is more fruitful of thorny discussion than that of education; it is at least as old as the human race, and one may presume that even primitive man argued long over the best methods of training the makers of stone axes, possibly resorting to methods of demonstration forbidden in these more peaceful days. We read the account of the discussion on the training of the chemical engineer with great interest, and were not surprised to find that a system of education advocated, on the grounds of its success, by one speaker, was rejected by another, who adduced equally good evidence for its failure. The question is so very difficult, be it that of educating the chemist, the chemical engineer, or even a skilled worker. Deductions from a survey of methods of education practised in other countries might possibly be rejected on the grounds that the conditions under which they are applied are different from those obtaining here. But this at least shows how elastic must be any system of education which is finally adopted, for a chemist or chemical engineer properly so called ought, we should imagine, to be equally competent, no matter what school he has passed through. One great difference between this and Continental countries is that abroad there is a more ready spirit of co-operation. Here we are well aware of the spirit of team-work, but its application outside the realm of sport is still not too frequent, and so it was with considerable interest that we read an account of an "instructional excursion" of the Royal Higher School of Industrial Chemistry at Bologna. The students, accompanied by the director of the school and three of the lecturers, spent the Easter vacation visiting industrial and mining centres in Tuscany. Visits were paid to a peat works, factories producing glass, copper, and cement, and the borax works at Larderello, where the party stopped one night as the guests of the Società Boracifera. The account concludes with the statement that the excursion was highly successful. Of its educational value there can be little doubt, and this led us to wonder whether such excursions would ever become a custom of our chemical schools. Of course, visits to works have long been customary adjuncts of scientific meetings, but for students? On questioning a manufacturer he replied that he did not believe such excursions were of great value, and thought that manufacturers would not encourage them. Apparently, they think otherwise on the Continent. However, the Institution of Chemical Engineers is to be congratulated on the way it faced a most difficult and important problem at its first corporate meeting, and we shall await with more than usual interest the publication of the curriculum for the training of the chemical engineer which, we understand, the Institution hopes to prepare during the coming year.

CHEMISTRY AND INDUSTRY

Address by the President

Dr. E. F. ARMSTRONG, F.R.S.

At the Annual General Meeting, Cambridge, 1923

This year's meeting marks a departure from the traditions of our Society. Instead of meeting in an industrial centre, we find ourselves for the first time amidst the colleges of one of the ancient seats of learning, "Where graced with many a classic spoil Cam rolls his reverend stream along."

Obviously, an address delivered under the influence of academic surroundings must take cognisance of the influence of science on industry. Such a subject were indeed far too wide for me, but happily it can be limited to chemical science. Holding, as we must, that industry in its turn has its reflex effect on science, it will be profitable to survey our subject from both aspects.

Science to-day—and chemical science offers no exception—is as it is owing to the patient labours of its disciples who have devised theories and put them to the test, only to discard them for other hypotheses which in their turn have been abandoned as always the knowledge of fact, based on experiment, increased. From time to time brilliant men have arisen more gifted than their contemporaries, either as experimenters or theorists, who have brought about progress, but it is correct to say that science is conservative and that its teachings are to a large extent based on tradition. There are, indeed, many dreamers amongst its votaries, but their dreams will first be regarded as heresies if they fail to conform to the orthodox. As Faraday said: "We receive as friendly that which agrees with, we resist with dislike that which opposes us; whereas the very reverse is required by every dictate of common sense."

Industry, too, has its traditions based on the ancient practice of rule of thumb; but, in the main, stern necessity based on the application of the principle of the survival of the fittest, has produced the methods of trial and error which in the hands of the venturesome have led to many discoveries to the great benefit of mankind. Such pioneer work to-day in all well-ordered industries is followed up by proper scientific investigation to understand the why and the wherefore, the answers to these questions in their turn leading invariably to improvements in the original process.

Industry cannot afford to neglect chemical science and its teachings. Just as in the domain of sociology those who disregard the past are not likely to cherish any real visions for the future, so in industry neglect, that is, disregard of science, will inevitably lead to failure to progress. There can be no question that the future of industry largely depends on the application of scientific principles to production, and that chemists should be exceptionally competent to advise on such matters.

Men of science necessarily proceed, step by step, along the pathway of known facts in searching for their conclusions, seeking knowledge may be for the sake of knowledge—which I hold not in itself to be a thing ignoble—may be for the sake of wisdom, seldom for the sake of gain. The inventor, like the dreamer, is impatient of him who would always verify his route and often seeks to reach the goal at the risk of being accused of vagueness by the scientist who seeks to follow him.

In any technical business—and all manufactures are highly technical nowadays—so long as all goes well the chemist is scarcely required, production being a question of organisation and management. But things never do go well for a long period of time; difficulties are always arising, and it is then that the co-operation of the technical expert—of the scientifically trained man, the chemist—is required.

The progressive manufacturer to-day—and there should be no others—realises this point: it remains for the chemist to fit himself by his training and experience to give the assistance required. If he fail, then science is blamed: some of us in industry to-day feel justified in asking: "Are there not too many failures?"

In the first place, no one should enter the chemical profession unless he feels a definite call to do so; chemistry is far too exacting a mistress. Secondly, the life of the chemist is one of investigation; he must always be asking questions as to the why and the wherefore, and must therefore possess in the highest degree the spirit of initiative, of research. His training must have been primarily in the methods of research, of original investigation; in no other way is it possible to cultivate those faculties which he will daily be called upon to exercise. Our chemical schools must be pervaded by an atmosphere of research; the proper spirit of inquisitiveness must be awakened and maintained in them until it becomes a habit. Such an atmosphere is effective above all else in bringing out individuality and self-reliance by fostering enthusiasm for one's work. If our colleges fail to provide the right type of men, then the manufacturer will have just cause for complaint. It is the exceptional man who is worth training; it is he who moves the world.

There has passed from amongst us this year perhaps the most brilliant experimentalist of his, or any, time, our President in 1887–8, Sir James Dewar. He was active in the laboratory until the end came in his eighty-first year, and the last of his renowned discourses at the Royal Institution showed no indication of any ageing of his mental activity. Dewar could only be appreciated at his very best—at all events in later years—by those who knew him. He was an artist in himself, a connoisseur with a love for the good, the beautiful, the uncommon, the interesting, and, above all, the genuine. As my father wrote me on the news of his death: "How much our atmosphere has lost its charm and colour will only gradually be noticed."

Full accounts of his life and work will appear in other places, but we can to-day in honouring his memory learn much from the manner of his success. Dewar's incursions into industry were many, probably all of them fruitful; if we had had more Dewars our chemical industry would, to-day, stand on a different footing.

It being granted that the right type of man is available—and I would here urge that the more we can attract the highest social classes into our ranks the better—and that the early training and spirit at our colleges are satisfactory it remains to enquire as to the facilities for the final post-graduate training which is all essential to the chemist who hopes to take a high place in industry. Our laboratories have, during the past few years, been greatly overcrowded and the staffs overworked, but many extensions are in progress and the pressure of students is likely to lessen in the near future: there is a widely-reported shortage of equipment and of funds for laboratory work which should be noted by manufacturers and others able to make donations to the cause of science. For post-graduates numerous scholarships and fellowships are now available and the research funds of the Chemical Society and other societies provide assistance in the purchase of equipment and materials; the pages of our journals give ample testimony to the increased quantity of original work being done in this country.

It must be remembered that at the time of the foundation of our Society in 1881 the facilities for obtaining a training in chemistry and physics were very limited and it was very difficult for a young man desirous of receiving an extended training to obtain financial aid.

During the next twenty years excellent facilities were created on all sides, and I may mention in particular the Finsbury Technical College, the Central Technical College, and later the London university colleges and the provincial universities. The existence of scholarships enabled many students to enjoy a training at these institutions which would otherwise have been denied to them, but at the end of their college and university courses only a very limited few are able to take advantage of that further course of training, often at a foreign university, which is required to fit a chemist to undertake research work and to qualify him for the higher posts in industry. It will be generally agreed that no scheme of endowment has borne more generous fruit than that of the 1851 Exhibition Travelling Fellowships; various institutions were allowed to nominate a Fellow for a year, the grant being renewed on the report of competent referees. Many of the best known men in chemical circles to-day were holders of these Fellowships.

Professors in the closing years of the nineteenth century frequently emphasised the need of research fellowships to enable an increasing number of graduates to stay on for the fourth, fifth and sixth years at college for training as research workers. Many such fellowships were founded by the generosity of the city livery companies during the nineties, notably the Salters' Company and the Leathersellers' Company; many of these Fellows entered industry and their record, although it is barely twenty-five years since the first of them left college, is already a very satisfactory one. The memorial to our former President, Sir William Ramsay, has also, in part, taken the form of the endowment of research fellowships, and the more recent scheme devised by the Salters' Company and known as the Salters' Institute is also based on a system of research Fellows. Before dealing with this in the detail which it deserves, mention must also be made of the numerous grants to individual research workers which are made by the Department of Industrial and Scientific Research.

On the creation of the Department in 1915, it was empowered to initiate proposals for the establishment and award of research studentships and fellowships, and a scheme has come into being which is described in the official publication of the Department.*

* Notes on Grants to Research Workers and Students.—H.M. Stationery Office, 1922.

As illustrating the magnitude of the scheme I may state that in 1921-22, 280 awards were made out of about double this number of applications, the grants being allocated as follows :—

Students in training	205
Research workers	55
Laboratory assistants	14
Equipment	6

No less than 163 of the recipients were workers in the subject of chemistry.

The Salters' Institute of Industrial Chemistry was founded by the Salters' Company with the idea of fostering and benefiting industrial chemistry by training suitable chemists who would eventually be able to occupy the higher posts in industry. The average chemist who leaves a University laboratory with an honours degree is not immediately at home in industry, and consequently during the process of his development he is often pushed into a backwater. The idea of the Salters' Institute is to select from the Universities men with pass degrees, and award to them Salters' Fellowships for a period of years, so enabling them to undertake a special training under the guidance of the Director of the Institute, so as to equip them for a high position in whatever branch of chemical industry they might propose to take up. It was felt by the Livery Company that a great benefit would be conferred on chemical industry by providing in this way for the training of a limited number of really first-class men on really practical lines.

The necessarily brief outline given shows that the position of the country in this respect is a good one, and that to-day we are far from lacking facilities for training the research worker and affording financial aid during the period of training. Indeed, the thought arises whether entry to the profession is not being made too easy at this stage, though it may be urged that this creates the element of competition which alone can stimulate imperfect man to his best efforts.

As regards those entering industry, I think many of my colleagues will agree with me that the time is ripe for a Conference with the teachers and a broad exchange of views either in public or in private where frank speaking can be the order of the day. I think I am justified in saying that we manufacturers find it very difficult to get the type of man we require. Possibly our Society can organise such a Conference, and I have in mind the utility of a somewhat similar meeting with Professor Meldola in the Chair, held under the auspices of the Institute. My remarks must not be held to place the blame on the teachers ; perhaps the material they have to work on is unsuitable.

Research in industry, above all in the chemical industry, is no new thing ; it is perhaps a little older than the industry itself, as the man who started the latter was certainly an original investigator.

Progressive firms have always had research departments, even though they have not publicly advertised the fact to the same extent as the German dye industry. Much, however, of the work has been more in the nature of the investigation of factory processes, mishaps and troubles, or the seeking of new applications for the firms' products and by-products. Only a limited number of companies have installed separate research departments with a large and independent staff working on a definite plan over a period of years. Naturally it is only the largest corporations that can undertake such a responsibility, and it is or was our national characteristic to prefer to manufacture in smaller units than those of the large corporations on the continents of Europe and America. Furthermore, until recently there was no surplus of skilled research workers.

As a result of the lessons learnt during the war, all this is now to be changed : scientific and industrial research in this country has during the last few years received direct and very definite State encouragement under the auspices of a Committee of the Privy Council, a new Department of Scientific and Industrial Research having been created for the purpose with Sir William McCormick as Chairman and Sir Frank Heath as Secretary. Perhaps the most interesting venture of this department has been the setting up of what are known as Industrial Research Associations, of which twenty-two are in active operation, and two others have received licences from the Board of Trade. Anyone conversant with the difficulties which confront research in industry will agree that some little time must elapse before results of real practical value are produced, and only a few of the Associations have been in existence long enough to have issued reports giving justification for their existence : actually two of the Research Associations have just passed into their fifth year of grant aid, while four others have commenced their fourth year. It will be remembered that when the scheme was started, it was thought that a period of five years would give a reasonable time for an industry to test the value of co-operative research, and it will be agreed that if the really fundamental problems of an industry are to be tackled, five years is no lavish space in which to found an institution, equip it with men and material, and produce results.

Broadly speaking, such research institutions are not intended for the largest firms able to organise and finance research laboratories of their own, but should be most useful to a combination of smaller firms, who in the past have not only been unable to incur the expenditure of a research department but have even been unwilling to contribute sums equivalent to no more than the yearly wage of an additional workman or foreman for the purpose of scientific investigation. Whether or no immediate results prove of practical value to the individual firms, it should become a point of honour with them to maintain a research institute within their industry.

The general scheme of these research institutions is too well known to need explanation here. It was considered that during the first five years of their existence, in which they received a monetary grant from the Department equal to the funds raised by their industry, sufficient would have been achieved to make the members of the research association willing to carry on the research, and even to increase their subscriptions, on finding that in the sixth year of their existence one-half of their previous income would cease. It may be noted that in the year 1921–22 the sum of £86,355 was paid in grants to the research associations.

The meaning of the word " research," particularly in its application to industry, is so often misunderstood that it is desirable to dwell a little on this subject. Pure research, as carried out by the investigator in the University or private laboratory, is in the main directed to affording proof or disproof, as the case may be, of existing theories, the research leading in practice to the detailed study of certain very limited problems ; the impulse for the particular piece of work being given by the bias of the individual and the work pursued for the pleasure it gives to the worker. Only those who have wrestled with Nature for her secrets can realise the joy of so doing.

The object of industry is definitely financial ; the object of industrial research is to work out new processes or improve existing onces. Investigations which have for their object the solution of special difficulties of particular processes and the utilisation of waste materials are not researches in the true sense of the word, although the solution of such problems would be to the financial advantage of the industry. These are matters more for the particular firm than for a research association.

In these research associations each industry should endeavour to develop on a scientific basis the fundamentals. Thus, it will be agreed that it is appropriate for the Portland Cement Research Association to endeavour to ascertain the exact nature of the compounds constituting Portland cement or to determine the ideal form of rotary kiln, and for the Cotton Research Association to study the fundamental properties of single cotton hairs rather than to undertake the investigation of the specific problems of a group of mills. Such fundamental problems are outside of the ordinary scheme of work of the research departments even of the largest firms engaged in the industry, whose chemists and physicists must always be more occupied with the immediate problems of the moment ; though work of this nature will be appropriately carried on as a side issue when time and resources permit and will in general be rewarded by brilliant practical and financial success, as witnessed by the achievements of the laboratories of the Eastman Kodak Company and the General Electric Company in America, and by Brunner, Mond and Co., and many others in our country.

Naturally, the scheme of the Department for Scientific and Industrial Research has not escaped criticism, but it seems to me that, from the point of view of our Society, we should suspend judgment until all the associations have had at least five years' experience, realising that the development of scientific research in twenty-four of our leading industries, and the interest taken by the manufacturers themselves in this work, cannot fail to be of far-reaching importance to our future as a manufacturing nation. The scientific workers on the staff of the research associations must justify by their diligence the confidence which their employers and we, their colleagues, have placed in them.

Any assemblage of men of science willing to face the facts will agree that science, scientific method, and scientific research have not yet won that position within the realm and its industries that is requisite if we are to maintain our place among the nations. It is customary to attribute the blame for this to the other party and speak of the " Neglect of Science." Perhaps it is desirable to have occasionally what our American cousins are fond of calling a heart to heart talk to ascertain whether all is well in our own camp.

During my year of office, in talking to the younger men in the sections, I have never failed to emphasise the fact that whilst they gain their first appointments on their qualifications as chemists they succeed afterwards because of their ability as men. Knowledge may be power but not until it is applied to the service of humanity. " Truth latent in the mind is wisdom that is hid and treasure that is not seen " (Richard de Bury). Probably the keynote to success in this and the next generation lies in all that is connoted by the term " service." It will not be enough to make and to offer for sale, caring not for the ultimate fate of the article ; rather must the manufacturer take an active part in instructing and advising the buyer. It was the early realisation of this fact, perhaps even more than any reputed technical superiority or cheapness of product, which formerly enabled the German dye industry to obtain its hold on the markets of the world.

Chemists must also be prepared to give service, above all they must be practical. It cannot be said too emphatically that the young chemist on leaving his university must have had such training as enables him to be at least a chemist: in the first place, a competent analyst—for analysis is the very basis of our science—and, secondly, a competent manipulator in the laboratory, with real experience in handling organic substances. He seldom gets an opportunity later in life to acquire this knowledge, whereas specialisation, which is mainly a question of application, comes all too early to most of us.

It is an admitted fact in industry to-day that far too many of the present graduates from the universities are weak on the purely chemical side; it is this experience that has caused me to urge that the prime duty of the university course should be to produce chemists and not "labelled chemists." From this point of view we as a profession should be proud to call ourselves "chemists" and not add an apologetic descriptive prefix. It is the application of chemistry in agriculture and in engineering that is wanted, not agricultural chemists, and I have even had the temerity to quarrel with the term "chemical engineer," believing that there is no such person, though at the same time positive that the highest gift his fairy godmother can give to the chemist is a knowledge of and still more an inclination for engineering—an art, not a science.

It may be as well to add that I regard physics as a branch of chemistry; a thorough knowledge of physics and physical chemistry is part and parcel of the chemist's training from his first week at college—though I cannot see why applied physical chemistry should be called "chemical engineering."

Chemists as a class are apt further to overlook that whilst their science is the most practical of all, being applied to every detail of everyday life, yet it has a jargon even more difficult to the layman than that used in the biological sciences. It is within our powers to alter this reproach, and whilst for our transactions it is convenient and proper to use the precise and wholly satisfactory terminology which is expressive of our knowledge, we must strive to approach the public using a plain honest language which they can understand. Frankly, it is from this point of view that I personally attach so much importance to the efforts we are making in the issue of our weekly *Journal*, and though its form may evoke criticism from those of an older school, the appreciation it has received from the very point of view I have in mind has more than justified our somewhat arduous labours. Our new venture must work out its own salvation, remembering always that we live in the present, that we have to build for the future, though we can learn and profit by our experience in the past.

It is possible to meet people of intelligence ready to discuss practically any subject of everyday importance, except chemistry. They have at best but a vague idea of the analyst and have no conception of constructive and creative chemistry.

The war gave chemists a chance we have never had before to bring our capabilities and achievements before the nation, and for a while we strutted in the limelight, both as destroyers and conservers of human life. But we were unprepared as a body, disloyal to the extent that we are not sufficiently proud of our profession and unable to take advantage of the opportunity—hardly any one of us was able and willing "to preach the gospel" as an American colleague puts it "of the value and importance of chemistry to the past, present, and future progress of mankind and to preach it in terms which are acceptable and comprehensible to the layman." We have not established any central organisation among our chemical societies responsible for this type of propaganda. Chemistry, if not more remote, is less obvious to the layman in its effects, though it obtrudes just as much on his daily life as medicine or engineering.

The engineer can bridge the river, annihilate distance by the train and steamer, harness the tides or, if of the electrical fraternity, turn the waterfall into light and power. Chemists must lay more stress on the fact that they beautify the world, or, at least, the feminine part of it, with their dyestuffs, turn wood into silk stockings, make our water potable, and render a thousand other like services to the community. Once we and the public realise that the professions of chemist and engineer are mutually complementary, then we have gone a long way towards attaining as a profession that place in the sun which rightly belongs to us. It is an interesting fact that during the month of April the New York Section of the American Chemical Society arranged for five popular talks on chemical topics to be broadcasted to people described as radio fans. This is regarded as an important test of the popularisation of chemistry. It is to be hoped our London Section will make efforts to follow suit.

This year is memorable in that we celebrate the Centenary of the establishment of the alkali industry in this country. The Leblanc process was not adopted in England, except on a very limited scale, until 1823, owing very largely to the existence of a duty of £30 per ton on common salt, which was repealed that year. Mr. James Muspratt then erected his works in Liverpool.

In a little work on British Chemical Manufactures, by George Dodd, published in 1844, occurs the statement that chemical works are affected both by political and by scientific events in a remarkable degree. "It is reasonable that they should be affected by the current of scientific discovery, but the bearing of political matters may not be so obvious. The imposition or the removal of an excise duty on a commodity of home production; the imposition or the removal of a customs' duty on an imported foreign product; the establishment or the cessation of commercial intercourse with a country richly provided with some commodity which we require in our manufactures ; the concentration, in the hands of a few, of a commodity required by the many ; the legislative enactments which occasionally give rise to a demand for a particular commodity at a particular time : all or any of these may work great changes in the arrangements of an establishment where chemical manufactures are carried on, irrespective of the still greater changes which naturally result from scientific discoveries in chemistry."

This quotation, though eighty years old, might have been extracted from the Chairman's Annual Address to the Association of British Chemical Manufacturers, and illustrates that then, as now, science and politics are the two main factors influencing the future of our chemical industries.

In the early 'forties, the cost of salt was 10s. to 12s. per ton, so that a duty of £30 per ton was fifty or sixty times as great as the cost of the article itself. Evidently the production of soda from salt was not to be thought of commercially. Soda was obtained from kelp, the ash remaining after the burning of the seaweed collected on the shores of the Scottish Highlands—an industry created about the middle of the eighteenth century. The weed was cut by the sickle at low water, conveyed to dry land on horseback, spread out to dry and burnt in coffers generally constructed in stone, or in the Orkneys merely excavated in the earth. The amount of labour required was considerable, and the consequent distress among the Highlanders when the industry was superseded very great. Soda was also obtained from barilla, imported from Spain and Italy in large quantities ; it was produced by burning a sea-plant called the *Salsola soda*, especially cultivated for the purpose.

The life history of Leblanc and his process is too well known to need reference here. At the time Muspratt started his works in the Vauxhall Road, Liverpool, Losh had already started a small works on the Tyne, and Tennant had made a beginning on the Clyde. Typical of the prejudice, which even to-day exists against the introduction of new articles, is the statement that when Muspratt commenced the production of soda ash he found the consumers of alkali so biased in favour of potash that he had actually to give the soda to the soap-boilers before they would use it, and even then he was condemned personally to superintend the making of the soap.

The new enterprise was soon successful, and in partnership with Gamble a new works was built at St. Helens. The alkali industry is essentially one which must be localised suitably for the supply of raw materials—*e.g.*, salt, limestone and coal, and for delivery of the finished product at home and abroad. Hence its main development in South Lancashire and Cheshire and on the Tyne and Clyde.

The subsequent rapid spread of the industry affords a fascinating chapter in the history of our industries. It was soon, however, attacked by troubles, and from 1832 to 1850 Muspratt was harassed by almost continuous and expensive litigation on account of the harm done by the escape of the hydrochloric acid vapours into the air. Finally, in 1850, he removed to Widnes and Flint, selecting sites for his works where less damage could be caused to the neighbouring countryside. The problem of absorbing the gases was finally overcome by William Gossage, of Widnes, perhaps the most inventive of all the practical chemists of the last century, who designed the absorption tower packed with coke, which is still generally in use, and conferred an incalculable benefit on the alkali trade. Curiously enough, Muspratt was incredulous with regard to this invention, and thought very large quantities of water would be necessary.

The partnership of Muspratt and Gamble only lasted two years, and in 1836 Joseph and James Crosfield, the soap-boilers of Warrington, became partners in Gamble's alkali business. Joseph Crosfield, alarmed at the damage done by the escaping acid fumes, insisted on the immediate adoption of Gossage's patent, but Gamble was opposed to this, and the quarrel which ensued resulted in the dissolution of the partnership in 1845.

The Leblanc process reigned supreme for many years, until a serious competitor came with the successful operation of the ammonia-soda process, patented by Solvay in Belgium, but established in this country by Brunner, Mond and Co.

As Dr. Conroy has said in the delightful little brochure issued in April last by the United Alkali Company, " Solvay pointed the road to success, but it may truly be said that the great extension of the scale of operations is due to the genius of Mond and the chemical and engineering work done in this country."

Our Society may claim to take a personal interest in the celebrations of the United Alkali Company and of Brunner, Mond and Co., because, as might have been expected, prominent representatives of both firms have occupied the Presidential Chair. Dr. E. K. Muspratt is fortunately still with us ; he was our fifth President in 1885–86, following Sir Wm. Perkin, and is now our senior Past-President. Dr. Ludwig Mond held office in 1888–89 ; Eustace Carey in 1906–07.

The firm of Brunner, Mond and Co. commenced operations in 1873, and celebrates its Jubilee this month, when doubtless opportunity will be taken to publish a detailed contribution to the history of the enterprise. It may suffice here to say that Mr. J. T. Brunner and Dr. Ludwig Mond became friends when both were engaged at the Hutchinson Works at Widnes, a friendship which lasted until the death of Dr. Mond in December, 1909. Mond visited Belgium to make an agreement with Ernest Solvay as to manufacture in England, and on his return he and Brunner set up in partnership, selecting a site on the banks of the Weaver, which is to-day the famous Winnington Works. Those who know the history of the early days can best testify to the courage and tenacity and, indeed, moral qualities of every kind required to make the new process, first a technical, and ultimately a commercial success.

But fascinating as is the early history of the alkali trade, we are here concerned more with the causes of its success. At the end of its first century it stands perhaps in a stronger position than ever before; it is for us—especially for the younger men and for a generation yet unborn—to see that a hundred years hence the same may be said. The names of the great pioneers are known to us all and the outstanding qualities which led to their success. Such men we shall have again, though it take a later generation to appreciate their fame. Nothing could have been accomplished without "team" work, the united efforts of chemists, engineers, and labour alike supplemented by the efforts of the commercial side. This factor becomes of increasing importance as the size of the individual firms increases, and will continue to do so. Constant research and invention have been the arteries whereby fresh life-blood has been continually pumped into the industry; without these it would long ago have been extinct, and fresh research and invention, even out of proportion to the growth in magnitude of the industry, must be applied if its position is to be maintained in face of the competition of the world.

It is no doubt permissible for me to dwell a little on some very early history of the trade with which I am now connected, and I am fortunate in possessing two very early pamphlets entitled "A Short and True Relation concerning the Soap Business containing the several patents, proclamations—orders whereby the Soapemakers of London and others, His Majesty's Subjects, were damnified by the gentlemen that were the Patentees for Soape at Westminster, with the particular proceedings concerning the same," printed for Nicholas Bourne at the South Entrance of the Royal Exchange in 1641, and "A Looking glass for Sope Patentees or a Prospective Glasse making discovery of a new Project contrived and propounded (by the Sope Projectors) to the Parliament to monopolize the Soping mystery under pretence of good to the State in the duty of excise" printed in London in the year 1646.

The first pamphlet contains an account of a patent granted in 1622 to a Company for the exclusive manufacture of soap, under the title of the "Governor, Assistants and Fellows of the Society of Soapmakers of Westminster," on condition of their paying to His Majesty £4 per ton on 5000 tons annually. The manufacturers of that day (twenty in number) refused to join and acknowledge this Company; whereupon the Company obtained a proclamation forbidding, amongst other things, the sale of soap which had not been assayed by the Company. An information was then exhibited in the Star Chamber, in 1633, against sixteen London makers for opposing and affronting the letters patent, to which the defendants pleaded and demurred, etc., and after much discussion (all the defendants having been committed to prison for having put in their answer one day too late) the judges certified "all the answer except the first four words and last ten as fit to be expunged." And it was decreed that the defendants be imprisoned during His Majesty's pleasure, and fined in various sums from £1500 to £500. All were sent to prison. Fourteen remained there for forty weeks, and two died in prison. These tyrannical acts were followed by various proclamations and orders in council restricting the manufacture of soap except by the patentees, and fixing the price at which soap should be sold, and the materials from which it should be made. In 1635 many other soapmakers were committed to prison, and greater power was given by proclamation to the patentees upon their covenanting to pay £6 per ton on 5000 tons annually. In a short time, however, the patentees, having "vexed the whole kingdom with their soap for three years," obtained in the year 1637 a warrant from His Majesty for £40,000 in consideration of their giving up the patent, and £3000 for their houses, and obliged the soapmakers of London to pay them £20,000 for their materials, so that they might have use of their trade again, of which they had been deprived.

The second pamphlet, which contains copious quotations from the Scriptures, is of a very amusing character. The grievance of the Sopeboylers apparently was "that there are divers persons of mean condition who in many bycorners do make and sell soap not having been apprentices to that Trade." They suggested that the excise tax on potashes should be doubled, that being the principal material without which soap cannot be made, and that they should be themselves empowered to collect this, thereby controlling the use of potashes. The pamphleteer makes a vigorous protest against the project, stating "that the Patentees are not sope-boylers in the right of serving apprenticeships thereunto but Salters and Leathersellers and concerning sope-boyling it is not a manufacture but an art or mystery which every Freeman that knows how to boyle may as lawfully as themselves use."

The excise on potashes would press hardly on all other Trades. The pamphlet ends with an injunction to the Senators "from whom as from a fountain we expect that justice shall run like water and judgment like a mighty flood" and with regard to the unfortunate Soap Patentees, quotes "Can the Ethiopian change his skin or the leopard his spots, then can ye also do good that are accustomed to do evil."

Little is known of the trade from this time to 1704, when Queen Anne imposed the first excise duty. Several pamphlets and statements, on half-sheets, are to be found in the British Museum, containing petitions to be relieved from taxes, etc., but there is no account of the quantity manufactured.

Perhaps at some future date it may be opportune to give the early history of some of the existing soap firms. That they had difficulties is shown by the following extract, taken from a full account of the process of soap manufacture published in 1844 :—

" Lastly, and perhaps to the manufacturers the least pleasant of all, there are rooms and offices fitted up for the Excise-officers, one or more of whom are in the factory day and night. It is a great blot upon the fiscal arrangements of this country, and one which seriously affects the manufacture of malt, of glass, of soap, and many other articles, that in order to collect the duties levied on these commodities, the officers of the Excise are empowered to control, as it were, every step of the processes, and to regulate the extent to which any improvement in the operations may be carried.

" It is not the amount of duty collected to which we here refer ; this is another subject : it is the mode of collection which is so objectionable, by imposing impolitic checks to the natural course of improvement in manufacturing processes. Considerable ameliorations have, however, within a recent period, been made in the mode of collecting the revenue, and the survey of the premises of soap-manufacturers."

Although soap is now freed from the attentions of the Excise officer, our fine chemical trade is not so fortunate, and we can imagine many of our colleagues reading this paragraph with the feeling that there has not been much change in the course of eighty years.

It is desirable in my opinion to make a definite pronouncement on the need of co-ordinating in some way or other our various chemical societies, even at the risk of repeating much of what I have said during my visits to the sections. I am, moreover, encouraged to do this to-day because, if we let this opportunity pass by without taking action, it may be a considerable time before circumstances are again so favourable.

We chemists are excellently catered for by a number of organisations, each of which may be stated to fulfil a definite purpose, with the consequence that a large number of us belong to at least four societies and the majority of us to more than one. The result is that, as the societies expand, there is a great deal of overlapping, the total subscriptions fall heavily on the individual, and there is unnecessary expenditure, particularly on publications and on administration. On the other hand, as several names appear on more than one of the councils of our societies, there is already some measure of community of thought in their policies.

An unfortunate result of the present state of things is that no one society can claim to speak for the chemists as a whole; indeed, it repeatedly happens that two voices are heard when one would suffice.

If we briefly enumerate our societies and their activities in the broadest sense, in no way intending to be critical, we have first the Chemical Society, whose main function is to facilitate research, publishing the results in its transactions and making reference to current work easy by its abstracts and annual reports. The Chemical Society is representative of chemical science. The Institute of Chemistry is essentially a qualifying body, keeping a register of professional chemists and striving to create and maintain a high professional standard and protect the professional interests of chemists. The Society of Chemical Industry counts among its members all kinds of chemists, and seeks both to encourage the spread of chemistry in industry, to proclaim its importance publicly, and to assist the individual chemist. Its transactions deal with the more practical aspect of chemistry, its abstracts and the Annual Reports are invaluable to the works chemist and consultant, and its new venture may have a far-reaching effect on the one hand in knitting us all more closely together, and on the other in making us understandable to the general public. Our Society was the first to have active Sections all over the country, and its peripatetic annual meetings have afforded an opportunity — not perhaps always used — of bringing the objects and aims of chemists before a wider public. The Institute has latterly established local sections, thereby helping to form opinion amongst men who hitherto felt that they were too far away from headquarters for this to be possible. To this extent it has begun to overlap the activities of our own Society, but the holding of joint meetings, particularly joint social functions, in many of the centres during the past year shows that the spirit of close cooperation for which I am about to plead is already in existence.

Next I would allude to the Chemical Industry Club, yet in its infancy, but destined to play a very leading part in the fusion of interests. In possession of small yet very comfortable premises, withal centrally situated, it is an example, as yet only in miniature, of what perhaps some of us desire most of all—a central chemical house, a club and a headquarters, housing all the societies and their joint central administration and forming the centre of organised propaganda on behalf of the chemist and the utility of chemistry for the service of the State.

Next we have certain smaller societies, representing special sections of chemistry, as typified by the Society of Public Analysts and the Biochemical Society, and further those societies interested in certain sections of industry and admitting to membership practical members of the industry as well as chemists—*e.g.*, the Society of Dyers and Colourists. The Faraday Society plays a special *rôle* in organising and publishing joint discussions of the most valuable character on subjects on the borderline between physics and chemistry. Mention must lastly be made of the British Association of Chemists, a body whose exact status has still to be defined, but which at the moment fills many of the functions—to my mind useful ones—of the extreme left wing of our corporation.

The attempt was made a few years ago to bring into being a body common to all the societies, and, accordingly, the Federal Council for Pure and Applied Chemistry was formed. Composed of delegates from a number of the societies, its functions are to initiate and co-ordinate effort and generally to advise in matters affecting all the societies—*i.e.*, chemists in general. Whilst a body so constituted can only act with diplomatic slowness, it has already much to its credit, in particular the initiation of the International gatherings, one of which has so felicitously preceded our own meeting. It has, moreover, served as a model to other countries and to other sciences.

The Federal Council includes among its members the Association of British Chemical Manufacturers, which, though primarily a trade protection association, has its constitution very widely drawn and is active in promoting the application of science in industry. We have in the Federal Council a nucleus or skeleton organisation to which can be entrusted the difficult task of forming one great chemical society and raising the necessary funds for our future home, the Chemical House.

I would suggest that the time has come to make the definite proposal that it should become the agreed policy of some, if not all, the above societies to take steps as appear expedient to bring about a gradual confederation. It would appear obligatory that I should submit a very crude draft outline of a scheme. Chemists and others interested in chemistry would become members in the first place of the Confederation, and in the second of a particular Society or Section. The government would be in the hands of a Grand Council chosen in part from the members and in part nominated by the sections; the actual work would be done by an executive elected from among the Grand Council. Tho administration would be in the hands of a general manager, assisted by sectional secretaries. A staff of editors would produce the publications. The existing societies under this scheme would be incorporated as a whole so as to retain in full the great asset of their "goodwill," but would have their activities more closely defined.

Each society would continue to devote itself to the particular branch of the subject with which it had been associated in the past, but all overlapping would be entirely eliminated. The Institute would continue to act as an examining body and maintain a register of Fellows and Associates, who alone would be entitled to use the professional qualifications, F.I.C. and A.I.C.; the remainder would be simply members using no professional distinction. The unnecessary custom of using the letters F.C.S., which have no meaning whatsoever as a qualification in the professional sense, would also disappear. The Institute would also watch over the important question of professional etiquette.

Weighty committees would be established to deal with the Government departments and with public propaganda.

It is not difficult to outline a fairly full and comprehensive scheme, but this is better done by a committee than by an individual. It will suffice, therefore, for me to make the proposal that the Councils of all the Societies proceed to examine the question next session and consider the propriety of asking the Federal Council to form a Committee to study forthwith the desirability and practicability of federating the Chemical Societies.

Difficult as it will prove to effect the welding together of the British Chemical Societies into one body, yet this is bound to come about if the pressure from the rank and file is strong enough; indeed, it can succeed in no other way.

A much more delicate question will then remain to be settled before the profession of chemistry can take rank with medicine or the law. Indeed, we have amongst ourselves to decide whether the word "chemist" is to have as wide a meaning as the term "engineer" or a restricted meaning like the term "solicitor" or "accountant." The engineer may be at the very peak of the profession or occupy any other grade down to the skilled fitter. By "solicitor" or "accountant" a qualified man is understood. At present we cannot even lay claim to a monopoly in the application of the term "chemist," though I do not despair of educating the public on this point, but the outstanding feature is that the chemist may or may not be fully qualified.

If we are ever to rank as a profession, then we must resolutely close our ranks to all but the qualified, possibly using the term "chemical assistant," for the large number in works who will be unable to qualify through no fault of their own. But it is essential that all who practise chemistry, either as consultants, analysts, teachers, or in any other public capacity, are qualified. The Institute of Chemistry, now that it has filled its ranks and is really representative of the profession, should devote all its influence and resources to attain this end.

The harm and the mischief which are being done to-day by unqualified and incompetent—the two words are generally though not necessarily synonymous—persons who style themselves "chemists" is very considerable, far greater than most of us realise.

There is one matter of great importance to us as a Society. We were, until recently, solely concerned with industrial chemistry and chemical engineering, but now we have arranged with the Chemical Society to publish in *Chemistry and Industry* articles and news concerning pure and physical chemistry. The step we took last winter in arranging this and publishing our journal weekly involved close consideration of the financial considerations involved and a large measure of responsibility. Personally, I do not grudge the expenditure of a good deal of time and thought which I devoted to this question. I am satisfied that the step was wise in the interests of the science and industry in which we are engaged. This is, however, only the first stage of a long and arduous task which lies before us, and I appeal to you all, both pure and applied chemists, young and old, rich and poor, to help the Federal Council for Pure and Applied Chemistry and this Society, which constitutes an important constituent of the Federal Council, in the effort now being made to do something to co-ordinate the activities of the various societies, associations, and the Club in a manner which will be helpful to chemistry and chemists. The expense of being a member of a number of such bodies is considerable and is a serious item to a large number of us; this is partly caused by their complete independence of each other. Some independence, especially in the details of policy, is essential, but collaboration in office and routine work will be economical, and some further measure of collaboration in publication may still be found to be possible.

You, who include manufacturers, teachers, engineers, consultants, works chemists and other research chemists, form the most powerful organisation for whose help we appeal. The provision of a large fund is of prime importance and the members of this Society will, I know, do their utmost, not only for the sake of the science in which we are interested, but out of a sense of pride in the Society which we have founded and to which we are so attached. It is our duty to set an example, and I have every confidence that we shall do so. It may be worth while considering whether the Federal Council might organise local committees in some places to discuss the best means of raising money in the locality. If this is done, I feel sure that the members of this Society will take an active and important part on such committees, as they always do when any question of public policy is at stake. It is my ambition that during my term as President the public spirit of this Society and its wideness of outlook will remain not only as great as in the past, but may even increase.

This address is already too long, but at this critical period for our profession I am only afraid of omitting, but never of repeating or dwelling too long upon anything which may be of the least use to our progress.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

The following are summaries of Reports presented at the meeting of the International Union held in Cambridge, from June 16 to 20:—

SOME NEW ASPECTS OF TAUTOMERISM

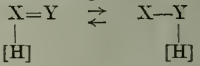
By Prof. J. F. Thorpe, C.B.E., D.Sc., F.R.S.,
and
C. K. Ingold, M.B.E., D.Sc.

This Report is a summary of certain aspects of the phenomenon of tautomerism which have been studied at the Imperial College of Science and Technology during the past few years.

The authors hold that the significance of the word "tautomerism" should not be restricted to the narrow definition originally given by Conrad Laar, but should be broadened to correspond with broadening philosophy of the subject, and modernised to keep pace with modern investigation. Thus, recommending a progressive rather than a "legal" attitude (*cf.* Lowry, *J.C.S.*, 1915, **107**, 1389), they propose that the term should apply to *all* reversible isomeric change (synonyms and qualificatory prefixes being abolished), and that it should continue to possess this significance until further discovery shows the definition unsuitable.

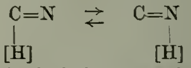
It follows from this view that the classification of tautomeric change must be based solely on *the nature of the isomerism* and not on the "one-sidedness" of the equilibria or the speed with which they are established in given circumstances. Adopting this mode of classification, the authors pass in review the various types of tautomeric change which have been the subject of recent investigations.

The Dyad Type:



$$\underset{\substack{|\\ [\mathrm{H}]}}{\mathrm{X}}{=}\mathrm{Y} \rightleftarrows \mathrm{X}{-}\underset{\substack{|\\ [\mathrm{H}]}}{\mathrm{Y}}$$

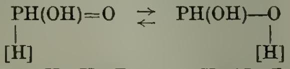
The principle example of this is hydrocyanic acid.



$$\underset{\substack{|\\ [\mathrm{H}]}}{\mathrm{C}}{=}\mathrm{N} \rightleftarrows \mathrm{C}{=}\underset{\substack{|\\ [\mathrm{H}]}}{\mathrm{N}}$$

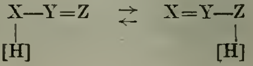
the equilibration of which has recently been investigated by (Miss) E. H. Usherwood (*J.C.S.*, 1922, **121**, 1604) by a method depending on the measurement of the thermal effect arising from the shifting of the equilibrium with changes of temperature. It has been shown in this way that the vapour consists of an equilibrium mixture containing a great excess of formonitrile, the proportion of carbylamine being of the order of 10^{-3}.

The case of hypophosphorous acid (A. D. Mitchell, *J.C.S.*, 1923, **123**, 629) is also referred to:—



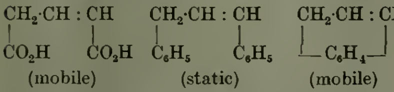
$$\underset{\substack{|\\ [\mathrm{H}]}}{\mathrm{P}}\mathrm{H(OH)}{=}\mathrm{O} \rightleftarrows \mathrm{PH(OH)}{-}\underset{\substack{|\\ [\mathrm{H}]}}{\mathrm{O}}$$

The Triad Type:



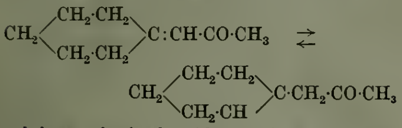
$$\underset{\substack{|\\ [\mathrm{H}]}}{\mathrm{X}}{-}\mathrm{Y}{=}\mathrm{Z} \rightleftarrows \mathrm{X}{=}\mathrm{Y}{-}\underset{\substack{|\\ [\mathrm{H}]}}{\mathrm{Z}}$$

The special section of this subject in which new work has been carried out is that relating to "three-carbon" systems (*i.e.*, systems in which X, Y and Z all represent C atoms) (see below). But there is a point of general application on which stress is laid, namely, that the existence of a triad system does not necessarily imply tautomeric mobility; thus benzylidenebenzylamine, containing the system C[H]·N : C, is static. That the character of the groups attached to the terminal atoms of the system plays an important part is shown by the following instances :—



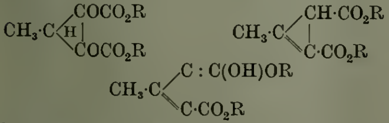
but no similar evidence at present exists which shows that the group attached to the central atom of the system is of like importance (Ingold and Piggott, *J.C.S.*, 1922, **121**, 2381; 1923, **123**, June). The probable reason for this is given by E. H. Usherwood (*J.C.S.*, 1923, **123**, July).

Birch, Norris and Kon have investigated a case of three-carbon tautomerism :—



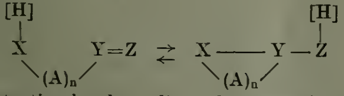
and have obtained evidence of the existence of a mobile equilibrium at the ordinary temperature (*J.C.S.*, 1923, **123**, June).

The question of the existence of normal forms of the glutaconic acids has recently been advanced by the isolation of a form of the methylcyclopropenedicarboxylic esters which conventional modes of formulation cannot accommodate (Goss, Ingold and Thorpe, *J.C.S.*, 1923, **123**, 327) :—

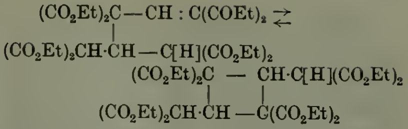


Geometrical isomerism is not possible in the cyclic structure, and thus the only concrete alternative at the disposal of those who disbelieve in what has come to be called "co-ordinated" hydrogen fails to apply.

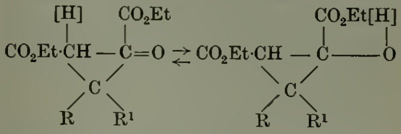
The ring-chain type :—



Attention has been directed to several types of ring-chain tautomerism. Ingold, Perren and Thorpe made a close study of certain instances in which X, Y, and Z are all carbon atoms :—

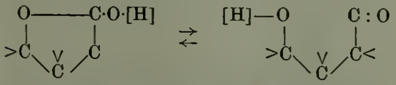


(*J.C.S.*, 1922, **121**, 1765), whilst cases in which X and Y are carbon and Z is oxygen :—

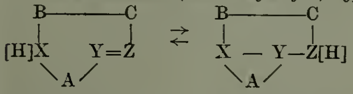


have been dealt with by Thorpe and his collaborators in a long series of papers, in which, in particular, the influence of the groups RR¹ is studied.

In another important type of ring-chain tautomeric change X and Z are both oxygen and Y carbon. It was first suggested by Jacobsen and Stelgner (see Meyer and Jacobsen, *Organische Chemie*), and has recently been shown by dynamical experiments carried out in this laboratory, that this change is at the basis of the mutarotation of the sugars :—

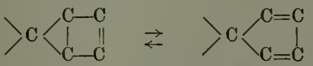


The intra-annular (*mobile hydrogen*) *type* :—

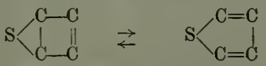


The evidence that α-campholytic acid conforms to this type is reviewed and discussed

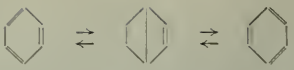
The intra-annular (*no mobile hydrogen*) *type.*—The chemistry of the bridged five-carbon rings which have recently been under investigation in the South Kensington Laboratories is reviewed, and is shown to be explicable only on the assumption that a condition of tautomerism exists between bridged and double-bonded isomerides :—



(Farmer and Ingold, *J.C.S.*, 1920, **117**, 1362; Farmer, Ingold and Thorpe, *J.C.S.*, 1922, **121**, 128). On account of the stability and tendency to formation of these substances it is suggested that the intra-annular tautomerism of thiophen is of a similar character :—



and that the nuclear vibrations of benzene are a development rendered possible by the greater molecular symmetry :—



This view has been supported by an examination of the properties of aromatic compounds themselves (Ingold, *J.C.S.*, 1922, **121**, 1133), by showing that the bridged structure produced by synthesis cannot be distinguished experimentally from ordinary aromatic structure (*loc. cit.*, p. 1143), and by showing that compounds of the five-carbon ring type simulate aromatic character to a remarkable degree if certain conditions relating to the stability of the bridged phrase are satisfied (Ingold, Seeley and Thorpe, *J.C.S.*, 1923, **123**, 853).

CONTACT CATALYSIS

By E. K. Rideal, M.B.E., M.A., D.Sc., Ph.D.

During the last few years numerous writers have entered the field of contact catalysis. The progress to be recorded in the visualisation of the mechanism of such reactions is slight, but none the less definite.

It is now generally conceded that contact action is no misnomer and that the reactants are adsorbed on the surface of the catalyst which does not exert any action by radiation at a distance. Doubtless at high temperatures there is an extended range of action due to electron emission.

The conception, postulated by Hardy and Langmuir, that adsorption of reactants occurs in monomolecular and orientated films, has been used successfully in interpreting a great number of gaseous catalytic reactions and is slowly being extended to reactions occurring in liquid media by van Kruyt for the surface of charcoal, and Hopkins at the surface of an enzyme, oxidase, present in liver tissue. The phenomenon of hydrogenation at colloidal palladium surfaces appears also to be amenable to the same interpretation. Easily liquefiable gases are certainly adsorbed in polymolecular layers at ordinary pressures, but no evidence of catalytic action in any but the first layer is at present forthcoming.

Attempts to elucidate the reasons for the variation in the catalytic activities of solid catalysts have revealed a number of possible variables ; the adsorption of the reactants in a suitable ratio, the adsorption of the reactants in suitably orientated positions, the spacing of the lattice work of the solid, and the activity of the complex catalyst reactant. Unless the first three factors are determined precisely it is difficult to evaluate the activity of the complex in terms of the critical energy increment. The function of the promoters in affecting catalytic activity is evidently more complex than was originally considered. In certain cases, *e.g.*, sodium carbonate in the presence of oxides and some metals, it affects specifically the reaction velocity of one reaction by the selective adsorption of one reactant, or product of a reaction. In other cases, *e.g.*, palladium platinum mixtures in hydrogenation, it apparently augments the active catalytic area by a species of peptisation. No case of selective activation apart from selective adsorption has yet been realised.

Recently two cases of a new species of promoter action have been established. Oxygen adsorbed by sulphur promotes the hydrogenation of sulphur, and a palladium copper mixture promotes the selective combustion of carbon monoxide in hydrogen. It appears certain that the juxtaposition of a foreign atom in the surface of an otherwise homogeneous material affects its neighbours. Many cases of such interphasial action confirm this action: thus calcium carbonate only undergoes decomposition at the $CaCO_3$–CaO interface. Copper oxide undergoes reduction only at the CuO–Cu boundary.

Experimental work on the nature of adsorption compounds which undergo catalytic change is proceeding in various directions. Accurate measurements of the primary and secondary adsorption of the reactants has been extended in the case of gases on metals and oxides, which will doubtless be extended shortly to the investigation of the adsorption of mixed gases so as to evaluate the relationship between surface concentrations and catalytic speed. More precise methods for the measurement of the heats of adsorption of gases on solids may reveal a relationship between activity and the decrease in free energy of the system. Various criteria are now available to distinguish an adsorption compound from a true chemical surface combination. If it be assumed that these criteria are valid it would appear that adsorption compounds, *e.g.*, those between carbon and oxygen, exist in different degrees of stability. The problem of quantitative measurement of the degrees of stability of such compounds still awaits elucidation.

Although support is still given by some to a purely radiation theory of surface action, the arguments against the theory in its simple form are now assuming very serious dimensions. On the other hand, the data on " quantumised " relationships are increasing in number. Adsorption compounds, if regarded as covalent compounds in which the binding electrons, one from the catalyst and one supplied by the reactants, can occupy fixed positions or more probably move in definite quantumised orbits, may supply the clue to the actual mechanism of catalytic action.

The work of Langmuir on the possibility of a connexion between catalytic activity and thermionic emission, of Haber and Richardson on electron emission in surface chemical action and of Frank on the combination of hydrogen and nitrogen effected by ionisation of the nitrogen by high-speed electrons, indicates potential methods by which the stability of the adsorption compounds might be determined in terms of radiation or ionising potentials.

THE STUDY OF SOAP SOLUTIONS AND ITS BEARING UPON COLLOID CHEMISTRY

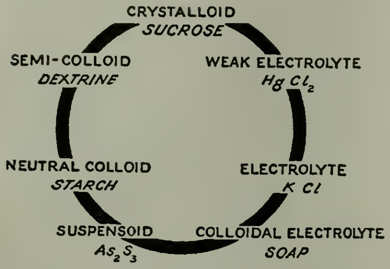
By Prof. J. W. McBain, F.R.S.

Soaps lend themselves particularly to the study of the colloidal condition. Not only are they of known chemical composition but their kinds are so numerous that almost any desired combination of properties can be obtained. Further, they typify a very great group of ionisable materials and exhibit a very close parallelism with the behaviour of the salts of protein and gelatin.

The present report deals chiefly with the properties of fluid solutions and clear transparent elastic jellies in the state of complete true reversible equilibrium. For the purpose of definition it is stated that dilute soap solutions are ordinary crystalloids, whereas more concentrated ones are colloidal electrolytes, and that if the soap is present in excess of saturation value, potassium soap separates out in the form of true crystals and sodium soap in the form of white curd fibres. The transparent jellies are confined to a portion of the region in which the soap is a colloidal electrolyte. The most concentrated solutions, or those to which much salt has been added, are those which constitute anisotropic liquids. A study of various physical properties enables the author to conclude with some confidence that the major properties of soap solutions are due to the soap itself, and not to products of hydrolysis. Two important properties of soap solutions are therefore osmotic activity and conductivity. Examination of these two properties shows that a strong solution of a higher soap may be said to exhibit one half the osmotic activity of an ordinary salt. This activity increases in dilute solution and diminishes with rise of temperature, intermediate values being shown by various solutions with regularity. The conductivity is shown to be equal to that of a salt. It is concluded that one half the conductivity of a soap solution is due to a negative carrier which does not exhibit osmotic activity and is therefore colloidal, *i.e.*, the ionic micelle. A colloidal electrolyte is a salt in which one of the ions is replaced by ionic micelle; that is, highly charged and solvated colloidal particles. The undissociated colloidal electrolyte consists of neutral micelle. From this, definite values can be calculated for the concentration of each of the constituents of the solution such as sodium ion and ionic micelle, and the mobility and equivalent conductivity of the latter directly follows. From a study of further evidence it is concluded that the ionic micelle must contain a certain amount of neutral colloid, although, on the other hand, there is evidence that much of the latter exists independently as neutral micelle. The chief difference between potassium and sodium soaps, and also between the saturated and non-saturated homologous series, is not due primarily to differences in the constitution of their solutions, but rather to the very great difference in solubility, the highest saturated sodium soaps being practically insoluble at room temperature, although all are extremely soluble at the boiling-point. The following theoretical consequences are arrived at:—It is thus established that true, complete reversible equilibrium can subsist in a colloidal system between all the various crystalloidal and colloidal constituents. There is here clear proof that the colloidal particles are definite stable aggregates in true equilibrium with their crystalloidal components. The unit is the colloidal aggregate, not the molecule or simple ion, the aggregate being large enough to be held back by an ultra-filter which allows the molecule to pass through. Much evidence is available that colloidal electrolytes constitute an enormous class of substances occurring both in aqueous and in non-aqueous solutions, being particularly important in the latter. The characteristics of this class are essentially the occurrence of poly-molecular aggregates and ionic micelle. Colloidal particles may conduct better than true ions, but it is not mere electrophoresis that is meant. The actual conductivity of one ionic micelle containing, say, ten palmitate ions, is 20 or 30 times greater than that of a single palmitate ion, so that the equivalent conductivity of the ionic micelle is still several times that of the simple fatty ion. Consideration of the relationship between a particle of ionic micelle, which is revealed by its high conductivity and the corresponding sodium or potassium ions, leads to a modified picture of the electrical double layer and the phenomena connected therewith. It is obvious that the electrical conductivity of these ions and charged surfaces is not impaired by their participation in an electrical double layer. The study of various organic derivatives, such as sulphonates, shows the importance of long molecules, in the formation of colloidal electrolytes and jellies as well as crystalline liquids.

The discovery of the ionic micelle, the extreme type of a fully charged colloidal particle, the transition through the slightly charged suspensoids to the other extreme of neutral colloids, such as rubber in benzene or nitrocellulose in non-ionising solvents. It is clear that the existence and stability of such neutral colloids is almost or quite independent of electrical charges, and that solvation is the key to their behaviour. The diagram on the next page suggests a rational classification of all solutions, showing the gradual transition between each pair of neighbouring types.

Soap in colloidal solution is hydrated, and the method used is of general applicability in colloid chemistry. It consists in ultra-filtration of a sol to which an indifferent reference substance has been added; the filtrate is more concentrated as regards reference substance than the original sol, and from this the amount of solvent held back in combination with the colloid is calculated. The salient facts observed by Miss Laing in her work on the properties of soap jellies are the following:—The conductivity of a soap solution is quantitatively unaffected when it sets to a clear, transparent elastic gel. The same is true of its osmotic activity, and of the concentration of sodium ions measured by sodium electrode. Indeed, the only difference between sol and gel appears to be the mechanical rigidity and elasticity of the latter. Neither shows any structure in the ultra-microscope. During electrolysis the relative movement of the constituents of the solution is independent of whether it is a clear, elastic jelly or a fluid sol.



The identity of the significant properties of sol and gel proves that the same equilibria exist in each. The colloidal particles in sol and gel must be identical in kind and amount. The unchanged conductivity shows that the process of electrical conduction is unchanged in kind and degree. The "electrolytic migration" in soap solutions is identical with "electro-osmosis" of water through a transparent soap jelly, and with the "electrophoresis" of pieces of soap jelly suspended in a soap solution. The identity of conductivity of sol and gel is particularly significant in discussing the structure of gels. Any theory conflicting with this is evidently untenable, as for instance, Wo. Ostwald's and M. H. Fischer's suggestion that gelatinisation is due to reversal of phases. Some miscellar theory of gels is clearly indicated. In the case of soaps the structure is probably filamentous.

Thus, although soaps, proteins, etc., are commonly called emulsoid colloids, they cannot be regarded as emulsions. Evidence indicates that the colloidal unit is an aggregate of molecules, and that these colloidal units persist and retain their identity in larger structures, such as gels and coagula. This behaviour appears to be general; compare, for instance, the study of particulate clouds (aerosols). The apparent viscosity of such systems as soap and gelatin solutions has no marked effect upon electrical conductivity; the viscosity of a soap sol may be altered a thousandfold or it may be solidified to a clear elastic jelly without affecting the molar conductivity.

The work on the properties of soap curds shows, principally, that there is a sharp distinction between true soap jellies and the soap curds with which they have been commonly confused. Gelatinisation is not a process of crystallisation in the sense of removal of colloidal particles from the sphere of action of the solvent; whereas the formation of curd or coagulum involves this separation. Presumably, jellies in general should be distinguished from coagula.

One result from this work on surface concentration of soap and other solutions requires to be mentioned. The surface tension of water is lowered by about 60 per cent. in a very dilute solution (about $N/1000$); and on further addition of soap the surface tension is not further diminished, but rather increases very slightly. According to Gibb's adsorption equation, there should be a deficiency of soap in the surface of solutions of ordinary concentration. Actually there is an accumulation in the surface which is not due to chemical decomposition. It seems to be the actual lowering of surface tension and not the slope of the surface-tension curve which governs the occurrence of adsorption. A modified formula based on the actual lowering of surface tension would appear to be more nearly in accord with all the known facts.

Only a few aspects of this vast subject have been adequately investigated; but it appears that its exact elucidation, so necessary to place the soap industry on a scientific basis, will also have a bearing upon a surprisingly large number of theoretical considerations.

PHYSICAL AND CHEMICAL SURVEY OF THE NATIONAL COAL RESOURCES

In pursuance of the policy of carrying out the work of the above survey with the help of local committees, the Fuel Research Board has appointed a committee to deal with the physical and chemical survey of the coal seams in the South Yorkshire area.

The composition of the committee is as follows: Mr. J. Brass, Mr. Robert Clive (hon. secretary), Mr. H. Danby (representing the South Yorkshire Coal Trade Association); Lieut.-Col. H. Rhodes, M.Inst.C.E., M.I.Min.E., F.S.I. (representing the Midland Institute of Mining, Civil and Mechanical Engineers); Prof. R. V. Wheeler, D.Sc.; Mr. C. H. Lander, D.Sc., M.I.Mech.E., A.M.Inst.C.E., Director of Fuel Research (chairman *pro tem.*) (representing the Fuel Research Board); Mr. Walcot Gibson, D.Sc. (representing the Geological Survey of Great Britain).

The first of these committees has now been actively at work in the Lancashire and Cheshire area for nearly eighteen months.

CHEMICAL JOURNALS IN JAPAN

By AKIRA SHIMOMURA

Anybody who has a faint idea what Japanese letters are like would be interested to know that in Japan several journals are published in Japanese for the advancement of chemistry, among which the following three may be counted as the most prominent :—

(1) *Nippon Kwagaku Kwai Shi* (Journal of the Chemical Society of Japan, formerly Journal of the Tokyo Chemical Society). This journal is published monthly by the Chemical Society of Japan, and is distributed among its members, whose number is given as 1122, and is intended as the medium for publication of original researches. It is rather interesting to know that the first volume appeared 44 years ago, only 12 years after the Deutschen Chemischen Gesellschaft was founded. The society holds scientific meetings periodically, and an annual meeting in Tokyo very much after the style of the Chemical Society of London.

This year the annual meeting was held in the Chemical Department of Tokyo Imperial University, on April 7 and 8, and 42 papers were read. Some of the titles of papers are given hereunder to give, as far as possible, a general idea of the nature of the investigations carried out :—

Vapour density of acetylene.
Catalytic action : Catalytic formation of cymene ;
 Catalytic reduction of methyl-naphthalyl ether.
Preparation of benzoin substitution products.
On amino acids and aldehydes.
Synthesis of indolketonic acids.
Metallographical investigation of sewing needles.
Copper-zinc system, containing 40-100 per cent. of copper.
Chemical investigation of Japanese minerals containing rare elements.
Chemical investigation of Japanese woods.
Estimation of sulphur in iron.
On analysis of elements of platinum group.
The nutrient value of condensed milk.

(2) *Yakugakuzasshi* (Journal of the Pharmaceutical Society of Japan). This monthly journal was started three years after the Journal of the Chemical Society of Japan, and is intended mainly for publication of papers relating to pharmacy and organic chemistry, and seems to be widely distributed among its members, numbering 3761, and including many apothecaries—a term which seems to sound more reasonable than "chemists," as they are called in England. The latest number contains the following communications :—

Some derivatives of indol.
Chemical constituents of Chinese "Hsing-chuang."
Rupture of furfuran nucleus.
On a new pulveriser.

(3) *Kogyo-Kwagaku Zasshi* (The Journal of Chemical Industry). The Society of Chemical Industry of Japan, having 3067 members, is much younger than its English brother, counting only 26 years from its birth. Its Journal consists of three sections,—*i.e.*, transactions, abstracts and reports, dealing chiefly with the industrial side of various branches of chemistry. In the latest number the following communications are found :—

Study of the ternary alloys of aluminium, copper and magnesium.
The manufacture of acetaldehyde from acetylene.
Heat value of bituminous coal.
The action of ultra-violet rays on raw rubber in an atmosphere of carbon dioxide.
Formation of petroleum hydrocarbons from turpentine oil.
The properties of Tsubaki oils from Nagasaki and eight other prefectures.
Liver oils from *Stereolepis ishinagi* and *Erilepis zonifer.*
Inquiry into the study of the manufacture of artificial petroleum for industrial purposes.

Besides these more academic periodicals, there are several popular scientific magazines which contain a good many chemical articles, some being miniatures of *Nature* or *Chemical Age*, and others an imitation of *Discovery.*

All these journals are, of course, written in Japanese, except (2) and (3), which have short abstracts of the original papers in either English or German in the same number. Although I am not inclined to say anything against our own language, I have to admit that Japanese is not a language suitable for scientific statements in general ; for instance, there are no articles, no distinctive difference between singular and plural, and the construction of our language necessitates explanatory phrases to be put before the noun. The difficulty arises in the nomenclature of organic substances. In fact, it is almost arbitrary according to authors, some using German pronunciation, and others English, although it is not exactly what it should be. It wants not a little practice to see the identity of "benzylacetonephenylmethylhydrazone" and "benchiiruasetonfenirumechiruhidoratsuon," as it is reproduced in Japanese characters, and which the editor of *Punch* might accept as a contribution.

It is rather interesting to note a tendency of late to publish the results of chemical researches in foreign languages, English, German or French. In this connexion the publication of the following new journals may be cited: *Japanese Journal of Botany, Acta Phytochimica* (which have been noticed in *Nature*, Dec. 30, 1922), *Japanese Journal of Chemistry* and the *Journal of Biochemistry.* They accept communications only in English, German or French, so that our European and American friends may be able to read the original papers of Japanese workers without depending on so-called abstracts, which are always very unsatisfactory and sometimes unreliable.

Apart from these regular periodicals, Science Departments of most Universities have their own Reports or Memoirs, which are, as a rule, published in foreign languages, either English or German. It is deemed an honour to have some work published in these University

Reports, as the publishing fund is rather restricted in each University. The Institute of Physical and Chemical Research, which was organised during the war by Governmental initiative, and very much resembles the British Department of Scientific and Industrial Research in its scope, also issues its reports in English.

Personally, I wish this tendency to use foreign languages, especially English, which is undoubtedly more suitable for scientific communication, as a medium of publication will grow stronger, and the three bigger journals mentioned above will ultimately take this step some day.

ITALIAN MINERAL OUTPUT IN 1922

The official statistics of the mineral and metal output in Italy in 1922 are given in the following table :—

	Metric tons		Metric tons
Minerals :—		*Minerals :—*	
Iron ore	416,400	Boric acid ..	2,500
Manganese ore ..	10,400	Graphite.. ..	7,300
Copper ore ..	7,134	Pumice stone ..	21,600
Lead-silver ore ..	28,027	Asbestos ..	500
Zinc ore	86.266	Steatite and talc	25,000
Gold ore	340	Barytes	19,000
Nickel ore ..	25	Coloured earths..	8,400
Antimony ore ..	495	Quartz and feldspar	27,300
Lead-zinc ore ..	180	Porcelain clay ..	7,600
Lead-zinc-copper ore	250	Refractory materials	44,900
Iron and cupriferous pyrites..	496,500	Siliceous sand ..	185,000
Mercury	1,530	Fluorspar ..	1,700
Anthracite ..	26,190		
Coal	171,730	*Metallurgical Products :—*	
Lignite	704,600		
Peat	61,500	Pig iron	77,000
Sulphur, raw ..	171,800	Pig iron, synthetic	14,400
Sulphur ore, ground ..	19,800	Steel ingots, etc.	943,000
		Alloys, metallic..	22,000
Salt, rock ..	49,100	Copper	—
Salt, medicinal ..	47,300	Lead	10,500
Petroleum ..	4,300	Silver	6,700
Asphalt and bituminous rock ..	66,200	Gold	9
Raw bitumen ..	700	Zinc	3,060
Bauxite	65,600	Antimony ..	200
		Aluminium ..	630

The output of iron ore shows an increase of 50 per cent. compared with the previous year, but is only one-third of the pre-war production. The present output of copper compares very unfavourably with the pre-war outturn of 89,000 tons, but owing to the accession of Istria, the production of mercury and bauxite has increased considerably ; it appears that a fair export trade in bauxite is being developed. A collapse in the sulphur industry was averted with Government help, and the agreement recently concluded with American interests should prove of considerable benefit (*cf. Chem. & Ind.*, 1923, p. 375).—(*U.S. Comm. Rep., April* 16, 1923.)

PERSONALIA

It is announced officially that the Lord President of the Council has accepted, with much regret, the resignation of Sir George Beilby, F.R.S., after nearly seven years' voluntary service as Director of Fuel Research, and Chairman of the Fuel Research Board under the Department of Scientific and Industrial Research. Sir George Beilby retains his membership of the Advisory Council of the Department, and has consented to act as Honorary Adviser to the Board. Dr. C. H. Lander has been appointed Director of Fuel Research, and Sir R. Threlfall, F.R.S., a present member of the Board, its Chairman. The following have accepted appointment as additional members of the Fuel Research Board:—Mr. R. A. Burrows, Sir John Cadman, K.C.M.G., D.Sc., Dr. Charles Carpenter, C.B.E., Mr. Samuel Tagg, Prof. Sir James Walker, F.R.S., and Prof. R. V. Wheeler, D.Sc.

Mr. E. A. Pinchin, B.Sc., F.I.C., has been appointed Public Analyst for the City of London, in place of Dr. F. L. Teed, F.I.C., who has retired after many years' service.

Sir E. Rutherford, F.R.S., has been elected an honorary foreign member of the Washington Academy of Sciences.

The following officers were elected by the American Institute of Chemistry for the ensuing year : President, Horace G. Byers ; Vice-president, Lloyd Van Doren ; Treasurer, Clarence K. Simon ; Secretary, Lloyd Lamborn.

Dr. E. G. Acheson has been elected an honorary member of the American Electrochemical Society in recognition of his many inventions in the field of electrochemistry.

* * *

With regret we announce the death of Mr. G. A. Boeddicker, managing director of Henry Wiggin and Co., Ltd., of Birmingham. Mr. Boeddicker, who was an authority on nickel and cobalt, was one of the founders of the Institute of Metals.

FORTHCOMING EVENTS

June 25.	THE INSTITUTION OF THE RUBBER INDUSTRY, at The Engineers' Club, Coventry Street, Piccadilly, W. 1, at 8 p.m. "Some American Rubber Manufacturing Problems," by Dr. W. C. Geer.
June 25-30.	THE INTERNATIONAL AIR CONGRESS, LONDON, 1923. Opening Ceremony by His Royal Highness the Prince of Wales at the Institution of Civil Engineers, and Inaugural Address by His Grace the Duke of Sutherland. Numerous papers will be read; Receptions will be held by the President (the Duke of York), the Lord Mayor of London, and the Duke of Sutherland; and the proceedings will terminate with a banquet at the Hotel Victoria, S.W. 1.
June 28.	THE INSTITUTION OF ELECTRICAL ENGINEERS. The annual conversazione will be held at the Natural History Museum, South Kensington, S.W., at 8.30 p.m.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinions by his contributors, but it must be understood that he does not necessarily agree with them.

Meetings

of all kinds are coming on us fast and thick. The International Mining Exhibition is only just over, and the International Conference of Pure and Applied Chemistry precedes the Annual General Meeting of our own Society at Cambridge. Dr. Armstrong and Dr. Charles Carpenter are sure to deliver most stimulating addresses at Cambridge, as they are both not only distinguished scientists, but also hold commanding positions in the industrial world. It is to be hoped that their addresses will be widely quoted in the daily Press so that the public may get to know at least something of the aims of chemistry and chemical industry.

A Quarter of a Century

ago the genius of Herman Frasch brought about the initial steps which have resulted in the transfer of the centre of gravity of the sulphur market of the world from Sicily to the United States of America. At that time an English Company, the Anglo-Sicilian Sulphur Company (formed in 1896) controlled the sulphur market of the world, but this Company soon recognised the great importance of Frasch's process of extraction, and retired from the field at a moment which was most suitable and beneficial to the interests of all connected with them. The sale of sulphur in Sicily then passed into the hands of a compulsory selling agency, the Consorzio Obbligatorio, initiated by the Italian Government, and this agency became by law the sole purchaser of crude sulphur from the Silician sulphur mines, and also the sole seller of crude Sicilian sulphur throughout the world. The Consortium was originally established for a period of twelve years, but before the first period elapsed an extension over a further twelve years had been decided upon, and, therefore, at the present day the visible life of the Consortium extends until 1930.

The American Sulphur Producer

during the whole life of the Consortium has been gaining ground at the expense of the Sicilians, and shortly after the termination of the war the Sicilian industry found itself in a lamentable condition, and had to seek the financial aid of the Italian Government. The reason for the financial difficulty was not far to seek. The artificial prosperity occasioned by the war had suddenly ended, large stocks of unsold sulphur existed at the ports, and the financing banks, having issued loans against these stocks during the period of prosperity, found that their security was rapidly decreasing in value, and that the sale of sulphur was also rapidly decreasing. In these circumstances the Government agreed to guarantee both the capital and interest of a loan which is shortly to be issued in the shape of debenture bonds for 120,000,000 lire, whereby the sulphur industry will be able to meet its liability to the banks with sufficient margin over to afford some capital for carrying on operations. During this period of difficulty, on the other hand, the American sulphur producers had done much to perfect their process, and although they also found themselves with large stocks which were not readily realisable, nevertheless their position was a very much stronger one.

Two Definite Results

follow from these factors. I hear that the American mine owners have united together to form a common selling agency for all sulphur sold outside the U.S.A., and that an agreement has been reached between the Americans and the Italians with regard to future sales of sulphur. The agreement gives the Mediterranean market to the Italians, which means they will have altogether an annual sale of about 250,000 tons of sulphur.

Professor Dreyer,

whom I met the other day, has now given to the world the results of his work on new principles in bacterial immunity. This work may have a far-reaching effect on the treatment of tuberculosis. The *Bacillus tuberculosis* is one of the germs which surround themselves with a fatty or waxy sheath. Professor Dreyer has produced a method of defatting the germs and at the same time killing them. The treatment of tuberculosis with defatted germs appears to be a great advance in our knowledge of this subject.

"Defatted"

is an ugly word, and I was interested to hear a number of philologists after dinner attempt to find a substitute. I do not think anything very useful was suggested on that evening, but since then it has been suggested to me, and I pass the suggestion on to Professor Dreyer, that a better word would be "desebate." At any rate the word sounds better, although I am not quite sure whether it is equally correct.

The Disease of Leprosy

is another ill which flesh is heir to and which our medical scientists are taking steps to overcome. I anticipate that at the International Leprosy Congress which is being held at Strasbourg next month the matter is to be discussed. We are fortunate in Europe in having a relatively small number, and the preparations of chaulmoogra oil which have been used in India have attained a large measure of success. The trouble with this disease, as with so many others, is that the victims will not come forward in its early stages.

SOCIETY OF CHEMICAL INDUSTRY

THE ANNUAL GENERAL MEETING,

CAMBRIDGE, 1923

By the time this issue has reached the hands of our readers, the business part of the Annual Meeting will be over, and those who have been able to be present will have heard Dr. E. F. Armstrong deliver his Presidential Address and have attended the receptions held by the Vice-Chancellor of the University and by the President and Mrs. Armstrong, in the Fitz-William Museum and the Guildhall, respectively. Still to come are the presentation, on Friday morning, of the Society's Medal to Dr. Charles Carpenter, who will then deliver an address on the subject of "The Evolution of a Chemical Industry"; the address by Dr. F. W. Aston, F.R.S., on "Isotopes," on Friday afternoon; and the trip to Ely Cathedral on Saturday.

As *Chemistry and Industry* has to go to press before the Meeting commences, a description of the proceedings must be postponed to a later issue. But for the convenience of those who have been prevented from attending the Meeting, it has been decided to publish the Presidential Address in this issue (*cf.* p. 603).

Sir W. J. Pope, K.B.E., F.R.S.

In former years the Society has met in industrial localities, where it was possible to visit factories representing branches of chemical and allied industries, where methods of production of varied kind could be inspected and discussed. It is true that Cambridge offers no attractions of this severely practical nature, but its significance to the members of the Society of Chemical Industry is none the less real. Since the far-off days when the town of Cambridge was a chief centre of English trade and commerce, trading with Northern Europe by means of the ships of the Hause towns and of Flanders, the University has grown—at times sluggishly, with animation almost suspended—until at last, now that the study of the humanities, so long dominant, has taken a more proportionate place in education, Cambridge has come to possess one of the foremost Schools of Chemistry, a school which provides training for more than 700 students. In such surroundings the addresses of Dr. Armstrong and Dr. Carpenter must take on special significance, all the more because, as the President points out, the time is now come for educational and industrial authorities to confer and decide what kind of training will produce the type of man wanted in industry—a most difficult question. This question of paramount importance is being discussed at large in England by other professions besides our own; that such discussion is needed once more emphasises the fact that in this country we have no general or national scheme of education. Nor have we an exact notion of the meaning of the term, some considering it to imply "mental discipline"; others the acquisition of "useful knowledge." But the British nation possesses a genius for practical life, and it is therefore essential that our educational system should be properly and adequately correlated with life. It has been said that a "haziness of intellectual vision is the malady of all classes of men . . . . who have not had a really good education." Dr. Armstrong once again utters the warning that

King's Parade

whereas a chemist obtains his first appointments on the basis of his professional qualifications, afterwards he succeeds because of his ability as a man. Education, then, from this standpoint, should consist in guiding the student in the acquisition of experience, whether experience of the properties of matter or—most valuable of all—experience of human relations gained by contact with fellow-beings in lecture theatre, where he is introduced to the thoughts and discoveries of the great men of the past, in laboratory, where he can put those discoveries to test, in playing fields, in social intercourse. Having had the right kind of education, the scientific worker should possess an intellectual clarity that should enable him to probe deeper, more subtly, into the reactions he must investigate, and whether his work lies in the industrial field or in the academic laboratory, it requires for completion the insight that intellectual clarity alone can give.

It was natural that an address to be delivered in Cambridge should consider the subject of education ; and it is to be hoped that the President's proposal for a conference with the teachers will be quickly acted on. At a meeting following so close on the heels of the International Conference of Pure and Applied Chemistry, it was to be expected that reference should be made to the necessity—still, unfortunately, as urgent as ever—of instilling into the public mind a clearer notion of the true meaning of the terms "chemist" and "chemistry." But, before chemists can bring their full influence to bear on public matters concerning the profession, they must perforce unite so that they can speak with no dissentient voice. Much still remains to be done before Chemistry House, the symbol of the underlying unity of the profession, can become a reality. The President has given the lead, and it remains for the members of the Society to act individually to insure the full fruition of their common aspirations.

St. John's College

The meeting at Cambridge will undoubtedly furnish the material for pleasant as well as stimulating memories in the minds of those who were present. The charm of the historic colleges and buildings (of which a few photographs are reproduced in this issue), the delightful surroundings, the venerable associations of Ely, all so impregnated with the fibre of history, will find due appreciation ; indeed, like the hospitality traditionally associated with the older Universities, they require no comment. Whatever may be the outcome of this Annual Meeting, it should at least have the result of steeling the determination of every chemist to help in raising his profession to the dignified rank which it should and must occupy.

Trinity College

MEETINGS OF OTHER SOCIETIES

ROYAL MICROSCOPICAL SOCIETY

Prof. A. Hutchinson presided over the meeting held on May 30, and Mr. H. B. Milner read a paper on "The Microscopical Investigation of Sands for various Industrial Purposes."

The paper discussed the application of the petrological microscope to the investigation and discrimination of sands and allied rocks suited to particular industrial requirements ; these included glass manufacture, ferrous and non-ferrous founding, silica-brick manufacture, scouring sand, sand-blasting, cement, mortar, concrete, brick and tile production. He also dealt with sands and gravels as a source of economically valuable minerals such as monazite and thorianite for the production of incandescent gas-mantles, tantalite for filaments, etc., and as a source of gem-stones, and showed to what extent the microscope could be employed as a rapid and economic means of studying the raw materials involved in each case. He contrasted the technical and popular conceptions of the term "sand" and then traced by means of a large series of lantern slides of photo-micrographs the distinctive characteristics of sands suited to the varied purposes mentioned above. This application of the microscope is still unappreciated by many manufacturers, some of whom, as was evident from the interesting discussion which followed the reading of the paper, were still labouring under difficulties which the aid of the microscope might lessen considerably or possibly overcome altogether. The author suggested several lines of research which could profitably be undertaken by microscopists in conjunction with manufacturers for the benefit of all those industries depending on the use of refractories. Silica-bricks, to mention one instance, lend themselves admirably to this type of analysis, both as regards their initial ingredients, their properties after being fired for different periods, and then again after prolonged use in metallurgical furnaces. In a similar way, much light is thrown on the problems presented by mortars and concretes, the internal structures of these materials frequently affording clues to inefficiency or inherent defects difficult to diagnose without the help of the microscope.

ACADÉMIE DES SCIENCES

At the meeting held on May 22 a paper by Chief Engineer Dumanois, communicated by M. Koenigs, gave an account of the results obtained with a motor fuel consisting of a mixture of 70 per cent. of alcohol (99·5°) and of 30 per cent. of paraffin oil. A fuel consumption was recorded of 10 litres per 100 kilometres for an average speed of 40 kilometres per hour. Prof. C. Moureu presented a note on work carried out with M. Dufraisse, which described their new device for estimating the water capacity of a calorimeter without the necessity of carrying out any electrical measurement; the device also eliminating thermometric errors.

On May 28 Prof. Lindet presented a paper by Prof. Stocklasa of Prague. By comparing the analysis of caliche with that of red and grey volcanic ash, the author claims to have discovered the true origin of the Chilean nitrate deposits. According to Prof. Stocklasa, Chilean nitrate has not been formed by the decomposition of organic matter, but to the transformation of the large quantities of ammonium chloride which impregnates the ash of Chilean volcanoes, bacterial nitrification of which had been intensified by radioactivity.

On June 4 M. D. Berthelot communicated a paper by M. Gantrelet on a new organic derivative of phosphoric acid and of methyl salicylate which possesses valuable properties as an analgesic and febrifuge. M. Lindet announced that M. Kayser had obtained methyl alcohol by fermenting calcium lactate, thus providing confirmation of the hypothesis that in fermentation lactic acid is an intermediary product between sugar and alcohol. M. G. Bertrand and Mlle. Benoist described the action of acids on cellulose. The final product of the reaction was glucose, but the authors claimed that the transformation is progressive, as they have discovered a new sugar with composition and properties intermediate to those of cellulose and glucose. The new sugar, "procellose," is changed successively into cellose and glucose when heated in slightly acid solution.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held on June 14, 1923, Sir Max Muspratt, Bart., presiding.

After disposing of various routine matters the Council discussed the recent action of the French Authorities on the Ruhr in commandeering a large quantity of German dyestuffs and its probable effect, not only on the dye industry in this country, but on the chemical industry generally. It was decided to make strong representations to the Board of Trade, the Foreign Office and the Dyestuffs Licensing Committee on the subject.

The General Manager reported that he had been requested to "broadcast" information relating to the chemical industry with the view to enlightening the public upon its importance. The Council was of the opinion that "broadcasting" would be a very useful means of propaganda and authorised the General Manager to supply such information as he deemed desirable.

Reference was made to the Tariff of the United States of America, especially to the powers vested in the President enabling him to revise the Tariff on a recommendation of the U.S. Tariff Commission. It was pointed out that, before any recommendation could be made to the President, the Commission had to inquire into the cost of manufacture of any product, the Tariff upon which is complained of, in the country of origin. The Commission has paid a visit to this country regarding certain chemicals, and has been referred to the particular manufacturers concerned for information.

The Council was of the opinion that in all cases where information is required the Tariff Commission should be referred to the manufacturers, who should decide for themselves whether they would furnish information under conditions of secrecy. The Council thought it might be of advantage to manufacturers that the cost of manufacture should be given.

The Annual Report of the Association for the year ending May 31, 1923, was approved for submission to the Annual Meeting to be held on July 12, 1923.

CORRESPONDENCE

A PLAUSIBLE ERROR IN THE THEORY OF CO-ORDINATION

Sir,—In your issue of June 1, Mr. C. H. Spiers has interpreted correctly the views that have been developed in this *Journal* (pp. 224, 316, 412 and 462) in reference to *one* of the factors which are of importance in determining the formation of co-ordination compounds, namely, the striving of a co-ordinating metal to complete its outer shell of electrons. He has, however, suggested a modification of these views which calls for an immediate reply, since it appears to be based on ignorance of physics, rather than on knowledge of chemistry.

In an article on "Some Factors Influencing Co-ordination" (this vol., p. 319), it was pointed out that, in several of the most important series of co-ordination-compounds, "six co-ordinated groups are just sufficient in number to complete the outer shell of electrons of the metal, if each group shares one pair of electrons with the metal," but that in other series "a deficiency of 1, 2 or 3 electrons can be tolerated readily," in marked contrast with the intolerance of even a single surplus electron which is displayed in compounds such as the cobaltocyanides. Mr. Spiers proposes to halve the number of cases in which the outer shell is incomplete, by the simple expedient of stealing the two inner electrons of the K-series in order to complete the outer shell. This robbery, which is good algebra, but very bad physics, was originally devised by Eastman in the case of carbon, where, however, the chances of successful theft are much greater than in the case of manganese or nickel. The fundamental objection to all these schemes is that they neglect the known properties of the electrons, and in particular the fact that the K-electrons are held far more tenaciously than those of any other series. A well-known writer in the columns of this *Journal*, to whom this matter was referred, suggested that the proposal to remove the K-electrons, in order to enrich the L, M or N series, was like asking a gentleman, who was financially embarrassed, to part with his most essential garments, when he still possessed an opera hat and a rain-coat, which he might pawn. When this metaphor was mentioned to an eminent physicist he was emphatically of the opinion that the metaphor was nothing like strong enough to represent the tenacity with which the nucleus clings to the two electrons of the K-series, since their elimination was in fact a far more drastic operation than the mere removal of a garment.

Mr. R. H. Fowler, of Trinity College, has supplied the following numerical data, which express the reluctance of a nucleus to part with its K-electrons. The energy required to effect this separation is approximately proportional to the square of the atomic number of the element, which is a measure of the charge on the nucleus, to which the K-electrons are closely adjacent. But even in carbon, with a nuclear charge of only six, the transfer of two electrons from the K to the L series involves a fantastic expenditure of energy, many times greater than that which is rendered available by any known chemical change. These energies are usually expressed in electron-volts—that is, the energy acquired by an electron in falling freely through a given voltage. The actual energies in the case of carbon are about 230 volts to remove a K-electron, as compared with only about 16 volts for an L-electron. The latter figure would be increased by the removal of the K-electrons from the nucleus, since the electric charge on the "kernel" would be increased thereby from 4 to 6 units. Under these conditions the removal of the L-electrons might require, say, 36 instead of 16 volts. These volts can be converted into calories per gram-atom by multiplying by a factor of about 24,000. To transfer two electrons from the K-series to the L-series would therefore require $(2\times230+6\times16-8\times36)$ 24,000 calories, *i.e.*, over 6,000,000 calories for each gram-atom. In nickel the K-electrons are closely adjacent to a nuclear charge of 28 units, whilst there are 8 L-electrons, 8-M-electrons and, in a co-ordinated compound, 16 N-electrons (some of them shared) in higher energy levels. To turn a K into an N-electron would require at least 6000 volts, *i.e.*, an expenditure of energy of the order of 300,000,000 calories per gram-atom! It would be difficult to suggest any physico-chemical change that is less likely to take place; and this attempt to explain a tolerated deficiency of two electrons suggests the process of jumping from a tepid frying-pan into a particularly hot fire.

As Robinson has pointed out, there is some evidence to show that, in the hydrides of boron, the K-electrons as well as the electrons of the L-series, may be shared between two atoms, since in these compounds the boron atoms, which possess only three L-electrons each, are united simultaneously to four other atoms, but even this does not mean that the K-electrons are converted into L-electrons. In carbon, however, the compounds in reference to which this assumption is made are all unsaturated substances, in which the depleted carbon atom is linked to three other atoms only. There is, therefore, no need to assume that the K-electrons are brought to the surface, and the motive for doing this is neither chemical nor physical, but purely arithmetical. Since, however, Eastman's hypothesis provides so obvious a pitfall, I may, perhaps, be allowed to call attention to another series of phenomena in which it is directly opposed by experimentally established facts. These facts are provided by the X-ray analysis of crystals. From this point of view, the carbonate ion, CO_3'', may be taken taken as a test case on which to decide whether *eight* electrons surrounding a carbon nucleus form a depleted octet of *eight* L-electrons or a sextet of *six* L-electrons surrounding *two* electrons of the K-series. In this respect the carbonate ion may be compared usefully with the chlorate ion, ClO_3', since the chlorine nucleus is here surrounded by *eighteen* planetary electrons, and these will obviously form a complete octet of *eight* M-electrons around the *eight* L-electrons and *two* K-electrons of the inner system. Professor W. L. Bragg has supplied the information that, whilst (*i*) the three oxygens of the carbonate ion are distributed symmetrically about a three-fold axis, in a plane which also contains the carbon itself, (*ii*) the three oxygen atoms of the chlorate ion are distributed about a three-fold axis of symmetry, but do not lie in the same plane as the atom of chlorine. It is clear that the symmetry of the chlorate ion is in general agreement with a tetrahedral arrangement of four duplets of M-electrons round the chlorine nucleus; but that the configuration of the carbonate ion differs from this in just the way that would be expected if the octet were converted into a sextet. Thus six electrons may be arranged either (*i*) as a hexagon, or (*ii*) as a triangular prism, or (*iii*) as an octahedron; but if these six electrons are grouped as three duplets, each shared with an oxygen atom, it will be found that the three possible configurations all give rise to a co-planar arrangement of the four atoms, the symmetry of which would be degraded by introducing a fourth duplet. The crystallographic evidence is, therefore, in harmony with the physical evidence in repudiating the plausible scheme of robbing Peter to pay Paul. The object of this note is to warn all whom it may concern that, apart from all questions of morality, this particular form of robbery is impracticable.

T. M. Lowry

LEAD ARSENATE SPRAYS AND BEES

Sir,—The exceptional weather this year has led to an abnormal multiplication of caterpillars and other insect pests that attack the foliage and blossom of fruit trees. In consequence, the spraying of fruit trees with poisonous solutions has been very prevalent and has produced disastrous results in several directions. The British Bee-keepers' Association has recently received reports from several of its members of great mortality among bees due to the spraying of open fruit blossoms with an arsenical solution. The particular solution which appears to have caused most damage is that of arsenate of lead, which in one case caused the death of 75 per cent. of the bees in a large apiary, at a time of year when the activity of these useful insects was most essential for the fertilisation of fruit blossoms. Through the misuse of this dangerous liquid the fruit-grower not only deprives himself and his neighbours of the services of all the insects which contribute to the fertilisation of flowers and the subsequent production of fruit, but he also perpetuates and increases the very evil he seeks to remedy. The insects that are poisoned by arsenic are eaten by insectivorous birds, who themselves fall victims, and in the ensuing years the fruit-trees are deprived of their natural and best protectors. In former years, before spraying with arsenic was introduced, the failure of fruit crops through insects was not so general as it is now. In some districts the insectivorous birds are disappearing rapidly. Of seven species of these useful helpmates to horticulture in my own orchard one only is left, the blue tit. I attribute this partly to the fact that these birds hang head downwards from the twigs and thus catch caterpillars which have been sheltered underneath the leaves from the fatal spray.

It is scarcely necessary to remind the chemist that the continuous use of a combination of two cumulative poisons such as arsenic and lead in any locality may be a source of considerable danger. Worms are poisoned by the solution and, before dying, come out of their holes and are eaten by birds and poultry. Where grass grows under the trees it is covered with arsenic, and cows grazing in such orchards must produce milk which no chemist would willingly consume. In fact, an orchard continually sprayed with arsenate of lead becomes a constant and increasing source of danger to its owner and his neighbours. From the bee-keeper's point of view I approached the Ministry of Agriculture, which writes :—" The Ministry deprecates the use of lead arsenate sprays on fruit trees in open blossom, has warned growers against it by leaflets, press notices, and exhibitions and will continue to do so." The Ministry also asks for suggestions as to " any substance the smell or taste of which is especially repulsive to bees " which might be added to arsenical sprays.

Among our numerous members all over the civilised world there must be many who could help with suggestions in this matter and who have experience with non-poisonous sprays, the substitution of which for arsenic would be the best solution of the question. I understand that in the United States there are regulations limiting or prohibiting the use of powerful poisons in this haphazard way, and it is high time for steps to be taken in Great Britain to prevent selfish individuals from injuring their neighbours and probably themselves in the way they are now doing. The subject is of great importance from the point of view of the chemical manufacturer, as there is a very wide field for the use of sprays to combat the pests and parasites that seem to be an inevitable accompaniment to the growth of large areas of any kind of vegetable produce.

Walter F. Reid,
Chairman, British Bee-keepers' Association

23, Bedford Street, London, W.C. 2
June 15, 1923

PROPAGANDA IN GERMAN SCIENTIFIC JOURNALS

SIR,—Strange ideas seem to be abroad as to the reason why " propaganda leaflets directed against the French " as well as " some gruesome photographs " have been sent out with some German scientific journals. On inquiry, I have come to know that it is being done because the German industrial magnates want it; without their financial support publication of a journal in Germany is quite impossible.

I might mention here that the propaganda is generally against the French Militarism and not against the French as you have mentioned in last week's editorial.

I am one of those whose almost everything was destroyed by the German soldiers, but this will never make me support the Imperialist policy of my country or of her allies. I think even had the German Chemical Society sent out propaganda sheets on their own initiative—it would have been a thoroughly justifiable act; men of science have every right to resent deeds of barbarity, be they done at Louvain, Cork or Dortmund.—I am, Sir, etc.,

J. ROLAND DE CARLI

Evian-les-Bains, France
June 15, 1923

" LUCIFER " ON " CALORIFER "

SIR,—In view of the strident tone and general assertiveness of Calorifer's further letter in your to-day's issue (15th inst.), I think, perhaps, the best course for me to adopt is hereby to invite my friend, Professor Armstrong, to come and take tea with me some afternoon at South Kensington, when I will submit to him the original pressure-time records and our analyses of them, after which I feel that I can safely leave him to deal with Calorifer, so saving me much time, which can be more usefully devoted to experimental work.

I hope that in my previous letter I have made our position in the matter sufficiently clear for the present; and when in the autumn (which, by the way, is the proper time for " garnering harvests ") we publish the results of our further experiments (now practically completed) upon the influence of varying initial pressures on the combustion of carbon monoxide-air mixtures, I think we shall be able to deal with the matter in such a way as will fully prove our case, and at the same time dispose of the hasty assertions made by Calorifer. Indeed, if only he knew where and how to find it, the proof of the matter already lies in the analyses of the pressure-time records published in our recent Royal Society memoir. Doubtless your readers will agree with me in the view that persons who have thoroughly studied the original photographic records are probably in a better position to divine their meaning than an outside critic who apparently has never seen them.—I am, Sir, etc.,

WILLIAM A. BONE

June 15, 1923

NEWS AND NOTES

CANADA

The Iron and Steel Industry

During the past two decades or so, the Canadian iron and steel industry has grown markedly. In 1920, according to the Dominion Bureau of Statistics, Ottawa, the total capital invested in 1475 establishments was $642,904.322, and no less than 102,661 workers were employed. Materials utilised in 1920 cost $321,298,396. the gross value of the production being $640,233.785. The chief group belonging to these industries is that of blast furnaces and steel mills, with a capital investment of $119,761,718, and a productive value of $138,882,823. The extent of this development can be realised when it is noted that in 1900 the capital invested in the iron and steel industry was only $61,800,987, and the gross value of the production $48,271,553. Imports of iron and its products in 1921 reached an average value per month of $21,287,984, whereas the monthly exports of iron and steel goods during the same year averaged $7,942.068.

UNITED STATES

Felspar in 1921

The U.S. Geological Survey reports that the crude felspar mined and sold in the United States decreased by 32 per cent. in quantity and 27 per cent. in value to 91,865 long tons valued at $617,652. The production in 1920 was the largest ever recorded and was apparently in excess of requirements. Owing to this and also on account of the increasing output in Canada and the depressed state of the domestic ceramic industries the production of felspar in the United States in 1921 was less than normal. The supplies of felspar are made up in large part of Canadian felspar, the Canadian production in 1921 being 33,597 short tons, of which 90 per cent. was exported to the United States. The increasing production of felspar in Canada is seriously affecting the industry in the United States.

JAPAN

The Mercury Industry

Practically the whole Japanese production of mercury comes from Hokkaido, the output during recent years having been 4990 lb. in 1917, 5836 lb. in 1918, 1400 lb. in 1919, 5965 lb. in 1920, and 13.221 lb. in 1921. The domestic consumption, however, greatly exceeds the production and imports have risen from 344.010 lb. in 1913, to 402,240 lb. in 1921, and 420,708 lb. in 1922. After the war, however, importation was excessive, and in 1920 over 200,000 lb. was re-exported, principally to the United States, to relieve the local market. The local demand for mercury actually varies from 375,000 to 450,000 lb. annually. It is used in mining, in making minerals, thermometers, drugs, and vermilion for lacquer work. At present Great Britain supplies about

34 per cent. of the imports, China 24 per cent., United States 19 per cent., Germany 11 per cent., and Italy 8 per cent. Prior to the war, Germany, Italy and Austria-Hungary were the chief sources.—(*U.S. Comm. Rep., May* 21, 1923.)

FRANCE

National Fuel

Tests on touring cars and heavy vehicles have been carried out at Toulouse with the "National Fuel," consisting of 50 per cent. of petrol and 50 per cent. of ethyl alcohol, according to the Sabatier formula. Other vehicles using portable gas generators, heavy oils and vegetable oils took part in the test. The tests were designed to show the effect of the carburants on the pistons, valves and other wearing parts.

GENERAL

Quicksilver in 1921

According to reports prepared by the U.S. Geological Survey the output of quicksilver in the United States in 1921 was 6339 flasks (of 75 lb. each), valued at $300,595, compared with 13,392 flasks in 1920 and 21,415 flasks in 1919. The output in 1921 is the smallest on record, and the United States, the leading producer of mercury in 1917 and 1918, now stands a poor third. Apparently only two mines in the United States had ore of sufficiently high grade and were favourably enough situated to be able to operate at full capacity during 1921. The small domestic output in 1921 was not due to large imports as the total import was only 10,601 flasks, much less than in 1920, and about the same quantity as in 1919. Similarly, domestic consumption has fallen from 36,564 flasks in 1918 to 16,547 flasks in the year under review. Figures are given below showing the world's production of quicksilver from 1918 to 1921 in flasks (of 75 lb.) :—

	1918	1919	1920	1921
United States ..	32,883	21,415	13,392	4,754
Spain	16,677	36,055	25,330	13,244
Italy	30,512	24,839	41,182	24,244
Austria	12,346	—	—	—
Hungary	2,352	—	—	—
Czechoslovakia ..	—	2,352	2,352	2,204
Mexico	4,809	3,496	2,269	2,204
Other countries ..	1,000	1,000	1,500	—
	100,579	89,157	86,025	46,650

The monograph on mercury ores by E. Halse, published by the Mineral Resources Committee of the Imperial Institute (pp. 101, price 5s.), gives a general account of the occurrences, characters and uses of these ores. Amongst the uses, it is stated that, according to a recent British patent, the addition of small quantities of mercury increases the hardness of certain lead alloys, and in a recent German patent mercury is substituted for tin in making stereo- and type-metal alloys. The figures of production in 1921 given in the above table are quoted from this monograph. Of the sources of supply of mercury ores, the only areas in the British Empire where there is apparently any prospect of commercial extraction are British Borneo, Canada (British Columbia and Ontario), Australia (New South Wales, Queensland), Papua, and especially in the Puhipuhi district of New Zealand, where roughly 1,000,000 tons of ore, without overburden, is believed to exist. The deposits in Europe are too well-known to require mention, and it is stated that there are promising deposits in Algeria, Mexico, Chile and Peru. The world's production of mercury at present is reported to be about two-thirds of the normal pre-war amount and consumption is even lower owing to the general commercial depression and the small demand from Germany, formerly a large consumer. A useful feature of the report is a discussion on the metallurgy of mercury, in which it is stated that the average total cost of producing a flask of mercury in Europe is about 175s. at the present time. The monograph concludes with a useful bibliography.

Journal of Scientific Instruments

The preliminary arrangements for the regular publication of the *Journal of Scientific Instruments* have now been made by the Institute of Physics in co-operation with the National Physical Laboratory. The special attention of those workers who have new designs for instruments is called to the fact that the Journal is to serve as a medium for the publication of detailed descriptions and critical surveys of the behaviour of such instruments. Original papers or laboratory and workshop notes on the practical or theoretical aspects of scientific instruments should be sent to the Editor, Dr. J. S. Anderson, National Physical Laboratory, Teddington, Middlesex.

Bulgarian Salt Production

H.M. Commercial Secretary, Sofia, states that the production of salt in Bulgaria during 1922 amounted to 20,000 ton, 15,000 t. being derived from the Atanas Kiew district, near Bourgas, which is again being exploited. The amount produced last year was sufficient for home requirements, and the price was low.—(Official.)

Cement Production in the Far East

Cement manufactured in several districts in China is exported, but at present the imports, principally from Japan, are much larger than the exports, although China has an enormous wealth of cement-making materials, the three elements—clay, limestone and coal—being found together in many districts. The bulk of the Chinese exports of cement goes to the Philippines and smaller amounts to the Dutch East Indies and to Hong Kong. Shipments from a factory in Manchuria go to Korea and Siberia and are growing in importance. In Japan the production has increased from 1,800,000 barrels in 1908 to 6,500,000 barrels valued at over 6½ million yen (2s. 0½d.) in 1919. Cement is also produced in French Indo-China and in the Philippines.—(*Cham. Comm. J., June* 1, 1923.)

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for June* 14)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1), from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Galvanised tubular poles, steel girders (tender)	11450/E.D./E.C./2
,,	Plant for making pharmaceutical preparations	11446/E.D./CC.2
Belgium ..	Chemicals, pharmaceutical products	758
British India	Electrical plant, wires and cables	747
,,	Cresol (tender) ..	*
Canada ..	Marine paint	748
Denmark ..	Chemicals, colours, iron and steel	760
Dominican Republic	Roofing iron	782
Egypt ..	Building materials ..	772
Netherlands. .	Glass, earthenware ..	763
,, ..	Technical and surgical rubber goods	764
New Zealand	Tanning materials, paint and varnish	752
Nicaragua ..	Leather, paper ..	8157/F.L./M.C./2
Norway ..	Sugar	765
Panama ..	Leather	783
Portugal ..	Tinplate, zinc sheets..	766
South Africa	Paint and varnish ..	756
,,	Stoneware pipes (tender)	11466/E.D./M.C./2
United States	Asbestos lumber ..	775
,,	Shellac, varnish gums	776

* The Director-General, India Store Department, Branch No. 10, Belvedere Road, S.E. 1.

TARIFF CUSTOMS EXCISE

Belgium.—Increased duties have been levied on the following articles (for which certificates of origin are required) :—Iron and steel, copper, paper, hides and skins, tin, lead and glassware.

Canada.—The rates of duty on iron and steel, dry red lead, orange mineral and zinc white, crude petroleum and artificial silk, have been revised.

Greece.—The duties on superphosphates, patent medicines, glassware, copper tubes, zinc, and inner tubes, have been modified. The importation of copper sulphate and of sulphur has been prohibited.

Honduras.—Cement, iron and steel girders, galvanised iron, and zinc plates are admitted duty free.

New Zealand.—Rubber goods will no longer be subject to depreciated currency surtax.

Poland.—The importation of sugar has been permitted.

Spain.—A Royal Order has been issued regulating the importation of solid rubber tyres, covers and tubes.

Syria.—Permission has been granted for the export and re-export of lead, slates and other building materials.

Syria and Lebanon.—The following goods are subject to sanitary inspection :—Olive and white oils, edible fats, sugar, saffron, vanilla, paper, coal tar, paint, soap, mineral oils, rubber, petroleum, chloride of lime, leather, natural fertilisers and a variety of heavy and fine chemicals.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

British Dyestuffs Corporation (Wages)

Sir W. Joynson-Hicks, replying to Mr. W. M. Adamson, said that the reduction made by the British Dyestuffs Corporation of a further ½d. per hour in wages in two cuts upon their employees, applied generally to the trade. He saw no reason for instituting an inquiry regarding its application to a single undertaking.—(June 18.)

Opium Traffic

Mr. Bridgeman informed Sir W. de Frece that at the meeting of the Advisory Committee on the Opium Traffic at Geneva it was decided to recommend the adoption by the interested Powers of measures for the more effective application of Part 2 of the International Convention of 1912 relating, *inter alia,* to the limitation of the manufacture of morphine, heroin and cocaine, and the production of the raw material from which these drugs were made.—(June 12.)

Manufacture of Dangerous Drugs

Replying to Captain Hay, Mr. Bridgeman said that at present two factories were licensed for the manufacture of morphine and heroin. In 1922 the amount of morphine made was 315,342 oz., of which 173,010 oz. was converted into codeine or heroin. The export was 115,465 oz. In the same year 31,673 oz. of heroin was manufactured and 25,911 oz. exported.—(June 13.)

The Albert Medal of the Royal Society of Arts has been awarded in duplicate to Major General Sir David Bruce, K.B.E., F.R.S., and Colonel Sir Ronald Ross, K.C.B., F.R.S., in recognition of their eminent services in the study of tropical diseases.

COMPANY NEWS

BRUNNER, MOND & CO., LTD.

Presiding over the ordinary general meeting, held in Liverpool on May 25, Mr. Roscoe Brunner said that the past year was better than the previous one. It was proposed to divide 75 per cent. of the trading profits, carrying the remainder to reserve, which now totalled nearly £3,300,000. The wages of shiftmen were 121 per cent. and of day-men, other than mechanics, 104 per cent. over the pre-war level. Work on the ammonia-soda factory at Wallerscote was proceeding as fast as possible, and progress was being made with the Billingham works of Synthetic Ammonia and Nitrates, Ltd.

The balance at credit of profit and loss was £1,650,295, which with £9293 brought forward, made a total of £1,740,588. Preference dividends of 7½ per cent. and ordinary dividends of 11 per cent. have been paid, absorbing £300,000 and £1,061,461 respectively; £62,215 was carried to reserve, making a total of £900,000, and £225,000 to suspense account, leaving £91,000 to be carried forward. It was resolved to issue up to 100,000 ordinary shares to the staff and work people.

THE BRITISH COTTON AND WOOL-DYERS' ASSOCIATION

The annual meeting was held in Manchester on May 16. In his address the chairman, Dr. A. Hoegger, said that as long as costs of labour and coal were double, and chemicals and dyes ten times the pre-war amount, dyers and bleachers could do little to reduce prices. The pledge that the textile and other colour-using industries should not be placed in an unduly disadvantageous competitive position by the Dyestuffs Import Regulation Act had not been kept, and British colour-users had to pay far higher prices for dyestuffs than those charged to competitors abroad. The Licensing Committee had agreed to grant import licences when British dyestuffs cost more than three times the pre-war value, allowing for strength and quality, but this had not been carried out, and often unsatisfactory reasons for refusal were given. It was essential that the dyestuffs industry should be firmly established in this country, but it was not fair that it should be built up at the expense of colour-users. The Association agreed with the suggestion that a direct Government subsidy should be given to British dye-makers, and colour-users would probably be willing to contribute towards the amount required.

The net profit of the past year, including a carry-forward of £5250, was £199,476. Dividends were paid of 10 per cent. on the ordinary shares plus a bonus of 5 per cent.; £50,000 was transferred to reserve fund, which now totals £225,000, and £42,382 was carried forward.

REVIEWS

LEHRBUCH DER CHEMIE. *By* PROF. MAX TRAUTZ. *Vol. II. Pp. xxxiv*+634. *Berlin and Leipzig: Vereinigung Wissenschaftlicher Verleger*, 1922. *Price* 25*s*.

This volume is devoted almost exclusively to the physical side of chemistry. The first part deals with the gas laws, and contains a brief description of a few examples of analytical chemistry in which the estimations depend upon the volume measurement of various gases. The thermodynamics of isothermal and adiabatic changes is then dealt with, and this is followed by an account of the behaviour of gases when strongly compressed, together with a critical discussion of Van der Waal's equation. The fundamental principles of the liquefaction of gases are described. The molecular structure of crystals and their optical properties are explained, and an excellent coloured plate showing the polarisation colours is given. Chapter II. deals with the properties of solutions non-electrolytic, electrolytic and colloidal; the effect on the surface energy; the optical and electrical properties of colloidal particles, together with a brief account of the methods of producing various colloidal solutions. The last portion of Part I. is devoted to a consideration of the kinetic theory of matter in the gaseous, liquid and solid states, a brief description of Laue's photograms and X-ray spectra being given in connexion with the theory of crystal structure. The physical properties (thermal and optical) of mixtures are considered.

The second part of the book is devoted to the dynamics of chemical actions. The second law of thermodynamics is discussed, and its application, as well as that of Le Chatelier's theorem and Clausius' equation to certain physico-chemical problems is explained. The equilibria diagrams of some single-component systems and diagrams showing the relationship between the water-content of gels and their vapour pressures are given, as is also an account of the thermodynamics of binary mixtures in relation to fractional distillation, lowering of vapour pressure, etc., of dilute solutions. The law of mass action as applied to many gaseous reactions of considerable technical importance is explained, and its application to solutions of electrolytes given. The Gibbs-Helmholtz equation and the Helmholtz-Thomson rule regarding the connexion between electrical and chemical energy are dealt with. The temperature co-efficient of the equilibrium constant is considered in the part dealing with Van't Hoff's equation to the reaction isochor. Gibbs' phase rule is applied to heterogeneous systems in equilibrium. Single potential differences, the E.M.F. of cells, and the electrochemistry of oxidation and reduction processes are discussed. An explanation of the numerous cases that can arise in the diagrams showing the equilibria between the various phases in a two-component system is given and three-component systems are briefly dealt with. The application of the foregoing to the formation of a number of minerals and alloys is an important part of this chapter which also contains a table showing which metals form the more important alloys and a fairly comprehensive survey of the mineral silicates. The last part of the book is devoted to a consideration of Nernst's heat theorem and the laws of radiation. The absorption spectra of the rare earths are described, and the position of these substances in the periodic classification of the elements is discussed. The natural radiation frequency, Planck's quantum theory and their application by Einstein, Nernst and others, to the calculation of the specific heats of crystalline solids, and the dissociation of some diatomic gases, etc., are dealt with.

The work as a whole is most comprehensive and covers a very wide field as may be judged from the fact that the table of contents at the beginning of the book occupies twenty-eight closely printed pages, and the index at the end consists of twenty-eight pages of three columns each. These, together with the marginal notes, make the book exceptionally well-indexed. There are, however, two or three peculiarities from which the work suffers. Many of the diagrams are far too small. Only in a comparatively few cases are actual examples quoted in order to illustrate a law or theorem that has been discussed. With the exception of two or three papers quoted in connexion with Nernst's heat theorem, no original references are given. In so large a work as this, more especially as it is intended for private study and the use of teachers, one would naturally expect references to original papers of fundamental importance to be quoted. After each subject has been discussed a summary of the results, definitions and laws is given: this, although quite useful, seems to be overdone. In parts the work is of necessity mathematical, and, obviously with the object of enabling the reader to follow the treatment given, a few pages are interspersed here and there which are devoted to a description of the mathematical formulæ used and an explanation of the operations involved. This seems unnecessary, as alone they can scarcely be regarded as proofs, and are insufficient to enable a reader with no knowledge of higher mathematics to grasp the meaning of the problems dealt with, whereas one possessing such knowledge as to be able to understand all the operations involved will have no difficulty in finding anything that may be required in a text-book of mathematics. In this volume advanced students and teachers of chemistry will find much of interest and value in the more theoretical treatment of the fundamental laws underlying chemical action.

A. Bramley

Laboratory Manual of Physical Chemistry. *By* Albert W. Davison *and* Henry S. van Klooster. *Pp. viii. + 182. New York: John Wiley and Sons; London: Chapman and Hall,* 1922. *Price* 10*s.*

This book consists of a collection of twenty-four exercises designed for the use of large classes of students who are simultaneously being given a course of theoretical instruction, and is especially addressed to students of engineering. Detailed instructions are given for the recording of results; the book is interleaved with blank pages and contains also some excellent graph paper. In these respects it differs from the more usual type of text-book on this subject, as also in the fact that the outlines of theory required for intelligent working and the interpretation of results are intended to be obtained from lists of references to specified chapters of selected text-books. In the reviewer's opinion it would have been better to follow the usual practice and make the book self-contained in this respect, especially as the relatively small amount of additional matter could easily have been printed in some of the very liberal space alloted to these lists. Whilst the selection of exercises is on the whole a wise one, there are others which seem to have a strong claim for inclusion. Amongst the omissions are:—the measurement of viscosity, the solubilities of gases and of solids in liquids, and spectroscopy. Much space is rightly devoted to the distillation of binary mixtures, and here the bibliography would have been strengthened by reference to Young's *Stoichiometry* and *Distillation Principles and Processes.* Among the newer features of the book are descriptions of a form of breaking release in the Victor Meyer vapour-density apparatus, the compact Eykman apparatus for determining molecular weight by elevation of boiling point, the phase diagram of the system Cd. Bi, and the choice of a bimolecular reaction.

In determining distribution ratio it is desirable to use some kind of rough thermostat; also it is neither necessary nor advisable to raise to the boil solutions containing benzoic acid, except perhaps at the end of a titration.

In the electro-chemical part there are no exercises on Faraday's laws except incidentally in the exercise on transport number. The hydrogen electrode is only used for electrometric titrations, and there are important omissions in the usually very detailed instructions, since no reference is made to the necessity for allowing the potentiometer current to become teady and for saturating the hydrogen electrode.

The suitability of the book for classes of university and technical college students in this country will probably be decided on some of the grounds mentioned above.

The book is well bound and printed; it has large and clear diagrams and will no doubt be a useful addition to the modes of presentation of this subject.

E. B. R. Prideaux

DIE INDUSTRIELLE HEIZUNG: ZUR EINFÜHRUNG IN DAS STUDIUM DER METALLURGIE. *By* H. LE CHATELIER. *Authorised German translation of the second French edition by Dr. B. Finkelstein. Pp. viii+418. Leipzig: Akademische Verlagsgesellschaft m.b.H.,*1922. *Price* 13*s.*

In this work we find industrial heating considered as an integral portion of the study of metallurgy. The subject matter is wide in scope and originally formed the course of lectures in the Ecole des Mines. Owing to limitation of space, as well as to its origin, the volume cannot be said to deal with the subject as comprehensively as might be desired. Indeed, in the reviewer's opinion, the treatise appears mainly to fulfil the function of an excellent text-book, the purpose of which is to lay the foundation of a general scientific knowledge of the subject of fuel. An investigator, however, interested in any particular aspect of the industrial heating problem, is hardly likely to gain from its perusal anything further than the fundamentals governing the application of the knowledge of which he is in search.

An intensely interesting introductory chapter deals with the relations and points of difference between science and technology, which should be of great value in the formation of that wider outlook so necessary to the student who proposes to put to practical use the knowledge acquired in the university or technical college.

The first chapter takes for its subject the general question of fuels and the chemistry and physics of combustion, whilst subsequent chapters consider in the logical manner associated with the author's name such matters as economy in heating, natural fuels, carbonisation, acetylene and water gas, illuminating gas, refractory materials and ovens, furnaces and kilns.

Carbonisation is dealt with from the standpoint of the existing industries, such as the manufacture of wood, charcoal and gas, and the production of metallurgical coke. Some stress is laid upon the desirability of regeneration, but here again limitation of space has apparently forced the author to confine himself to generalities. Certain important subjects at present engaging the attention of the carbonisation industries are conspicuous by their absence, these including the wide range of research work at present being undertaken in this country by the gas undertakings as a result of the freedom of working granted to them by the Gas Regulation Act of 1920. Nor is mention made of the possibilities of low-temperature carbonisation of coal in spite of the fact that data to a considerable extent are available, and inquiries in this direction are being prosecuted in French mining circles.

The difficult question as to whether the distillation of coal is or is not an exothermic process is treated in a paragraph of some two hundred words, the author having quoted briefly from the work of Mahler. Although at first sight the subject may appear relatively unimportant, dealing as it does with quantities of heat in the neighbourhood of 1 or 2 per cent. of the initial heat content of the coal, it assumes greater importance in connexion with those methods of carbonisation depending upon internal heating by the sensible heat of gases. The quality and quantity of the final mixture of distillation and heating gases depend upon the quantity of heating gas used; and it is quite conceivable that a process which might be of commercial value when the distillation acts upon the whole in an exothermal direction, would produce an unmarketable gas should thermal conditions operate in the opposite direction. In spite of the scant attention which has been given to this aspect of the subject, the author is to be congratulated on having avoided quotation of the doubtful conclusions which have been put forward from time to time in various quarters.

In a few paragraphs M. le Chatelier deals with peat as a raw material either for domestic use or in connexion with carbonisation, but dismisses in a word or two the large amount of experimental work which has been done in this field during the past few years in Canada, Germany and Scandinavia. No reference is made to the marked effect upon both the drying and the hardness of the resultant fuel by a simple process of maceration before spreading and air drying. During the course of some experimental work in Ireland three crops were obtained by means of this process during an exceptionally wet season, as compared with the one crop of air-dried peat usually obtained by hand-cutting. The method indicated also results in the production of a very dense fuel of specific gravity in the neighbourhood of unity. Such blocks can be sawn and can easily withstand the disintegrating effects of transport.

The volume under consideration appears to offer a fairly close translation of the original work, but the general production and paper are decidedly poor. It is recognised, however, that M. le Chatelier's work should be of considerable value for teaching purposes in Germany, since the author has from first to last realised the necessity of treating the subject in a thoroughly scientific manner, presenting the fundamental facts. Its study should render the student capable of drawing accurate conclusions when dealing with the practical applications encountered in the metallurgical industries, but there are already books in English catering for his needs in this direction.

C. H. L.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Although business is still very much on the quiet side when looked at from the standpoint of tonnage, there is a decidedly better tone prevailing in the chemical market. The Continental position again renders buyers somewhat nervous, but prices are steady, and forward purchasing almost entirely absent. Undoubtedly the strongest feature is the continued steady business in alkali and caustic soda, which show distinct firmness.

Acetic Acid, 40% tech.	£24 per ton. Still firm, but rather less inquiry.
Acid Hydrochloric	3s. 9d.-5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw.	£24 10s. per ton. Quiet.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Demand steady, export inquiry good.
Arsenic (White)	£71-£74 per ton. No increase in business.
Bleaching Powder	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Business much below normal.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand.
Copper Sulphate	£27 per ton.
Potash Caustic	£33-£34 per ton. Little moving.
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Potass. Chlorate	3d. per lb. Very dull.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76%	£20-£21 per ton. Steady demand.
Soda Crystals	£5 5s.-£5 10s. per ton ex railway depots or ports.
Sod. Acetate 97/98%	£26 per ton. Very scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. More business lately.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	2¾d.-3¼d. per lb. Very dull.
Sod. Nitrate refd. 96%	£13 5s.-£13 10s. per ton ex Liverpool.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	£15-£16 per ton carr. paid. Very quiet. Prices unstable.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. por lb.
Carbon Bisulphide	£26-£28 per ton according to quantity.
Carbon Black	1s. 5½d. per lb. ex wharf. Still very scarce.
Chromium Oxide	1s. 5d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb. Firmer on advance in price of Rape Seed Oil.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£11 10s. per ton.
Thiocarbanilide	2s. 6d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood distillation products.

Acetate of Lime—	
Brown	£10 15s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£9 10s.-£10 10s. per ton.
Iron Liquor	1s. 6d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. ,, ,, 60% O.P.
Solvent	5s. ,, ,, 40% O.P.
Wood Tar	£6 per ton d/d.
Brown Sugar of Lead	£45 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 4½d.-1s. 5d. per lb. A better demand at these prices.
Crude 60's	3s. 4d.-3s. 6d. per gall. Not much business.
Acid Cresylic—97/99	2s. 0d.-2s. 6d. per gall. Demand fairly good.
Pale 95%	1s. 10d.-2s. 5d. per gall.
Dark	1s. 10d.-2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	8¾d.-11d. per gall. Not much demand.
Unstrained	8¼d.-9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1¼d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.

Benzole (*cont.*)—	
Pure	2s.-2s. 2d. per gall. No business.
Toluole—90%	1s. 9d.-2s. per gall. Quiet.
Pure	2s.-2s. 6d. per gall. Not much inquiry.
Xylol	3s.-4s. per gall. according to quality. Good demand.
Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil Heavy Standard Specification	8d.-9¾d. per gall. Market steady. Good demand.
Naphtha—	
Crude	8½d.-10½d. per gall.
Solvent 90/190	1s. 7d. per gall. Market quiet.
Solvent 90/190	1s. 5d.-1s. 7½d. per gall. Market moderately active.
Naphthalene Crude—	
Drained Creosote Salts	£6-£8 per ton. Fair demand. Supply short.
Whizzed or hot pressed	£11-£14 per ton. Plenty of inquiries.
Naphthalene—	
Crystals	£18 per ton.
Flaked	£16 10s. per ton.
Pitch, medium soft	No business for this season. Prices for Autumn delivery 125s.-127s. 6d. per ton, f.a.s. Manchester.
Pyridine—90/140	16s.-18s. per gall. Dearer. Demand still good.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Since the beginning of June there has been a decided improvement in business in aniline dyestuffs. There is considerably more inquiry about and orders have improved both in number and weight. There is every likelihood of still further improvement in the near future.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 8d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 6d. per lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 9d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market has been quiet, and prices weaker in consequence of lack of business.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s.-3s. 3d. per lb. The tendency is to ease somewhat, but the strong demand prevents any marked lowering of prices.
Acid, Benzoic	2s.-2s. 9d. per lb. Still very scarce.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8¾d. per lb., less 5%.
Acid, Gallic	3s. per lb. Steady demand.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d. per lb. for quantity.
Acid, Tannic	3s. 6d. per lb. Firmer tendency.
Acid, Tartaric	1s. 4d. per lb. Demand still below normal owing to bad season.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d. per lb. Slow of sale.
Amidopyrin	14s. per lb. Still neglected.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. per oz.
Barbitone	22s. per lb. In very short supply.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Owing to the fluctuation in marks, Hamburg dealers are offering all bromides on this market at very low rates, but British makers maintain their prices without difficulty.
Calcium Lactate	2s. 9d. per lb. for best makes.
Chloral Hydrate	4s. per lb., duty paid.
Chloroform	2s. 2d. per lb. for cwt. lots.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	£90-£92 per ton. Very firm.

Guiacol Carbonate	8s. 6d. per lb.
Hexamine	4s. per lb. down to 3s. 10d. for ½ ton lots. Tendency rather weaker.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Market good with considerable inquiry.
Magnesium Carbonate—	
Light Commercial	£37-£38 per ton net, according to quantity.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	1s. 9d.-2s. per lb. Good demand.
Menthol	40s. per lb. spot.
Methyl Salicylate	2s. 6d. per lb. for carboys. Somewhat weaker in common with other salicylates.
Methyl Sulphonal	15s. per lb.
Paraformaldehyde	3s. 6d. per lb. Weak.
Paraldehyde	1s. 6d. per lb. accepted for large orders. In better supply.
Phenacetin	6s. 6d. per lb. spot value. Very steady.
Phenazone	7s. 6d. per lb. Very firm.
Phenolphthalein	7s. per lb. now wanted by most holders. Considerable advance in view of shortage.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	96s.-98s. per cwt., less 2½%.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. In very strong demand, with no offers from Japan, where there seems to be a great shortage.
Potass. Permanganate	10d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	6s. per lb. still quoted without inquiry.
Salol	2s. 9d. per lb.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 9d. per lb. now wanted by holders. Still in short supply, fresh stocks being quickly absorbed.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality.
Sod. Hyposulphite—	
Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	80s.-82s. per cwt. net.
Sod. Salicylate	Demand not so good. Powder is slightly weaker at 2s. 7d. per lb., with crystal at 2s. 9d. per lb.
Sod. Sulphite, anhydrous	£27 10s.-£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.
Thymol	16s. per lb. would now buy finest white crystals. Demand very slow.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Butyrate	7s. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	2s. 9d. per lb.
Benzyl Benzoate	3s. 3d. ,, ,,
Cinnamic Aldehyde	17s. 6d. ,, ,,
Coumarin	18s. 6d. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	18s. 6d. ,, ,,
Ethyl Phthalate	4s. 3d. ,, ,,
Eugenol	11s. 6d. ,, ,,
Geraniol (Palmarosa)	30s. ,, ,,
Geraniol	5s. 6d.-12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	16s. 6d. per lb.
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	21s. ,, ,,
Methyl Anthranilate	7s. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Xylol	11s. ,, ,, Dearer.
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	23s. 6d. per lb.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	2s. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	29s. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4¼d. per oz.
Cassia Oil 80/85%	12s. 6d. per lb. Sharp advance.
Citronella Oil—	
Java 85/90%	4s. 2d. ,, ,,
Ceylon	3s. 8d. ,, ,, Dearer.
Clove Oil	8s. per lb.
Eucalyptus Oil 70/75%	1s. 10d. per lb. Dearer.
Lavender Oil, Mont Blanc 38/40%	13s. ,, ,,
Lemon Oil	3s. 1d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	13s. 7d. per lb. Advanced.
Otto of Rose Oil—	
Anatolian	24s. per oz.
Bulgarian	30s. per oz.
Palma Rosa Oil	19s. per lb.
Peppermint Oil—	
English	80s. ,, ,,
Wayne County	13s. ,, ,,
Japanese	6s. 7½d. ,, ,, Advanced.

TRADE NOTES

Germany's Export Trade in Chemicals

Estimates prepared by the "Verein zur Wahrung der Interessen der Chemischen Industrie Deutschlands" state that the exports of German chemicals (excluding deliveries on reparations account) in 1922 were 890,000 metric tons valued at 290,000,000 gold marks, compared with 690,000 t. (330,000,000 gold marks) in 1921, and 2,529,000 t. (912,000,000 gold marks) in 1913. The chemical industry imports about 1·8 per cent. of the total German imports, whereas the textile industry imports about 12·8 per cent., so that the chemical industry, with most of its raw material produced at home, has, perhaps, prior claim to importance as an asset in Germany's foreign trade, of which it represented 7·8 per cent. in 1922.

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications for licences under the above Act during May, 1923, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 497, of which 409 were from merchants and dealers. To these should be added the 17 cases outstanding on May 1, making a total for the month of 514. These were dealt with as follows:—

Granted, 304 (of which 293 were dealt with within seven days of receipt).

Referred to British makers of similar products, 136 (of which 130 were dealt with within seven days of receipt).

Referred to Reparation Supplies available, 53 (all dealt with within two days of receipt).

Outstanding on May 31, 21.

Of the total number, 514, of applications received, 458, or 89 per cent., were dealt with within four days of receipt.

PUBLICATIONS RECEIVED

Chemistry Inorganic and Organic, with Experiments. *By* C. L. Bloxam. *Eleventh edition, revised by* A. G. Bloxam *and* S. Judd Lewis, D.Sc. *Pp. ix+832. London: J. and A. Churchill*, 1923. *Price* 36*s*.

Alcoholic Fermentation. *By* A. Harden, Ph.D., D.Sc., F.R.S. *Third Edition. Pp.* 194. *London: Longmans, Green and Co.*, 1923. *Price* 6*s*. 6*d*.

Analytical Microscopy, its Aims and Methods. *By* T. E. Wallis, B.Sc., F.I.C. *Pp. viii*+149. *London: E. Arnold and Co*, 1923. *Price* 6*s*.

Industrial Hygiene and Medicine. *By* E. W. Hope, O.B.E., M.D., D.Sc., *in collaboration with* W. Hanna, M.A., M.D., *and* C. O. Stallybrass, M.D. *Pp. viii*+766. *London: Baillière, Tindall and Cox*, 1923. *Price* 25*s*.

Comparisons of Some Methods of Running Water-Gas Plant. *By* J. G. King, B.Sc., *and* J. Fraser-Shaw, R.N. *Department of Scientific and Industrial Research. Fuel Research Board. Technical Paper No.* 6. *Pp. iv*+25. *London: H.M. Stationery Office*, 1923. *Price* 2*s*.

Memoirs of the Geological Survey. *Special Reports on the Mineral Resources of Great Britain. Vol. I.* Tungsten and Manganese Ores. *Third edition. By* H. Dewey *and* H. G. Dines, A.R.S.M., *with contributions by* C. N. Bromehead, T. Eastwood, G. V. Wilson *and* R. W. Pocock. *Pp. iv*+83. *London: H.M. Stationery Office*, 1923. *Price* 2*s*.

Kelly's Directory of Merchants, Manufacturers and Shippers of the World. *Vol. I. Pp. cccvii*+2382. *Vol. II. Pp. cxvi*+1868. *London: Kelly's Directories, Ltd.*, 1923. *Price* 64*s*.

Qualitative Organic Analysis. *An Elementary Course in the Identification of Organic Compounds. By* Oliver Kamm. *Pp. vii*+260. *London: Chapman and Hall, Ltd.*, 1923. *Price* 12*s*. 6*d*.

Monographien aus dem Gebiete der Fett-Chemie. *By* Prof. K. H. Bauer. *Part II.* Leim und Gelatine. *By* Dr. R. Kissling-Bremen. *Pp.* 214. *Stuttgart: Wissenschaftliche Verlagsgesellschaft m.b.H.*, 1923.

Die Fabrikation des *Zellstoffes* aus Holz. Sulfitzellstoff. *By* R. Dieckmann. *Vol. II. Pp. viii*+360. *Berlin: Otto Elsner*, 1923. *Price* 20*s*.

Practical Bacteriology for Chemical Students. *By* David Ellis, Ph.D., D.Sc., F.R.S.E. *Pp. viii*+136. *London: Longmans, Green and Co.*, 1923. *Price* 4*s*. 6*d*.

Publications of the Imperial Mineral Resources Bureau. The Mineral Industry of the British Empire and Foreign Countries. *H.M. Stationery Office*, 1923:—

Copper, Statistics 1919—1921. *Pp. iv*+70. *Price* 3*s*.

Iron and Steel, Statistics 1919—1921. *Pp. iv*+43. *Price* 1*s*. 6*d*.

Graphite (1913—1919). *Pp.* 57. *Price* 1*s*. 6*d*.

Bulletin of the Cleveland Scientific and Technical Institution. A Monthly Periodical containing Abstracts of the Most Important Scientific Articles published during the month. *Compiled and edited by* E. L. Johnson, F.G.S. *Vol* 2, *No.* 7. *Pp.* 387—445. *Middlesbrough:* 1923.

Publications of the United States Bureau of Mines. *Department of the Interior. Washington: Government Printing Office:*—

Talc and Soapstone, their Mining, Milling, Products and Uses. *By* R. B. Ladoo. *Bulletin* 213. *Price* 25 *cents*.

Publications of the United States Geological Survey. *Department of the Interior. Washington: Government Printing Office*, 1923:—

Natural Gas in 1919—1921. *By* R. S. McBride *and* E. G. Sievers. *No.* II: 32. *Pp.* 335—369.

Summary of Mineral Production in Foreign Countries, 1919 and 1920. *By* L. M. Jones. *No.* I: 29. *Pp.* 513—564.

Cadmium in 1922. *By* C. E. Siebenthal *and* A. Stoll. *No.* I: 1. *Pp.* 1—5.

Iron Ore, Pig Iron and Steel in 1921. *By* E. F. Burchard *and* H. W. Davis. *Part I. Pp.* 565—597.

JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

Official Organ of the Federal Council for Pure and Applied Chemistry

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EDITORIAL

THE *Morning Post*, two or three days ago, published a further instalment of the Farington Diary for the year 1810, from which we make the following extract.

"March 7th.—Smirke's I dined at.—Lysons spoke of the death of the Honble. Henry Cavendish, F.R.S. He was the largest Stockholder in England. He had in different stock to the amount of a million Sterling. He had also a large landed estate. He left of His stock two 6ths. to His Cousin Lord George Cavendish; & to each of three of His Sons, one sixth each, & the remaining Sixth to His Cousin Lord Besborough.—He also left £15000 to Sir Charles Blagden; He was son to Lord Charles Cavendish, Great Great Uncle to the present [the fifth] Duke of Devonshire. He had been a constant attendant at the Royal Society Club for 50 years past, at the Crown & Anchor tavern, a dinner meeting every Thursday throughout the year. He resided principally at Clapham. He was a man of mild manners, but it was remarked of Him that He was in His political sentiments always in opposition to whoever might be in power. His Philosophical discoveries had long made Him a distinguished man. He was born Octr. 30th, 1731, & died Feby. 24th, 1810."

In a leading article of the same issue the *Morning Post* takes as its text, Farington's phrase, "He was a man of mild manners, but it was remarked of him that he was, in his political sentiments, always in opposition to whoever might be in power." In a light vein of philosophy our contemporary makes a number of reflections on people who rebel against authority, not all of whom are distinguished by the mildness of their manners. To chemists the extract is of some interest, for the date of Cavendish's death has been hitherto somewhat disputed.

* * *

We sometimes wonder whether the Society takes due advantage of its opportunities for publicity. Take for instance, the Presidential address: this is usually delivered in the middle of the morning after a Council meeting and a business meeting when important matters have been discussed. No matter how good the address may be, how many points are made in it, what questions of policy are involved, time does not permit any adequate discussion of it. This year the address is one which requires a good deal of careful study, and if such topics as the education of chemists, their status and function in society, the co-operation of chemical societies, the Federal Council Fund and journalistic experiments, cannot be discussed immediately after the delivery of the address, it might nevertheless be very useful to have them discussed at some other time during the meeting. The members of Council have a few opportunities of discussing these matters, but the great majority of the members have practically no such opportunities. A rather informal debate on some such matters might elicit interesting points of view, and disclose powers of oratory which hitherto have blushed unseen. The daily newspapers can hardly be expected to publish leading articles on tautomerism or colloid chemistry, but they could very conveniently deal with some of the larger questions such as have been indicated, and in this way their readers might gradually realise that many chemists exist besides those who sell tooth-brushes and weed-killer. It occurs to us that at some Annual Meeting a special effort might be made to stir up activity in such directions. The President has indeed indicated some directions in which this may be done, and his remarks show that he has some fairly definite views on a number of these which in due time he will disclose. It is a pity that when our interest and enthusiasm are aroused we cannot speedily measure the extent to which they will evoke active help from so large and influential a body as the members of the Society assembled in General Meeting. Probably late in the autumn there will be the usual dinner of the Society in

London; can this occasion be made use of for some real discussion, not a few after-dinner speeches by carefully selected raconteurs, but an open talk for two or three hours, where everyone can criticise, make suggestions, offer to help and light such a fire as no man shall ever put out? Then afterwards let us refresh our bodies with meat and drink, and unbend our minds with the aid of flippant jests and carefully thought out repartee. This year will be an important one in the development of ideas, and we hope at Liverpool it will be found possible to spare a large measure of time for their consideration.

* * *

We awaited with great interest the announcement of the results of the Ballot for Members of Council, but we were extremely disappointed to learn that only about eight per cent. of the total membership of the Society had sent in voting papers. For some time past the President has not spared himself in urging chemists to work for the unity of their profession, and, considering the new spirit that prevails in chemical circles, we were surprised that so few members had fulfilled one of their corporate obligations. This apathy is, unfortunately, characteristic of the age; in parliamentary and municipal elections the proportion of the electorate that goes to the polls is far too small, and in certain foreign countries it has been found necessary to pass legislation compelling citizens to use their votes. The results of this neglect are too obvious to need comment, and it is our concern only to record the fact. It has been suggested that as our membership is so widely scattered, members may not be sufficiently "in touch" to feel justified in discriminating between the names set down on the ballot paper. But it can be urged that votes are often given for parliamentary or municipal candidates of whom little is known save their political "label," and, in any case, it is always possible to obtain unbiased information. The question is too important to be neglected, and we invite members to send us their views, so that discussion may suggest a remedy.

* * *

The Society of Chemical Industry has made a new departure in electing honorary members. Five men of distinction in chemistry have been elected as such—Dr. C. F. Chandler, an American who was President of the Society in 1899-1900; Monsieur Paul Kestner, the President of the Société de Chimie Industrielle; Prince Ginori Conti, President of the Italian Chemical Society, who has harnessed for power purposes the steam issuing from the earth in some volcanic districts of Tuscany; Prof. H. Sakurai, one of the best known of Japanese chemists; and Sir Dorabji Tata, a founder of great chemical and engineering works in India, and one who has generously endowed science in that country.

BYGONE CHEMICAL TECHNOLOGY

By Prof. J. R. PARTINGTON, M.B.E., D.Sc.

In a recent book* Prof. Fester has attempted an account of the development of chemical technology from the earliest times to the beginning of the nineteenth century. His sources have been mainly existing treatises on the history of chemistry and the introductions to technical works, although he has apparently made use of some original treatises, the number of which was especially large about the period of the amazingly productive sixteenth century. In the following sketch many statements are not found in the book in question, the author of which must not be held responsible for them. The illustrations have all been added by the reviewer.

One of the oldest branches of chemical technology is the art of working in metals. Gold objects of the Neolithic Period (*c.* 10,000 B.C.) have been found, and gold ornaments occur in the oldest tombs of Egypt (*c.* 5000-3500 B.C.). Copper appears in Egypt, but sparingly, as early as 4000 B.C.; by 3000 B.C. it had displaced stone implements, and it is noteworthy that the earliest copper contained arsenic, which made it harder and more fusible. Bronze appeared first about 3000 B.C., both in Egypt and Mesopotamia; in Babylonia the tin was partly replaced by lead. In Central Europe the alloy did not appear until about 2000 B.C., and the earliest articles of bronze were probably imported. Egypt imported tin for bronze-making from the East, probably from Persia. The Scilly Isles, which served as a market for British tin, appeared as part of the Phœnician trade route not before 1000 B.C. The "Cassiterides," doubtless the British Isles, appear as sources of tin first in Herodotus, about 550 B.C. The Ægean civilisation centred about Crete was the forerunner of the Phœnician in maritime trade; Ægean traders penetrated to Egypt, and an interchange of Egyptian and Ægean wares occurred as early as 1400 B.C. After the sack of Knossos, the Minoan civilisation relapsed, and the Phœnicians appeared. The oldest iron seems to be the fragment found in the pyramid of Cheops (IVth Dynasty), but iron was scarce in Egypt until 1200 B.C. Silver appears in the Ægean about 2900 B.C.; Mesopotamia in the time of Hammurabi (*c.* 2000 B.C.) was rich in silver, the shekel being the unit of coinage. In Egypt silver was more valuable than gold as late as 1500 B.C.; it came from the North through the Phœnicians, perhaps from Spain, which was no doubt the source of the mercury found in an Egyptian tomb of the fifteenth or sixteenth century B.C. Mercury is first definitely mentioned by Aristotle

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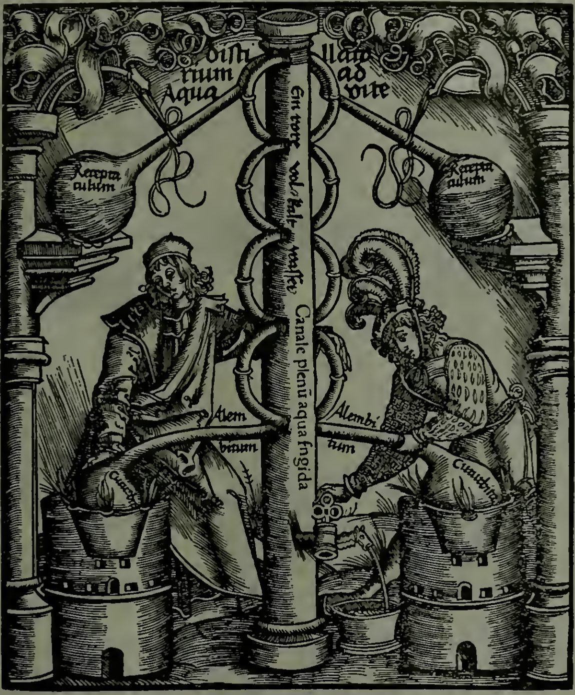
* *Die Entwicklung der Chemischen Technik bis zu den Anfängen der Grossindustrie. Ein Technologisch-Historischer Versuch.* By Gustav Fester. Pp. viii+226. Berlin: Springer, 1923. Price: paper, 6s. 3d.; bound, 7s. 6d.

(384-322 B.C.). The famous "asem," probably a natural electrum or gold-silver alloy from Nubia, is mentioned in one of the oldest Egyptian inscriptions: it played an important part in the beginning of alchemy in the Alexandrian period, as is shown by the Leyden papyrus (*c.* A.D. 100).

Tanning was in use in Egypt under Sesostris (*c.* 1880 B.C.); dyed mummy wrappings appear as early as 2500 B.C., indigo being first used in Egypt about 1000 B.C., as is proved by recent discoveries. The "Phœnician purple" is now known to have been produced in Crete about 1600 B.C. The Egyptian blue, used as a glaze, and in powder form as a pigment, dates back to the earliest period; it was essentially a frit of copper, sand and natural soda, the preparation being described much later by Vitruvius. One dark blue glaze of 1375 B.C. is coloured almost entirely by cobalt.

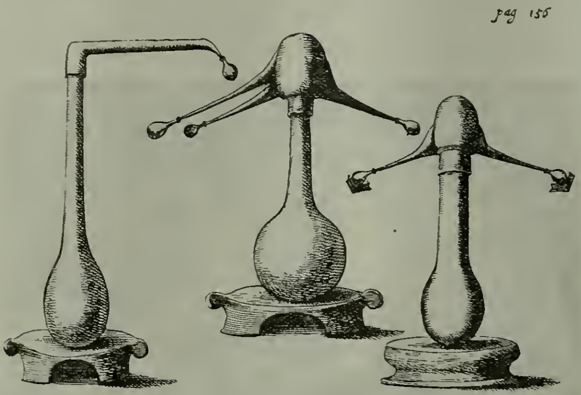


Fractionating Column for the Distillation of Alcohol in Ulstadius' "Coelum philosophorum," 1526

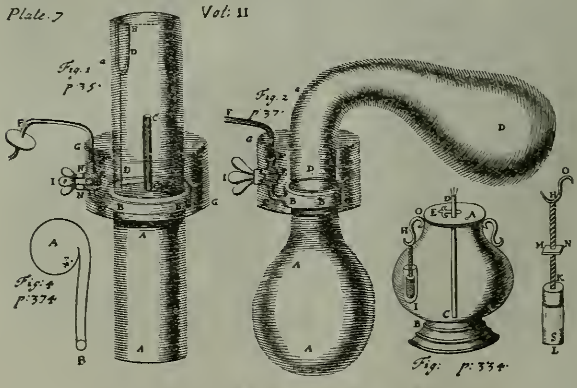
The manufacture of glass probably arose in Egypt, the soda being obtained from the lakes. Tyre and Sidon became only later centres of glass manufacture, but their fame lasted until the Middle Ages. Egyptian glass beads of 3500 B.C. are the earliest specimens; a lead glass vase of 2800 B.C. was merely fritted, and the first important centre of glassmaking appears to have been Tell-el-Amarna (fifteenth century B.C.). The first glass vase dates from 1500 B.C., although glass work, including imitation gems, was much older, as stated above. The glass was moulded; glassblowing was probably invented in Sidon only about the beginning of the Christian era.

In his description of the Hellenistic period Prof. Fester probably lays too much stress on the supposed close connexion between the development of chemistry and the Egyptian priests. The descriptions of Otto, on which Lippmann, for instance, appears to rely, speak rather against than for any personal activity of the priests in technical matters, and in any case Otto disclaims any special knowledge of Egyptology. Workmen were attached to the temples to do various kinds of work, but they were not priests, and their work was of no unusual character.

It is quite possible that the "divine art" (θεία τέχνη) may have been only the "sulphurous art" of producing changes in metals by *sulphur* (θεῖον), including arsenic. The papyri of Leyden and Stockholm can hardly bear the interpretation of being intimately connected with temple industries: they are almost certainly the working-notes of a successful and fraudulent Egyptian goldsmith; they were buried in his tomb so that, in accordance with religious beliefs, he would have them available for use in the next world. The expression: *ώς καὶ τοὺς τεχνίτας λανθάνειν*, quoted by Fester, speaks for this: “as good as, if not better than . . .” is in common use to-day in similar circles! Alexandria, in the Hellenistic and Roman periods, was a buzzing hive of industry, as is testified by Hadrian's well-known letter (now regarded as apocryphal). The glass industry was particularly famous. For this period we have the inimitable *Historia Naturalis* of Pliny, which was drawn upon by later authors—even by Agricola in the sixteenth century. The preparation of white lead by the “Dutch process” is mentioned, but precise directions for its preparation in this way date back to Theophrastos (fourth century B.C.). A Bactrian coin of the third century B.C. contains nickel: oxide of zinc was known to Dioscorides (A.D. 75) as a deposit in brass furnaces; vitriols (blue and green) and alum, cinnabar, orpiment, etc., are all described by Pliny. “Nitrum” was probably natural soda, not saltpetre.



Distillation Apparatus of Zosimus (c. A.D. 300) reproduced by Olaus Borrichius, 1684

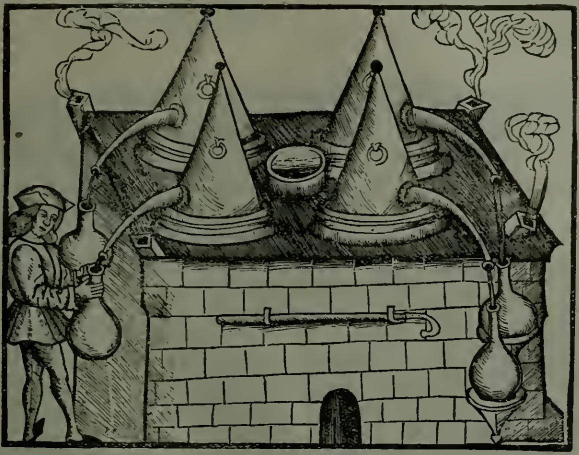


Robert Boyle: Apparatus for Distillation in Vacuum

It was in Hellenistic Egypt at the beginning of the Christian era that distillation was probably first invented. This was clearly stated by Hoefer (*Hist. de la chimie*, 1842, 1, 196). Pictures of distillation apparatus occur in the manuscript of Zosimus (fourth century A.D.), in the Paris National Library. This was seen by Borrichius, in whose book (*Hermetis Aegyptiorum et chemicorum sapientia*, Copenhagen, 1684) there is a reproduction of the alembics figured in Zosimus (ἄμβιξ, which the Arabs called *al-ambic*). These Greek MSS. are referred to by Agricola (*De re metallica*, 1556), but were first carefully examined by Hoefer at the beginning of the last century. The text and translation have been published in full by Berthelot.

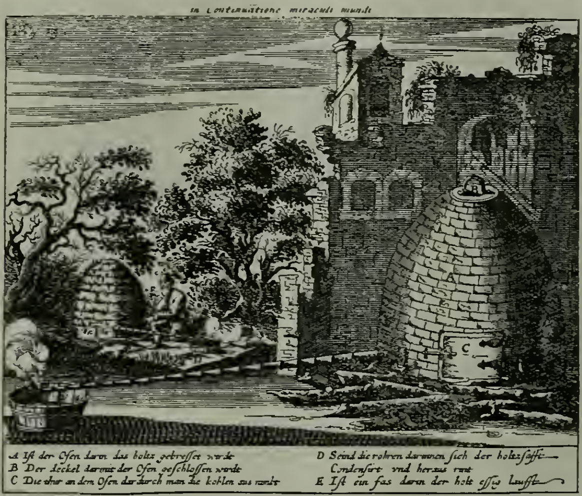
Fester suggests (p. 28) that the famous Roman *vasa murrhinae*, of which Nero was an ardent collector, were Millefiori glass (bundles of coloured fibres melted together: 1830 B.C.)—but Pliny says: "ob amorem abroso ejus margine" of a wealthy Roman owner—surely not of *glass*. We miss Pliny's account of malleable glass: the inventor showed a cup to Tiberius, dashed it to the ground, when it was merely bent, took a hammer and beat it back into shape. Whereupon the Emperor had him put to death as a dangerous person. Nowadays he would merely have been swindled out of his patent by way of punishment. Gilt and silvered pottery was produced in Mykenae; the silky red surface of the Roman *terra sigillata*, it is said, has recently been reproduced by coating a weakly fired vase with a layer of the finest clay, refiring, and polishing. [This method appears to have been used with Trojan pottery before glazing was discovered: see Dorpfeld's *Troja und Ilion*, 1253.] The Grecian and Roman technology is well described by Fester, but not nearly so completely as in Hoefer's delightful *Histoire*, which contains a wonderful account of this period. Lanoline (forgotten till about A.D. 1700), creosote, etc., were known. Indigo and Tyrian purple were used, but it was not known until the seventh century how to reduce them and bring them into solution as "vat dyes."

From the eighth to the thirteenth centuries the Arabs kept alive the Alexandrian chemical knowledge, which reached them by way of Syria. Harran, in Mesopotamia, the town of the Sabian heathens (who inherited some Hellenistic culture), was a centre of alchemy, and said to be the birthplace of Jabir ibn Hayyan—later identified with the Geber of the Latin works, then (Berthelot) separated, and now again (Holmyard) at least approaching him asyptotically. The "pseudo-Geber" is put by Fester in the fourteenth century, in spite of the fact that a MS. not later than 1300, evidently a copy of an older work, is known. "Geb[er]" (perhaps "another person of the same name") is mentioned by Vincent de Beauvais (*d.c.* 1260). Until Berthelot's time the Arabs were credited with the discovery of the mineral acids. These are not mentioned in Geber's principal work, *The Sum of Perfection*, but their preparation is described in another work attributed to him, *The Invention of Verity or Perfection*, in which he speaks of the "solutive waters" obtained by distilling nitre with green vitriol. The authenticity of this work has been strongly disputed; Lippmann suggests (following Berthelot) that the acids were discovered in Europe about 1300, probably in Italy. This view is reported by Fester, but the date has recently been put back about two centuries by Lippmann, so that the problem is hardly any nearer solution. The method of preparation of nitric acid, for the purpose of parting gold and silver, is described in some detail by Biringuccio (uniformly given as "Birineuccio" by Fester) in his *Pirotechnia* (1540, Venice). The Arabs made ceramics,



Distillation with Alembic in Jeronymus Brunschwyg's "Liber de arte dystillandi," 1500 (Johann Grueninger) which they took over from the particularly skilful manufacturers of Persia. In Damascus there was a continuation of the old glass-making industry: true enamels were also made for the first time. Salammoniac was an Egyptian product, obtained from the soot of dried camels' dung used as fuel. Borax is described as a flux. The Arabs were also practised in distillation: it is doubtful if they obtained alcohol, according to Lippmann, but they distilled large quantities of rose-water, and Alkazini (*c.* 1200) describes the distillation of tar and crude petroleum. They manufactured sugar, probably deriving their information from India.

When Hellenism fell to pieces, the chemical information which had been accumulated spread in two directions. Part of it, as stated above, went to the Arabs and came back to the West as alchemy—about A.D. 1200. Another part was handed down as technical tradition, and this came more especially from Byzantium. There are several of these collections of recipes, one of which is the "Liber ignium ad comburandos hostes" attributed to Marcus Græcus, which Fester (p. 42) puts down to "Constantinople, 1250." Hoefer, who first published the text in an easily available form (*Histoire*, 1, 491*ff.*), tentatively placed Marcus in the eighth century. Lippmann (*Alchemie*, p. 478) quotes Kopp, who quotes Gmelin, who quotes Jebb, in Bacon's *Opus majus*, as mentioning "a MS. in Dr. Mead's collection entitled $\pi\epsilon\rho\iota\ \tau\omega\nu\ \pi\upsilon\rho\omega\nu$ by Marcus Græcus." The reviewer finds that no such Greek title is mentioned by Jebb, who merely gives "Liber ignium," and there is no such title in Mead's catalogue of MSS. This is an excellent example of the way in which errors are propagated. In the *Liber ignium* there is a description of gunpowder: so there is in Bacon, in the form of an anagram. Prof. Fester inclines to the view that the discovery was made in China about A.D. 1150–1200. The "monk Berthold Schwarz" is no longer regarded as sharing the discovery with Bacon. Collections of recipes and technical information were published in the sixteenth and early seventeenth centuries: Cardan's *De subtititate*, Wecker's *De secretis*, Alexis of Piedmont's *Secrets*, Ulstadius' *Coelum philosophorum* belong to this category.


in Continuatione miraculi mundi
C
A Iſt der Ofen darin das holtz gebreſſet werde
B Der deckel darmit der Ofen geſchloſſen werde
C Die thür an dem Ofen dardurch man die kohlen aus nemb
D Seind die rohren darinnen ſich der holtzſafft Condenſirt vnd heraus rint
E Iſt ein fas darin der holtz eſſig laufft

Collection of Wood Tar from Beehive Ovens in Glauber's "Miraculum Mundi Continuatio" (first published 1657); Packe's English translation of "The Works of the Highly Experienced and Famous Chymist, John Rudolph Glauber," London, 1689

Another type of early technical treatise is Agricola's *de re metallica* (1556; the date 1546 given by Fester is probably incorrect: see Hoover's preface to his English translation) and Biringuccio's *Pirotechnia* (1540). These contain very detailed information on metallurgical processes. The separation of gold and silver by nitric acid was carried out in Venice at the end of the fifteenth century. [Venice was then a most important industrial centre: Tachenius in his *Hippocrates chimicus* speaks of the soap industry there in his time, and describes an accident to a workman who fell into a vat of boiling lye. This was drawn off, "but nothing was found except the harder bones."]

Many of the recipes given in these old collections might no doubt be foisted on the modern world by ingenious experts: the writer has come across several of them in the latest patent specifications.

In the seventeenth century one of the striking names is Glauber. He was a prolific inventor, although some of his discoveries seem to have been appropriated from others. He suffered by having his own best processes stolen from him and sold by more businesslike contemporaries, and decided to publish the whole of his secrets for the benefit of humanity. Among other things he distilled wood and separated the distillate into tar, acid and spirit. Robert Boyle also made useful discoveries, some of which were much in advance of his time. He describes distillation under reduced pressure (*Works*, abridged by Boulton, 2, 1700, 35 : "An instrument to distil in vacuo ").

The story is continued by Prof. Fester until the beginning of last century, the interest diminishing as the industrial period is reached. His book is a courageous attempt to deal with a vast subject within a reasonable compass, and cannot fail to interest all chemists. Apart from the absence of illustrations, one criticism may be offered. It is quite useless to refer merely to the title of a book running, in some cases, to over a thousand pages. Such a reference as "Vgl.auch Glauber, Furni novi," is useless.

In one case Prof. Fester discusses the cause of the great expansion of English trade at the beginning of last century (p. 119). He puts this down to "the absence, or early disappearance, of retarding monopolies, privileges and trusts." There is surely something in this, added to the fact that the goods supplied were good and cheap. Future historians will doubtless tell us something of the modern period.

PARLIAMENTARY NEWS

The Appointment of a Public Analyst in Gloucester

Mr. Chamberlain, answering Mr. C. S. Garland, said that his attention had been drawn to the terms and conditions offered by the County of Gloucester and the City of Gloucester for the appointments of public analysts to the county and city, respectively. He was aware that these authorities had appointed as public analyst a person whose qualifications did not appear to be within the terms of the regulations as to the competency of public analysts, and informed Mr. Garland that he was therefore in communication with those authorities as to the qualifications required for the post.—(June 25.)

Electricity Commissioners

Replying to Sir J. Remnant, Col. Ashley said that the expenses of the Electricity Commissioners were defrayed by the industry, and not from moneys voted by Parliament. The expenses, apart from the repayment of past advances, in respect of the year 1922–23, were £35,567, and the estimate for the year 1923–24 was £46,250. This included £15,227 in respect of salaries, and £20,273 for staff.—(June 25.)

THE EXISTENCE OF AMMONIUM HYDROXIDE IN SOLUTION

By Prof. T. S. MOORE

In a previous article (*Chemistry and Industry*, 1923, p. 343) I criticised the arguments used by Professor Caven (*Ibid.*, 1923, p. 164), and dissented from his view that the reactions occurring in aqueous solutions of ammonia are more likely to be

$$NH_3 + H_2O \rightleftarrows NH_4^{\cdot} + OH' \quad \text{(I.)}$$
$$\text{or } NH_3 + H^{\cdot} + OH' \rightleftarrows NH_4^{\cdot} + OH'$$
$$\text{than } NH_3 + H_2O \rightleftarrows NH_4OH \rightleftarrows NH_4^{\cdot} + OH' \quad \text{(II.)}$$

I wish now to deal with a second article (*Ibid.*, 1923, p. 448), in which Professor Caven defends his original position. As regards the argument based on the vapour pressures of hydrated salts, the facts reported by Caven and Ferguson are :—(*a*) The pressure of aqueous vapour at any one temperature, for the systems $CuSO_4.M_2SO_4.6H_2O \rightleftarrows CuSO_4.M_2SO_4.2H_2O'' + 4H_2O$, diminishes as M passes along the series K, Rb, Tl, Cs ; and (*b*) the temperatures at which 'rapid loss of water' occurs when the hexahydrates are heated in air are, for the same order of radicals, 33°, 55°, 60°, and 65° C. The correlation between these two properties in this series of compounds is obvious. Pending the investigation of the dihydrates it is a reasonable assumption, though by no means a certainty, that the same correlation will be found in this closely related series, in which case the dihydrated cæsium compound, which loses water on heating in air at a lower temperature than any other of the dihydrates, will be found to have the highest vapour pressure. The point raised by Professor Caven, that although the ammonium double salt has a lower vapour pressure than the rubidium compound, it loses water rapidly at a lower temperature than the latter, is so far from refuting my argument that it really tells against him. For whereas the compounds containing K, Rb, Tl and Cs show the definite correlation between vapour pressure and temperature of rapid loss of water already mentioned, the ammonium compound does not —*i.e.*, in this respect ammonium cannot be placed anywhere among the series of alkali metals.

In correspondence with me, Professor Caven has defined his views on the general question of variation of vapour pressure of systems containing hydrated salts with the basigenic character of the radicals they contain, and has stated that he does not advance any generalisation in this connexion. In fact, no basis, either theoretical or empirical, exists on which such a generalisation might be founded. Thus the results of Caven and Ferguson have no special significance as regards the basigenic properties of the radicals concerned, but with the exception of the discrepancy already mentioned, must be regarded simply as adding another case to those described by Tutton, in which, so far as the properties of its solid compounds are concerned, ammonium falls into a definite place among the alkali metals. But what reason is there for assuming that other properties of different systems containing these radicals; *e.g.*, systems involving solution, will be in the same order? If predictions of this kind may be made at all, one would expect them to apply most certainly in cases where the solid phase is still involved, such as solubility. Actually the solubilities recorded in Landolt-Börnstein (and the molecular percentage solubilities calculated from them) show that for the chlorides of the radicals concerned at 10° C., and for the corresponding alums at 0°, the order of radicals is not that found by Tutton and by Caven and Ferguson. If, then, the prediction fails for such a property as solubility, what confidence can be given to a prediction of the relative basigenic strength of $NH_4^{\cdot}$ in solution?

In the last part of his article Professor Caven quotes from Holleman's text-book a passage which implies that the salts of ammonia are hydrolysed in solution to a smaller extent than would be expected from the measured strength of ammonia as a base. This revival of the idea of 'abnormal hydrolysis' has been dealt with by Dr. A. E. Clarence Smith in a previous article (*Chem. and Ind.*, 1923, p. 578). It is worth while noticing, in addition, that Hantzsch, the original author of this idea, abandoned it when, in consequence of the theoretical paper of Kauffman, he was led to make accurate quantitative experiments (Ley and Hantzsch, *Berichte*, 1906, 39, 3149); and further, that the work of Lundén (*J. de chim. phys.*, 1907, 5, pp. 145 and 574) proves conclusively that for salts of ammonia and other nitrogen bases with weak acids, where the hydrolysis is sufficiently extensive to allow of accurate measurement, the theoretical relation between hydrolysis of salts and the strength of the base concerned, is fulfilled.

Thus all the arguments on which Professor Caven relies to prove that NH_4 is a strongly basigenic ion, break down on examination. Since, apart from his view on this point, Professor Caven urges no objection against equation II., and offers no evidence in favour of equation I., there seems to be no reason why the former should be discarded. I admit that there is no independent evidence that the undissociated compound shown to exist in considerable quantities in aqueous solutions of ammonia by Moore and Winmill is NH_4OH, but would point out that the same negative statement is true as regards the formula $NH_3{\cdot}H_2O$ proposed by Professor Caven for this compound. In such a case it is best to adopt the simplest hypothesis—that the undissociated compound has a configuration corresponding to the ions with which it occurs in solution.

Royal Holloway College,
Surrey

SAFEGUARDING OF INDUSTRIES ACT

FORMALDEHYDE

The complaint by the Chemical Merchants and Users' National Vigilance Committee, that formaldehyde was improperly included in the Schedule of dutiable articles under Part I of the Act, was heard by the Referee, Mr. Cyril Atkinson, K.C., on June 15. The application was opposed by the Board of Trade, Messrs. Synthite, Ltd., and others.

Mr. K. Swan, who appeared for the Vigilance Committee, said that the world production of formaldehyde was now roughly 10,000 tons per annum, possibly more. He hoped to satisfy the Referee that formaldehyde, obtained from methyl alcohol, was not a synthetic product: there had been no building up by orderly steps which would make the process synthetic according to the previously accepted definition of synthesis. Formaldehyde was not described as a synthetic chemical, or as manufactured by synthetic processes in any of the textbooks. The Board of Trade asserted that formaldehyde was a synthetic organic chemical, a fine chemical and an analytical reagent. To call it an analytical reagent was a positive misnomer, and he could give instances to show that formaldehyde was regarded in the trade as a heavy chemical. The very varied uses of formaldehyde showed it was an industrial chemical. Over 90 per cent. of the output was used for industrial purposes, not more than 1 or 2 per cent. being used in pharmacy; its chief pharmaceutical use was in the manufacture of hexamine. Mr. Swan said that the Board of Trade stated that formaldehyde was a carbon compound formed by restricted oxidation of methyl alcohol in presence of a catalyst. But oxygen had not been added: the methyl alcohol had been deprived of its hydrogen, so that to say that methyl alcohol had been oxidised was not correct. He did not agree that until recent years, formaldehyde had been manufactured exclusively by fine chemical manufacturers. He took serious exception to the statement that formaldehyde was an alcohol derivative, and as such, belonged to another recognised group of fine chemicals. It was not an alcohol derivative, but a derivative of methyl alcohol, and was a paraffin derivative.

Mr. E. Parry confirmed the statement as to the method of producing formaldehyde with one exception; recent investigations by Le Blanc and E. Plaschke showed there was no oxidation at all, the formation of formaldehyde being due to catalytic dehydrogenation of methyl alcohol. He had never used formaldehyde or heard of its being used as an analytical reagent. Many trade journals had for many years past referred to formaldehyde as an industrial chemical, but *Kelly's Directory for the Chemical Industry*, 1919, the *Buyers' Guide for the Chemical Industry*, issued by the Society of Chemical Industry, 1923, and a publication by the Association of British Chemical Manufacturers (1922) did not state that formaldehyde was to be obtained from fine chemical manufacturers. After describing the pharmacopœial standards for formaldehyde, Mr. Parry said that the British Drug Houses list of chemical products contained three grades of purity, but he did not think that that indicated whether the chemical was fine or not. Mr. Parry said the statement that methylene glycol was formed in the formation of alcohol, but that, once the solution of formaldehyde was obtained, the methylene glycol present decomposed in the formaldehyde, did not agree with published statements. He could not disagree that formaldehyde was a remarkably pure product, but this did not correspond with information he had obtained from manufacturers outside this country, or from users. Dealing with the remark that formaldehyde was classified under the heading " Drugs and Fine Chemicals " in the *Oil, Paint and Drug Reporter* (U.S.A.), Mr. Parry observed that the difficulties of definition had become so great in the United States that only this month the Synthetic Organic Chemical Manufacturers' Association of the United States had attempted to define a synthetic organic chemical, but the definition arrived at was meaningless (*cf. Chem. & Ind.*, p. 481).

Dealing with the point that formaldehyde was classified in so many trade publications under the heading of " Industrial Chemicals," Sir A. Colefax submitted that the word " industrial " did not distinguish between fine and heavy chemicals ; chemicals were called industrial chemicals because their main uses were industrial. Answering further questions, Mr. Parry agreed that no organic chemist would be without formaldehyde in his laboratory, but it would be there as a reactive substance and not as an analytical reagent. He agreed that formaldehyde was a synthetic organic chemical if the methyl alcohol used had been prepared synthetically, but he pointed out that the synthetic method of producing formaldehyde was not practical, so that they had to start with methyl alcohol as a raw material and subsequent operations were in no way synthetic.

Sir A. Colefax stated that the United States Customs classified formaldehyde as a synthetic organic chemical, the definition of a synthetic organic chemical laid down by a United States Treasury Minute being : " Any substance which is known commercially as a chemical or drug and which contains carbon in chemical combination with other elements except cyanide, cyanamide, carbide, carbonates and bicarbonates of metals or inorganic radicles, and which has been produced by any chemical process other than that necessary to extract, isolate or purify the substance from a natural source, or to effect its separation from a more complex natural compound by hydrolysis, or to form a solvent."

On June 22, 1923, the cross-examination of Mr. Parry was resumed by Sir A. Colefax. Counsel asked a number of questions with reference to phenanthrene and anthracene dihydride with a view to eliciting witness's opinion as to synthesis. In reply to the Referee, Mr. Parry said :—" There are undoubtedly a number of bodies largely prepared by reactions which are so definitely those of the synthetic chemists and synthetic chemistry that although the molecule is not increased by carbon the mere act of introducing hydrogen into the anthracene ring is such a complicated synthetic operation that I do not think you could deny that anthracene dihydride was a synthetic body in spite of its not having a carbon compound attached to it." On this further questions arose as to the distinction which witness was drawing between the passing of a hydrocarbon to one containing more hydrogen, which he agreed was synthesis, and the passing from methyl alcohol to formaldehyde, which he would not agree was synthesis. But Mr. Parry continued to maintain that the production of formaldehyde from methyl alcohol was not a synthesis because hydrogen was split off and it was an ordinary oxidation process. Mr. Butler, of Messrs. Greef & Co., Ltd., gave evidence that he had not regarded formaldehyde as a fine chemical nor was it so regarded in the trade. Similar evidence was given by Mr. R. R. Wilkins, of Messrs. Victor Blagden & Co., Ltd., who said he regarded formaldehyde as an industrial chemical.

This concluded the evidence in favour of the removal of formaldehyde from the list of articles under the schedule to the Act. Sir A. Colefax, for the other side, first submitted to the Referee that he had no case to meet. He then suggested that on the evidence before him the Referee could not come to the conclusion that formaldehyde had been improperly included in the list. As the Referee held that there was a case to consider, Sir A. Colefax opened his evidence with some trade witness.

Mr. W. T. Bruce, of Messrs. W. T. Bruce & Co., stated that he had been dealing with chemicals for over forty years and that he had always classified formaldehyde as a fine chemical. He was followed in the witness chair by Dr. W. R. Walkey, the Managing Director of the London Chemical Works, who gave evidence of having started manufacture of formaldehyde since the passing of the Act. Mr. W. T. Allen, of Messrs. Allen, Craig & Co., who said he was a dealer in fine and heavy chemicals, gave evidence that he had not regarded formaldehyde as a heavy chemical. Mr. W. Gregory, an analytical and metallurgical chemist and a director of Messrs. William Gregory & Co., Ltd., gave his opinion that formaldehyde was fine chemical. This concluded the day's proceedings, which were continued on Thursday, June 28.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

A Great Week closed on Saturday last at Cambridge. It is perhaps not too much to say that the events of that week mark a very definite step forward in the advance which British Chemical Science is making. The choice of Cambridge as the meeting-place for the International Union for Pure and Applied Chemistry and for the meeting of the Society of Chemical Industry was a very happy one. I think that no other town which might have been chosen would have left the same impression on the minds of the foreign delegates. The meetings of the International, which occupied the first three days of the week, were noteworthy for the part played by the British representatives. Sir William Pope was an ideal chairman, and the "despised and rejected" Professor Armstrong (as he described himself later in the week) came into his own. Perhaps his verbal duel with Professor Bancroft was the best of his efforts and greatly pleased his audience.

The Most Picturesque of the ceremonies was the congregation on Wednesday, when honorary degrees were conferred on Profs. W. D. Bancroft, E. J. Cohen, Albin Haller, C. Moureu, R. Nasini, A. Pictet and F. Swarts. The stately procession, the pleasing manner of the Vice-Chancellor, and the sonorous speeches of the Public Orator all added to the dignity of the proceedings. I heard afterwards that there was one person who was a little taken aback. Earlier in the day, in trying to find the Arts School, he commandeered the services of an amiable gentleman to conduct him to the meeting-place only to discover later on that his guide was no less a dignitary than the Public Orator.

The Fitzwilliam Museum was used for the reception of the International on the Wednesday, as well as for the reception of the Society on the Thursday. On both occasions the Vice-Chancellor of the University and Mrs. Pearce were the hosts. I am inclined to think, however, that it was the smoking concert on the Wednesday night which assured the success of the Society's meetings. By that time all the members who were attending had assembled, and the function formed an opportunity for everybody to get to know everybody else, and a number of discoveries were made. We saw Prof. Armstrong in a new *rôle*. It says a good deal for the "atmosphere" of the concert that even this hero of a thousand fights should have been compelled, for a brief moment, to lay aside the protective armour with which he has surrounded himself, and reveal to us a very human but hitherto carefully concealed side of his character. The insistent demand for a speech from him we attribute to his intellect, but the applause at the close showed that the audience had detected something finer which perhaps many had not suspected.

The Annual Meeting opened with speeches of welcome from the Vice-Chancellor and the Mayor, who in their several ways extended a very cordial invitation to the members to participate in the various delights of the University and town. Then followed the President's address, which he read in abstract, but gave us sufficient to warrant our looking forward to reading the address in full, which we were able to do when *Chemistry and Industry* arrived in the afternoon. The ball at the Town Hall in the evening has already been described in the lay press as a brilliant function, but I was more interested in some of the byplay which went on among the senior officials of the Society. It was obvious that something rather serious had happened, but it was not until the following morning we discovered that Dr. Carpenter had been unavoidably prevented from coming to Cambridge to receive the Society's silver medal and to deliver his address. No wonder the officials were in a quandary; however, when we met the following morning in the Arts School, the President read Dr. Carpenter's letter, and having told us something of the origin of the medal, he called on Sir William Pope to give an abstract of Dr. Carpenter's address. It transpired that it had only been placed in Sir William's hands an hour before the meeting, but notwithstanding this, in the space of twenty minutes he gave what was truly described by those who had seen the paper as a masterly abstract. It was indeed a remarkable performance. Mr. E. V. Evans received the medal on Dr. Carpenter's behalf, and Mr. Woolcock wound up the proceedings with a short speech describing some of Dr. Carpenter's activities in chemical industry.

Dr. Aston's Lecture on "Isotopes" was another outstanding feature of the meeting. For clearness of thought and lucidity of expression it would have been very hard to beat. We had begun the day well, and were continuing it with growing interest. The garden party in the grounds of Sydney Sussex was delightful, and then at the close of the day came the dinner in Trinity College Hall. No similar function in other surroundings approaches the ascetic pleasure of a dinner given in a College Hall, but as to the speeches I will only say that to my mind they were not unworthy of the place in which they were delivered. Looking back on the week I cannot help feeling that it was most successful. It has enhanced the prestige of the Society, and done a considerable amount of good to chemistry, both pure and applied.

CHEMISTRY AT CAMBRIDGE

INTERNATIONAL UNION

The meetings of the Union Internationale and of the Society of Chemical Industry at Cambridge were an unprecedented success. They can hardly be separated, they formed two acts of the same play, and now that we have time to look back upon it we realise how good it was. The Union Internationale was well attended both by British and foreign representatives; Sir William Pope, Professors H. E. Armstrong, Crossley, Pickard, A. G. Perkin, Hopkins, Dixon, Barlow, Thorpe, Kipping, Hewitt, Lowry, McBain, Brame, Harden, Smithells, Drummond, Bedson and Barger, Messrs, Carr, Rideal, Marsh, Clarence Smith, Chattaway, Chapman, Gardner, Hulton, McNab, Coward, Mond and Miall attended, and most of these stayed for the whole or part of the meeting of the Society of Chemical Industry. France was represented by Professors Haller, Moureu, Bertrand, Boudouard, Lindet, Béhal, Messrs. Kestner, Marie, Kling, Deschiens, Gérard, Etienne, Lormand, Delépine, Marquis and some others. Italy sent Prince Ginori Conti, Professors Paternò, Giordani, Nasini and Parravano, Signors Bianchi, Pomilio and several others; America sent Professors Bancroft, W. A. Noyes, Hibbert, and others. The Dutch delegation was a large one, including Professors Cohen, Kruyt, Verkade and Mr. Prinz; from Denmark came Professor Biilmann and Mr. Warming; Professor Boedtker came from Christiania, Professor Minovici from Roumania, Professor Swartz and several others from Belgium, Professor Pictet and some others from Switzerland, and many others from many places. Their names form a long and distinguished list and their presence and that of the ladies who accompanied them ensured the success of the meeting.

THE CONFERRING OF HONORARY DEGREES

On Wednesday, June 20, the Vice-Chancellor, preceded by the Esquire Bedells and followed by the University Marshal, headed a procession clad in scarlet and other gay colours to the Senate House. Degrees of Doctor of Science (*honoris causa*) were conferred upon seven eminent Professors of Chemistry with due solemnity. There is a calm dignity about such proceedings which appears to be a survival from a period when trains and telephones did not exist and time was ampler than now. The Public Orator, Dr. Glover, made a short speech in Latin and introduced to the Vice-Chancellor the new doctors with seemly observations in Latin of which the following is a rather crude paraphrase or summary :—

First I present to you Albin Haller. Whatever is done in science in France they discuss in his Académie des Sciences; in that society are gathered all those who pursue such studies; over this assembly each year some renowned man presides. As he is worthy of such a distinction we to-day honour him and ourselves. Wilder Dwight Bancroft follows, our colleague in study and of our own kin, who, a second Ulysses, skilled in many things, adorns a new Ithaca with modern science. Next comes Ernest Julius Cohen from Holland, whose intellect, like that of Ovid, compels him to tell of the changed forms of new compounds. Another Frenchman follows, a professor in the Collège de France at Paris, Charles Moureu, one who by no means despises the most minute of substances but keenly investigates their ways.

To-day, while far-off Etna thunders with dreadful destruction, we greet, with special fervour, an Italian, Rafael Nasini, whom the Etruscan city, Pisa, well known to Virgil, has sent to us. He has chosen for study the volcanic vapours which are poured from the bowels of the earth towards the heavens and Albunea exhaling its dense gas. Now a Swiss approaches, the senior professor of the University of Geneva, Amatus Pictet, who has searched out the very foundations of matter, investigating the facts of the most rarefied vacuum. Next comes a professor from the Academy of Ghent, whose work there are many here present capable of explaining more fluently than I can; it is agreed by all who are engaged in that branch of knowledge that none excels Frederic Swartz. Blessed is that man who knows the causes of things.

The Fates do not give everything to all men; I was born in Arcadia, an unworthy student of the ancient Muses, happy to officiate in my little temple. You, who have done such great deeds, forgive me if, ignorant of the various languages you speak, I bid you all welcome in Latin.

This journal would attain to very unwieldy proportions if we attempted to give an account of the discussions on soap solutions, on tautomerism, on oxidation in vital tissues and on catalysis; a summary of the reports on these topics has already appeared and the discussions were both valuable and voluminous.

PRESENTATION OF THE PATERNÒ MEDAL TO DR. F. W. ASTON

Italy has produced great names in art, literature and science; in the science of chemistry the name of a distinguished Italian, Professor Paternò, is now given to a special medal to be presented to original workers in the science. The Paternò medal is a symbol of the esteem in which Prof. Paternò is held by a number of his colleagues in Italy, France, England, America and other countries. Professor Paternò is Marchesa di Sessa, a Senator of the Kingdom, and the head of an ancient Sicilian family; he is in chemical circles perhaps best known for the method he discovered of making phosgene, $COCl_2$, by the direct combination of carbon monoxide and chlorine, absorbent charcoal being used as a catalyst. He has also studied the preparation of various poison gases, and made investigations in other departments of organic chemistry. During the recent meeting of the International Union at Cambridge, the first Paternò medal was presented to Dr. F. W. Aston, F.R.S., in recognition of his discoveries of isotopes, and his measurements of the mass of their atoms.

Dr. Aston is both a chemist and a physicist, and one of his earliest publications was a joint paper with Prof. Percy Frankland, on some derivative of tartaric acid. In connexion with isotopes, Dr. Aston greatly improved on Sir J. J. Thomson's method of recording mass spectra, and by suitable adjustment of the electric and magnetic fields through which the atoms travel he obtained a method so accurate that it can be used quantitatively, and will measure the atoms to a nicety of one part in a thousand. He has since devised a new method which promises to be still more accurate, and to be applicable to a number of elements which have hitherto resisted treatment.

Sir William Pope took the chair on the occasion of the presentation of the medal and gave a brief and pleasant account of the creation of the Paternò Fund and some of the essential features of the work of Prof. Paternò. He was followed by Prince Ginori Conti, the President of the Italian Chemical Society and of the Italian delegation to the Union Internationale. He explained how on the seventy-fifth birthday of Prof. Paternò the fund was organised, and a triennial gold medal instituted, to be awarded to those who conspicuously excelled in chemistry and physical chemistry. He was particularly pleased to see present Sir J. J. Thomson, Sir Ernest Rutherford, and other Cambridge men of science, to whom the Italian chemists presented their greetings and congratulations, and called upon Prof. Paternò to present Dr. Aston with the medal. After this ceremony and a suitable speech by Prof. Paternò, Dr. Aston thanked Prince Ginori Conti and his colleagues, and called attention to the great importance, especially at the present time, of maintaining a close connexion between researches in chemistry and physics. Dr. Aston remarked on the great value of such awards, not only as an encouragement to those engaged in study, but as a means of retaining the international character of science and promoting agreeable relations between chemists and physicists in all countries. Sir J. J. Thomson and Sir Ernest Rutherford spoke with appreciation of the valuable work of Dr. Aston, and of the kindly manner in which a great Italian chemist, with the co-operation of distinguished Italian chemists and engineers, had on this occasion done honour to an English colleague. It was hoped the good relations between the two countries would long remain as cordial and happy as they now were.

At the final meeting of the Union Internationale, Prof. Cohen, of Utrecht, and Prof. Sakurai, of Japan, were elected as additional Vice-Presidents, and the invitation to hold the next Annual Meeting in Copenhagen was very cordially accepted. Having sketched in this slight and hasty manner some of the main features of the earlier meeting we come now to our own meeting.

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THE SOCIETY OF CHEMICAL INDUSTRY

This was well attended, and from the social point of view, was exceedingly good. There were no papers on industrial subjects, and no visits to works had been arranged. "The Spanish fleet you cannot see, because it is not yet in sight." These omissions made it difficult for some members to reconcile their desire to attend the meeting with their duty towards their work. Desire said "Go!", Conscience said "Stay!". In future years it may be worth while to have just that minimum of applied chemistry which will be an adequate excuse for all except the most obstinate and inflexible conscience. It is not intended to cast any reflection on those who did attend the meeting; many of these got their work done by superhuman effort, concentrated in the two or three days prior to the meeting; others did their work at Cambridge, others merely postponed it until a more convenient opportunity arose. One should take a wide view of such problems; the man who eats oysters should not think of the pleasure it gives him, but of the remunerative employment which he provides for those who go down to the shore of Colchester or Whitstable. During the Society's meeting at Cambridge there was a sort of gaiety, a cheerfulness, even a light-heartedness from which we fear we have not yet entirely recovered. It began with the Smoking Concert, which was really an uncommonly good one. The conjuring, both amateur and professional, was most amusing, and how Mr. Kipping has managed to snatch the time for practising juggling, *de solido die*, passes our comprehension. There was some good music, and an amusing and very delightful speech by Professor Armstrong, who felt a just pride in the fact that two of his pupils were professors at Cambridge and his son President of the Society. This was some consolation to him when he reflected that years ago he unsuccessfully applied for a professorship at Cambridge himself. Singing is perhaps not quite our subject, but we think that the following shows that the Chemical Department at Cambridge does not confine its attention to optically active compounds with sesquipedalian names; the song was composed by Mr. Hxxxxs, and sung with great success by Mr. Harding.

THE CHEMIST'S LOT

(With apologies to the late Sir W. S. Gilbert)

When a crystallising substance looks like gravy,
looks like gravy,
And a prep. yields almost nothing else but tar,
else but tar,
The chemist wishes he was in the Navy,
in the Navy,
Or in Commerce, Church, or pleading at the Bar,
at the Bar.
When distilling flasks disintegrate with vigour,
-grate with vigour,
And flames and smoke obscure the wintry sun,
wintry sun,
Then is seen the Chemist's life in all its rigour,
all its rigour,
For the Chemist's lot is not a happy one.
Ah! when you carefully consider all its rigour,
all its rigour,
The Chemist's lot is not a happy one,
Happy one.

When your final product is a dirty ointment
And smells like nothing else you've met before,
It is hard to hide your bitter disappointment,
And cheerfully begin the prep. once more.
When you take a synthesis through several stages
And the yields get worse and worse as you go on,
You disbelieve the writings of the sages
With their stories of the clever things they've done.
Ah! when synthetic preparation's to be done,
The Chemist's "lot" is such a little one!

When a superheated dye solution bubbles
And the Red Guards gain another new recruit,
The remainder of the lab. forgets its troubles
And assists to clean the victim's face and suit.
When junior students smash SO_2 syphons
And all who wish to live have got to run,
The research-man-demonstrator (note the hyphens)
From these incidents derives a lot of fun!
Ah! when the matter is considered, all and done,
The Chemist's lot is quite a funny one!

R. T. M. H.

THE SOCIETY'S MEDAL

As the scrutineers of the ballot for Officers and Members of Council had not completed their task when the meeting adjourned on Thursday their report was not read until Friday morning, when it was announced that the following had been elected :—

President: Dr. E. F. Armstrong, F.R.S., (Re-elected).

Vice-Presidents: Dr. T. H. Butler, Mr. F. H. Carr, Professor G. G. Henderson, F.R.S., Mr. Emile Mond.

Ordinary Members of Council: Prof. P. P. Bedson, Dr. R. T. Colgate, Prof. A. R. Ling, Dr. J. Reilly.

The President announced with very great regret that Dr. Charles Carpenter had sent a message stating that he regretted he was unable to come to Cambridge to receive the Society's Medal and to deliver his address. He had, however, sent the notes on which his address was to be based. Dr. Armstrong said that the Council felt that the reasons which prevented Dr. Carpenter from coming to Cambridge must have been of very great weight. The Society's Medal was awarded to a scientist, a chemist who had contributed either to the advancement of science or to that of the Society. It was first awarded in 1896 to Mr. Glover of sulphuric acid fame, and since then it had been awarded to many other eminent scientists and chemists, including Dr. Perkin, Professor Ira Remsen, Mr. T. Tyrer, Mr. C. F. Cross, and Monsieur Paul Kestner. Dr. Carpenter had joined the Society 30 years ago, and he could be regarded as the prototype of the chemical engineer. During those years he had so developed the South Metropolitan Gas Company, of which he was President, that from the point of view of the application of science to industry it stood second to none in the world. Dr. Carpenter's policy, to provide those within the Company's area with so good a gas that nobody would wish to change it for any other form of lighting or heating, had only been made possible by the technical work he had initiated, lead, and in part contributed to.

The President said that he did not think it desirable to deal in great detail with Dr. Carpenter's work, but he wanted to feel that in saying little he left nothing unsaid (*cf. Chem. & Ind.*, May 25, p. 515). Commenting on Dr. Carpenter's work for the Society and for chemical industry itself, Dr. Armstrong reminded the members that Dr. Carpenter was President of the Society during the two critical years 1914 and 1915, and that he was instrumental with others in forming the Association of British Chemical Manufacturers, a feat which he—the President—believed would probably be found in future to have been fraught with greater consequences to the industry than almost any other of his many achievements. Sir William Pope then gave a brief outline of Dr. Carpenter's address and read extracts from the notes which he had received.

Sir William Pope said that Dr. Carpenter's address was a very comprehensive account of the past history of the gas industry, and its present condition, and an extremely illuminating exposition of what the author imagined the future of the industry would be. Dealing with the early history of the distillation of coal, he told how, in the *Transactions* of the Royal Society in 1739, the Rev. Dr. Clayton had communicated a paper, the first published on this subject, in which Dr. Clayton had said, "I got some coal, and distilled it in a retort in an open fire. At first there came over only phlegm, afterwards a black oil, and then likewise a spirit arose, which I could no ways condense; but it forced my lute, or broke my glasses. I then had a mind to try if I could save any of this spirit, and in order to do this I took a turbinated receiver, and putting a candle to the pipe of the receiver, whilst the spirit arose, I observed that it catched flame, and continued burning at the end of the pipe, though you could not discern what fed the flame. I then blew it out, and lighted it again several times; after which I fixed a bladder. I kept the spirit in the bladders a considerable time, and endeavoured several ways to condense it, but in vain."

Dr. Carpenter told of the early work of Murdoch and Watt on the production of coal gas, and then came what was a very characteristic touch on the part of Dr. Carpenter. He was primarily an engineer, and therefore one would not suspect him of having any bias towards chemical subjects. He had pointed out, in describing the conditions under which the gas industry was carried on, that we could look upon the whole industry concerned with the distillation of coal as a kind of circle, in the centre of which the actual process of coal distillation stood, and, radiating from this centre, ancillary to the actual process of coal distillation itself, was the enormous complexity of industries which were based on the utilisation of coal and its products. Commenting on this picture, he said that everywhere we met the hand of the chemist controlling these industries, but when we came to the primary operation, the destructive distillation or carbonisation of coal in the production of town's gas, we saw but little evidence of his work in the operations generally carried on to-day. The plant employed was, in principle, practically what it was a century ago. He did not mean to imply by this that no development had taken place; the retorts were larger and longer, and, being more resistant to heat, were worked at a higher temperature. Also, machinery had been substituted for hand labour in many of the subsidiary operations. These tasks were peculiar to the functions of the engineer, and he had performed them admirably. He was, of course, carrying out what was primarily his own particular task, *i.e.*, the mechanical operation of a particular process. Dr. Carpenter went on to ask, "What must be said of a process the raw material of which has been most inadequately studied?" and, throughout the whole of the Address, the keynote was to the effect that coal itself, the original raw material used in gas manufacture, had received far too little study at the hands of the chemist.

An account was then given of our present knowledge of the nature of coal, contrasting the very imperfect state of the information on coal itself with the very complete and highly complex knowledge that we now possessed of the constituents of coal tar. It was obvious that the picture the author had in mind was one in which he saw that the question of the composition of coal tar, and the utilisation of the enormous number of chemicals which it contained, had been carried to a very high pitch of perfection, and that many great industries had been founded upon this minute examination of coal tar itself. Apparently, he foresaw that ultimately we should be able to utilise coal in the same multiplicity of ways in which we now utilised the constituents of coal tar, by reason of getting, in the fullness of time, a more perfect knowledge of the composition and constitution of coal itself. It was easy to lament the small amount of information now available upon the complex questions of coal constitution, but only those in intimate touch with the subject could appreciate the great intricacy of the problem. Despite the considerable work carried out in recent years, it was still very bewildering to attempt to form a clear impression of the position to-day. One body of workers had studied the palæobotanical side with commendable results, others had submitted the coal substance to the action of solvents and to chemical reagents; another set of investigators had investigated the coking properties of coal and its general behaviour under heat. We were indeed only collecting bricks wherewith to build a temple of our knowledge, and as yet no master architect had arisen to design the structure. Until that was done we must, apparently, be content to study effects rather than determine causes. He believed that much greater knowledge of organic chemistry was required before this large accumulation of knowledge was correlated. The general idea which inspired Dr. Carpenter was that the engineer had done all he could, and it was now the part of the chemist to take the work in hand, to study the raw material, coal, with the same energy and efficiency as had been devoted to the study of the components of coal tar.

Discussing the behaviour of coal under heat Dr. Carpenter stated that Weyman had recently shown that a more rapid heat transference was effected by the gases evolved during carbonisation than by conduction through the charges or by radiation. With bituminous coal this method of heat transference was retarded by the formation of plastic layers, whereas with anthracitic coal heat transference by means of the gases could take place readily, and this accounted for the rapidity of carbonisation of these coals.

Discussing the coking of coal, Dr. Carpenter gave a brief account of the way in which the binding of the coal is affected by the oxygenated constituents of the coal itself, and concluded by saying that probably a true picture of the mechanism of the carbonising process was that it was one of high velocity, *i.e.*, that so soon as the coal particle was raised to the required temperature, the destructive distillation process proceeded very rapidly. The lag in the process arose from the time taken to raise the coal particles to the required temperature, and this was accentuated by the poor conductivity of the material and the formation of the plastic state through which the coal passed. This plastic state proceeded in layers in each coal particle from outwards inwards, and thus retarded the evolution of gas. When the plastic state was reached at the centre of the coal particle, it might be imagined that a turbulent state of affairs existed and the gases evolved had to pass the gauntlet of the maze of cells of the hot coke to gain their freedom. The designation of "destructive distillation" was no misnomer; in fact it was always a wonder to him (Dr. Carpenter) how so many of the complex hydrocarbons withstood the drastic treatment to which they were exposed.

Neglecting the many subsidiary factors influencing carbonisation, Dr. Carpenter said that the main factors which determined the value of carbonising results were :—

(a) The type of carbonising vessel and the pressure maintained therein

(b) The temperature to which the mass was eventually raised

(c) The rate at which heat entered the mass and the time taken for the mass to attain the final temperature

(d) The degree of heat and contact to which the volatile products from the coal were subjected

(e) The state of division of the mass under carbonisation.

The possibilities of low-temperature carbonisation were being slowly developed. The future of low-temperature tar was as yet unknown, but extensive investigations by Fischer and his colleagues had added appreciably to our knowledge of the subject. Apparently we were only on the fringe of the possibilities presented by low-temperature tar, and the future of the process itself might depend upon the results of this investigation. He was unable to appreciate, with the present state of knowledge of the low-temperature distillation of coal, the economic advantages of this process, and imagined that a suitable solid, smokeless fuel would be obtained eventually by the carbonisation of coal under special conditions, but at high temperature. The study of low-temperature tar had, however, proved of great value in interpreting the carbonisation process itself, and it might eventually result that the study of tars produced at various temperatures might be one of the keys to solve the problem of the carbonisation process.

In any discussion on the merits of various methods of coal carbonisation, it must be borne in mind that the adoption of any one method was generally determined by special local requirements, or the demands of the times. As coal was not only a source of gaseous energy, but also of tar products, nitrogen and sulphur compounds, development would take place along those lines which gave the highest yields of the particular products required. Whereas low-temperature carbonisation gave a comparatively low yield of ammonia, a very rich gas with a high yield of tar rich in low boiling-point paraffins, and a soft and easy burning coke, gasification with air and steam on the Mond system resulted in a high yield of ammonia and a very large volume of a low grade gas.

Dr. Carpenter emphasised the fact that the distillation of coal in the production of town's gas was not only a chemical industry, but that its development was only possible along lines to be laid down by the chemist and supervised by him. Vivid though Dr. Carpenter's dreams of the future might be, he had never yet visualised the community wholly supplied with gaseous thermal energy. He believed that gaseous and solid fuel had each their sphere of usefulness and that their systematic use would go hand in hand. He also believed that in the largest cities, as in the smallest villages, the gas works would be the portal through which all our raw coal would be required to pass, and whilst it was the chemist to whom we must look for the achievement of that ideal, it was certain that he would need all the assistance he could obtain from his brother worker, the engineer, who had no longer the monopoly of "directing the Great Sources of Power in Nature for the use and convenience of man."

The President, after thanking Sir William Pope for his admirable abstract of Dr. Carpenter's paper, asked Mr. Evans to accept the medal on behalf of Dr. Carpenter. Mr. Evans, he said, was the chief aide-de-camp to Dr. Carpenter on the chemical side of his work, and he was an excellent representative of the team which had aided and was aiding Dr. Carpenter. He felt that in handing the medal to Mr. Evans the Society was in a sense stimulating Mr. Evans and his colleagues at Greenwich and elsewhere to give even more arduous service to the cause of chemical industry, and in that way the medal would gain still more in utility, though primarily awarded to honour the work of a great man. In accepting the medal, Mr. Evans said that he knew Dr. Carpenter was deeply appreciative of the honour conferred upon him by the Society. They had only heard late on the previous evening that Dr. Carpenter was unable to be present, and he could assure them that the cause of Dr. Carpenter's absence was something quite beyond his control, because he had been looking forward with great enthusiasm to meeting the members again and addressing them. Mr. Evans then went on to give what he described as an "impression of a student's appreciation of a master," stating, however, that did he convey a true impression of his appreciation for the achievements of Dr. Carpenter, he might offend, owing to Dr. Carpenter's modesty. After describing

Dr. Carpenter's demand for a gas of constant quality, and the devices which he had designed and the organisation which he had built up to effect this, Mr. Evans thanked the Society in the name of Dr. Carpenter for the honour bestowed upon him and expressed his regret that the recipient had been unable to be present in person.

Mr. W. J. U. Woolcock, Manager of the Association of British Chemical Manufacturers, said that the man to whom the Society had given the greatest honour it could bestow, was a very many-sided man, but they were not so familiar with the various aspects of his character as they might have been because Dr. Carpenter repressed himself in many directions. He was a great lover of art, a student of literature, a born expert witness, as well as a great scientist, not to mention one of those chiefly responsible for the development of co-partnership. There was something about him which told his workpeople that he was a man who had other thoughts beyond his immediate work, and had thoughts and ideals for his workers. Both the Association of British Chemical Manufacturers and the industry owed a great debt to Dr. Carpenter. Previous attempts to unite chemical manufacturers in this country had failed until Dr. Carpenter applied himself to the task, seizing the opportunity and enthusiasm due to the war. The action taken by Dr. Carpenter, then President of this Society, in conjunction with the then Presidents of the Society of Dyers and Colourists and of the Chemical Society was most far-reaching. The question of the disposal of the chemicals produced by gas companies had always been one which might at any time have wrecked the industry, for gas companies on the one hand had the security of their Acts of Parliament and the necessity of disposing of their by-products to produce gas at a reasonable price, whereas the chemical manufacturers had no constant product such as gas to help them out in making and selling chemicals in this country. The problem of solving this possible conflict of interest between gas companies and chemical manufacturers was solved by the genius of Dr. Carpenter, and the solution was a monument to his tact.

DR. ASTON ON "ISOTOPES"

On Friday afternoon we listened to a capital address by Dr. F. W. Aston, F.R.S., on "Isotopes." Dr. Aston sketched the once rival hypotheses of Dalton and Prout, and showed how the knowledge we possessed during the nineteenth century compelled us to reject that of Prout. But the discovery of radioactive bodies seemed to show that bodies with identical chemical properties but different atomic weights could exist, and in the year 1910 Professor Soddy definitely put this idea forward as the only explanation which seemed to fit the facts. Such elements he called Isotopes, and in 1912 and 1913 Sir J. J. Thomson demonstrated the existence of two isotopes of neon. Dr. Aston was then assisting Sir J. J. Thomson in this work, and he schemed a detailed examination of the elements by a greatly improved method he had devised. The outbreak of war interfered with this piece of research, but so soon as the war was over Dr. Aston attacked the problem with vigour, and has now measured with an accuracy of one part in a thousand the mass of the various isotopes of hydrogen, helium, lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, neon, sodium, magnesium, aluminium, silicon, phosphorus, sulphur, chlorine, argon, potassium, calcium, iron, nickel, zinc, germanium, arsenic, selenium, bromine, krypton, rubidium, tin, antimony, iodine, xenon, cæsium and mercury. Some few of these elements have also been measured by Dempster and some by G. P. Thomson, but to the credit of Dr. Aston must be placed by far the largest number of determinations to date. Of the isotopes investigated, all, with the exception of hydrogen and tin, have atomic weights which are whole numbers. It would not, however, be at all surprising if some other elements with high atomic weights have isotopes which are not whole numbers. These determinations are of far-reaching importance in the theory of chemistry, and the Society was both prudent and fortunate in securing the address from this brilliant experimenter. The next feature on the Society's programme was the Garden Party at Sidney Sussex College. The Master of Sidney Sussex and Mrs. Weekes welcomed us all very cordially, and showed us a number of interesting things; in their house and garden they are rich beyond the dreams of avarice, and many chemists who spend the bulk of their time in Widnes, St. Helens, Stratford and Silvertown, would gladly act as *locum tenens* at Sidney Sussex, if a temporary exchange of duties were mutually acceptable.

THE BANQUET AT TRINITY

The Annual Dinner was held in the hall of Trinity College on Friday evening, the President in the chair. The attendance numbered roughly 230, including a number of Cambridge guests. The loyal toast having been duly honoured, Mr. W. J. U. Woolcock proposed the toast of the University of Cambridge. The Society was extremely fortunate in meeting at Cambridge this year and in receiving the wonderful hospitality of the University. It was appropriate that the Society should come to Cambridge to join with members of the University in discussing scientific subjects because the foremost position held by Cambridge in the scientific world was well known. The members had had a most delightful time in Cambridge, and had come to the point when they had to express their thanks and to say how very sorry they were to go. He referred to Sir William Pope, who had represented both the members and the Cambridge authorities as occasion required, and to Mr. J. E. G. Harris, of the University chemical laboratory, who had contributed very much to the enjoyment of the members. He coupled with the toast the name of the Vice-Chancellor who had welcomed the Society to Cambridge and received the members in the FitzWilliam Museum. The Rev. E. C. Pearce came of a very distinguished line of Vice-Chancellors, and there were not many Vice-Chancellors with a longer record of service; in fact, only three Vice-Chancellors had maintained that office for three years. The Society would remember its visit to Cambridge, and in thinking of it would remember that the Vice-Chancellor of that time was a most perfect host. The Vice-Chancellor, responding, said that he had the honour of addressing an audience of chemists, but he was in ignorance of the rudiments of the science. He then referred to the University's Bill which was then being discussed in the House of Commons, and said that owing to the financial position at Cambridge the Government had offered assistance, but he hoped the Government would realise that Cambridge had not sold its independence. In conclusion the Vice-Chancellor said that he was very glad that the members had come to see the place where chemists were made, and hoped that in due time they would return.

The Master of Sidney Sussex College, the Rev. G. A. Weekes, proposed the Society of Chemical Industry. Sir William Pope had asked him to propose the toast, and as he was so little qualified to do it justice, he began to make inquiries about the Society and had been using his powers of observation. He was greatly impressed with the youthful vigour of the members of the Society, whether at a reception, dance, smoking concert or dinner, and from his observations he should say that they applied the same concentration of mind and youthful vigour when they dealt with serious problems. It said much for the Society's perspicacity that the centre of industry chosen this year for their meeting was the University of Cambridge. It would not be too much to say that Cambridge was one of the great power stations of the country, energy being supplied by the professors, teachers, and other investigators doing scientific work. Its staple industry was education, and he had observed with interest that the President had emphasised the necessity of combining the theoretical with the practical. If the Society was trying to teach the country this necessity it was doing a very great service, not only to the industry, but also to the nation. He coupled with the toast the name of the President, for whom he had conceived a very profound respect. In response, the President said that after Mr. Woolcock's speech it only remained to add the Society's thanks to the Mayor of Cambridge. They had had a busy week, almost a frivolous one, but there had been time to consider the inner meanings of things in a place such as Cambridge. They came to Cambridge as the embodiment almost of a new age because chemists were the embodiment of the first rank of industrial progress. As President of the Society, he might well say to Sir William Pope as President of the International Union, and paraphrasing the words of Bishop Latimer, "Play the man, Master Pope, for this day we have lit such a torch in Cambridge, the torch of a new chemistry, which I trust will never be put out." Those who had listened to the reports presented to the International Union had been struck by the fact that the subjects dealt with represented in each case the overthrow of past views of chemists. Something new had taken the places of those views. Dr. Aston, in his lecture, had advanced an entirely new conception of the most fundamental facts in chemistry, therefore he was justified in his exhortation to one of the greatest leaders of the present time. He exhorted everyone to resolve that the Cambridge meeting should lead to earnest striving for the advancement and betterment of the profession of chemistry.

Sir William Pope, in proposing "The Guests," spoke of the guests from across the Atlantic and the stimulus their work had given to modern chemistry. There were also representatives of other nations, including a very prominent representative of Italy, Prince Ginori Conti. Mentioning Prince Ginori Conti's work on the utilisation for power of the steam produced in volcanic centres, Sir William Pope said that when one considered the resources of this kind which Italy had one could understand that with such a man at its head Italy would be the country of the future. He then referred to Monsieur Paul Kestner, who was President of the Société de Chimie Industrielle, and remarked on the collaboration between that Society and the Society of Chemical Industry. He hoped that this collaboration would always continue and the only complaint he had to make was that Monsieur Kestner showed himself too seldom amongst the members.

In reply, Monsieur Paul Kestner said that the President had made a grave error in asking him to reply to the toast. The honour of replying rightly fell to a guest, and he asked by what right the Society had considered him as a guest. He had joined the Society thirty-five years ago, was one of the senior members, and had formed many precious friendships among generations of eminent members. However, he would lay aside his dignity as a member of the Society and become like Maître Jacques in Molière's comedy: Jacques was both coachman and cook, so when his master wanted to speak to the cook he removed his coachman's hat and appeared dressed as a cook. Monsieur Kestner therefore would now appear as a cook; indeed chemists were often called cooks. In making such a comparison he was sheltered by the authority of a special correspondent who had represented *Chemistry and Industry* at the recent Pasteur Celebrations. That special correspondent, in the columns of *Chemistry and Industry*, had declared and proved Pâté-de-foie-gras to be a synthetic organic chemical. After addressing Sir William Pope in French, he expressed the thanks of the foreign guests for the hospitality of Cambridge and pointed out that the annual meetings of the Society were attaining more and more effect in establishing and tightening the bonds of friendship between scientific and technical chemists of every civilised nation. Unfortunately academic duties had prevented many from accepting invitations to join in the meetings during that week. Last year the annual meeting of the French sister society clashed with that of the English society, and this prevented many British friends from visiting Marseilles, where the meeting was held. He hoped in future arrangements would be made to prevent the various annual meetings from interfering with one another. Such an arrangement was all the more important in that French chemists could not regard any of their own celebrations as complete without the presence of their English colleagues, and he could assure them that an identical view was taken by the chemists of every nation represented in the International Union. Neither English nor French provided him with sufficiently eloquent terms with which to thank the University, the British Federal Council and the Society of Chemical Industry for the cordiality of their reception, and he paid special tribute to Sir William Pope who had rendered great service to his country by conferring upon it a reputation for cordiality and friendliness.

EXCURSION TO ELY

Throughout the week the weather steadily improved; the earlier days were grey, showery and bitterly cold, but we had pleasant conditions for the garden party at Sidney Sussex, and for our one excursion the weather was superb. We motored to Ely in charabancs, and were met by the Dean, who very kindly devoted the greater part of the morning to showing us round and explaining the history of the building and the features of special architectural interest. There was ample time to see the Cathedral, and after the preliminary tour one could spend a quarter of an hour admiring the late Norman nave or the Early English choir. And after lunch we gradually made our way to our homes.

Most of those who attended the meeting at Cambridge agreed that an occasional visit to some University centre is very desirable. Hitherto our meetings have been deliberately held in industrial centres and visits to works have been conspicuous features. It is well every few years to have such a meeting as this; it is good for the Society to become better acquainted with the life, the professors and the laboratories at our old Universities. It is perhaps good for the Universities to have fuller opportunities of meeting manufacturers and works chemists. The President in his address dealt with the education question from the point of view of the manufacturer, and he by no means covered the whole field of this problem. Some day this must be discussed again, and an exchange of views will take place which will be more useful after such an experience as we had at Cambridge. The geniality of our reception, the great hospitality, both official and private, shown to us, and the pains taken by all to make our visit both useful and happy have made a lasting impression on us. Naturally the President and Honorary Treasurer and Honorary Foreign Secretary were present; other members of the Council who attended were:—Messrs. Ardern, Burrell, Butler, Bedson, Cranston, Carr, Cox, Colgate, Garland, Hinchley, Jones, Levinstein, Monier-Williams, Morgan, Marsden, Maxted, Radcliffe, Trobridge, Thompson, Woolcock, Waterfall and Young. Other members of the Society who attended for the whole or part of the meeting were:—Messrs. Andrews, Anderson, Adan, Byard, Bolton, Barry, Boyce, Bowley, Burford, Barber, Bennett, Boardman, Bernard, Prince Ginori Conti, Messrs. Brown, Braunholtz, Berry, Blizzard, Chaston Chapman, Cross, Cullen, Collett, Clayton, Chapman, Dunningham, Damon, Davies, Drummond, Davis, Dorée, Greenwood, Goldsmith, Greenfield, Goodwin, Gibson, Heaton, Hart, Hill, Horner, Hooper, Hilditch, Horton, Humphries, Jerdan, Jennison, Jordan, Johnston, Jones, Kanga, Kestner, Lomax, Lessing, Leonard, Mann, Mason, McWilliam, Marlow, Morrell, Marshall, Macadam, Moore, May, McLaren, Ogg, Phillips, Procter, Pickard, Rodd, Roff, Radford, Robinson, Smith, Sibbald, Sturrock, Sutton, Stuart, Tainsh, Wood, Walker, Wright, Weyman, Wright. One of our lady members (Miss Dorothy Webster) was able to attend, and about fifty members were accompanied by their wives, so that the attendance altogether was a large one. The General Secretary (Dr. Longstaff), the local organiser (Mr. J. E. G. Harris), and the members of their staffs had a great deal of hard work in organising the functions so successfully, and must feel pleased that all enjoyed themselves so thoroughly. The other officials of the Society attended, but the meeting was to them a holiday.

The Council Meeting held in the Arts School in the morning of June 21 has not been so far officially reported, but we are informed and verily believe that it was decided that next year the Annual Meeting will be held in Liverpool. After the Council Meeting the Society was formally welcomed to Cambridge by the Vice-Chancellor of the University and the

Mayor of the Borough, and then the President delivered his address. Although this has already been published, there are certain passages in it which will furnish us with topics for comment, and it will be convenient to summarise them in this article.

THE PRESIDENT'S ADDRESS

Industry cannot afford to neglect chemical science and its teachings. Just as in the domain of sociology those who disregard the past are not likely to cherish any real visions for the future, so in industry neglect, that is, disregard of science, will inevitably lead to failure to progress. There can be no question that the future of industry largely depends on the application of scientific principles to production, and that chemists should be exceptionally competent to advise on such matters.

In any technical business—and all manufactures are highly technical nowadays—so long as all goes well the chemist is scarcely required, production being a question of organisation and management. But things never do go well for a long period of time ; difficulties are always arising, and it is then that the co-operation of the technical expert—of the scientifically trained man, the chemist—is required.

As regards those entering industry, I think many of my colleagues will agree with me that the time is ripe for a Conference with the teachers and a broad exchange of views either in public or in private where frank speaking can be the order of the day. I think I am justified in saying that we manufacturers find it very difficult to get the type of man we require. Possibly our Society can organise such a Conference, and I have in mind the utility of a somewhat similar meeting with Professor Meldola in the Chair, held under the auspices of the Institute. My remarks must not be held to place the blame on the teachers ; perhaps the material they have to work on is unsuitable.

The object of industry is definitely financial ; the object of industrial research is to work out new processes or improve existing onces. Investigations which have for their object the solution of special difficulties of particular processes and the utilisation of waste materials are not researches in the true sense of the word, although the solution of such problems would be to the financial advantage of the industry. These are matters more for the particular firm than for a research association.

Any assemblage of men of science willing to face the facts will agree that science, scientific method, and scientific research have not yet won that position within the realm and its industries that is requisite if we are to maintain our place among the nations.

It is desirable in my opinion to make a definite pronouncement on the need of co-ordinating in some way or other our various chemical societies, even at the risk of repeating much of what I have said during my visits to the sections.

* * *

It was pleasant to wander about the Colleges, to admire the Chapel of Kings, the Combination Room of Peterhouse, the gardens of Magdalene, the spacious court of Downing, the quaint hall of Queens, the bridge of Clare, and the score of other beauties which we had brief chances of enjoying, to see the members of the Society

Come forth by twos and threes,
From the broad tower of Trinity,
From the green gate of Caius.

Six centuries of civilization, of history and of learning cannot be properly treated in a few columns of ephemeral chemical news.

* * *

The Reception by the Vice-Chancellor of the University at the Fitzwilliam Museum may have pleased some of the guests. Personally we should have preferred to have spent a few hours wandering about and seeing the treasures of art, not distracted by friends and acquaintances, by ices and cakes, by greetings and jests. The pottery, the majolica, the pictures and the manuscripts are superb, and we hope in the future to have due time to see these in a leisurely manner. It is hard to have the latest gossip from Liverpool, and the opportunity of seeing a Corot at the same instant of time. It is not the fault of those who provide so much for us, but our fault for possessing an insufficiently nimble mind.

* * *

In due course we made our way to the Guildhall, where the band and the floor were both good. The arrangements for dancing and sitting out were stated to be excellent, and the reception enabled both the Cambridge residents and the chemical visitors to become better acquainted.

At the Dance we noticed our President gaily disporting himself and apparently enjoying it. This is all very well for the young, but you wait until you get a bit grey, as Horace puts it :—

Sperne, puer, neque tu choreas,
Donec virenti canities abest
Morosa.

One lady who seemed to have neglected her original partner for a temporary co-ordination with the President was chided in suitable terms and overheard to remark to the neglected swain in a soothing voice :—

Though you be treacherous as audit
When at the fire you've lately thawed it,
For E.F.A. no more I'd care
Than for their plate the Dons of Clare.

Perhaps some local reader may explain this abstruse allusion to us. In any case we ought to be grateful to our President for his strenuous and successful advocacy in support of a dance. It will no doubt become a regular feature of our Annual Meetings, and the older members of the Society must make assiduous practice compensate for their lack of youth.

COLOUR USERS' ASSOCIATION

The annual meeting was held in Manchester on June 19, the chairman, Mr. H. Sutcliffe Smith, presiding. After reviewing the activities of the various committees of the Association, Mr. Sutcliffe Smith referred to the Dyestuffs Advisory Licensing Committee and said that the chief difficulty with applications was on the score of price differences. The Licensing Committee stated officially on September 30 last that, temporarily, applications would be granted when British prices were more than three times pre-war level and higher than current foreign prices. If a colour could be made here, the British makers were given the opportunity of supplying it at the foreign price quoted or at three times pre-war price, whichever was the higher. If the makers could not do this, the user was granted a licence to import.

In discussing the work of the Dyestuffs Industry Development Committee, Mr. Sutcliffe Smith urged it to tackle the cost of production, the prevention of overlapping and the interchange of intermediates, so as to reduce the price of British-made dyes. The Committee might also consider how to facilitate the production, at an early date, of dyestuffs not yet made here, and for which import licences were now issued, the import value during 1922 being :—Germany £375,675, Switzerland £694,740, other countries £33,404, a total of £1,103,819. He deplored that the committee had not executive power, so that constructive views for placing the dye-making industry on a better footing could be carried out. We were called upon not only to pay high prices for home products, but the import prices were at a very high level, the average price per pound of finished coal-tar dyestuffs, excluding indigo and alizarine, having increased from 11·7d. per lb. in 1913 to 79·2d. in 1920, 66·7d. in 1921 and 65·8d. in 1922. A deputation had interviewed the President of the Board of Trade to urge that British makers should reduce their prices to a maximum not exceeding three times the pre-war level and that if the makers refused to do so, the Licensing Committee should grant licences to import foreign dyes and apply a similar factor to the prices of reparation dyestuffs. The request to reduce prices from 300 or 400 per cent. to 200 per cent. above the pre-war level was not unreasonable, as at present the whole cost of establishing the dye industry in this country was being borne by the users. A further serious aspect of the situation was the effect of the high prices of British products on the prices of foreign colours sold in this country, the foreign producers taking full advantage of the artificial state of the British market due to the Dyestuffs Act. The average value of colours imported from Switzerland in 1922 was 101·5d. per lb., approximately seven times the price in 1913, whereas the selling price of foreign colour was less in France, Italy and Germany. Further, reparation colour was sold by the Board of Trade at a large profit on the same high scale, so we were deprived of competition from lower rates in that direction, whereas had those prices been reasonable, they would have tended to reduce foreign prices. We thus appeared not only to be subsidising the British dye industry and increasing revenue to the Treasury, but supporting the foreign colour-maker as well. He had no reason to doubt that the British makers were making 80 per cent. of the colour used in this country, but he could not account for the imports ; if these represented only 20 per cent. of the total consumption, the total cost to the users must be many times greater than was realised. Imports of foreign colours, exclusive of intermediates, in recent years equalled an average annual import of 5421 t., worth £3,472,793. It was fair to assume that a large stock was carried forward from 1920 imports to 1921 and 1922, so that if British makers were providing 80 per cent. of requirements, the total colour used was well up to pre-war quantity. He could not agree that the consumption much exceeded 60 per cent. of the normal. It was evident, however, that a considerable tonnage of imported colour could be manufactured here and thus enable the makers to increase output and bring their prices down. If the British maker could not reduce prices without financial assistance, then the Government should give a grant in aid. There was a definite pledge to the users that the cost of establishing the industry should not fall unduly upon the using industries, and, remembering that the establishment of the industry was necessary for national security, it was only fair that the nation should bear its proportion of the charge. Recently it was stated in the House of Commons that the total sales of reparation dyestuffs up to March 31 last were over £1,000,000. If the total proceeds from selling reparation dyestuffs were placed at the disposal of the British dye-makers through an independent committee, it would probably form the basis of a fund to support the industry for another two years. Describing the procedure for obtaining reparation dyestuffs, Mr. Sutcliffe Smith observed we were not making the fullest use of the facilities afforded by the Reparation Agreement, and the sale of reparation dyestuffs was being largely used, not directly to assist the users, but as a means of obtaining additional revenue for the Treasury. It was time to review the procedure of obtaining reparation dyestuffs in the light of the experience of the past two years. A standard list of essential colours made in Germany but not made in this country had been prepared by the users and agreed to by the British makers, and he suggested that this list should be used as the basis of a new reparation arrangement with the German Government in consultation with the Association and that the selling prices should be fixed by an independent committee collaborating with the users. The occupation of some of the German dye-works by the French and the removal by them of part, at least, of the stocks was of serious interest to colour users in this country. There was, as yet, no official information on the course which the French and Belgian Governments proposed to adopt with regard to the stocks seized, but he was satisfied that the British Government was closely watching the position and taking all possible steps to safeguard British rights.

SOCIETY OF GLASS TECHNOLOGY

The last ordinary meeting of the session 1922-23, was held in Leeds on June 20.

The first paper was presented by the President, Prof. W. E. S. Turner, D.Sc., his subject being "Specifications in the Glass Industry." Prof. Turner pointed out that certain types of glass, *e.g.*, optical glass, were bought on specification and had to conform very strictly to certain properties. But in the enormous industry that produced containers for liquids and solids, no one seemed to have attempted to make or even purchase on the basis of specification. Several recent cases emphasised that lack of precision in the industry. For example, a fairly recent law case was fought round the quality of bottles supplied, and the evidence showed that, so long as the purchaser obtained something which had the shape of a bottle, the actual quality of the glass was apparently not specified. Several other cases of note had recently arisen, all pointing to the need of deciding to what specification different glass articles should conform. If the glass industry were to insist that furnace-material makers should provide refractories, for example, to specification, then the glass manufacturers themselves must at least show they were prepared to supply their own goods to specification. Prof. Turner then dealt with specifications which he thought might be made the working basis for common articles such as medicine, beverage and other bottles.

Mr. Th. Teisen, B.Sc., then contributed some "Notes on the Design of Pot Arches," illustrating his remarks by means of lantern slides. Criticising the old type of pot arch, Mr. Teisen said the flue outlet for burnt gases at the back wall near the bottom was certain to give cold pockets inside the furnace, but the ensuing lack of proper heat distribution could be somewhat helped by longer soaking, as this tended to equalise the heat. The fire boxes being open, the fire itself was not under proper control. An experienced fireman, however, would endeavour to overcome this by his method of firing, which was by no means so simple as was commonly assumed. The Continental type, with direct fired furnace, fire-box below, combustion flues and air flues leading to the uptake at the back of the chamber, and fumes passing through holes in the floor near the front and thence to the chimney, was a better design; but the arranging of it in the glass-house was not so practical. With the entry of the gas-fired pot furnace in the glass industry, a demand had arisen for a more modern type for heating pots. Mr. Teisen then described a gas-fired recuperative pot arch, which he designed some years ago, and which proved a success. He also described a pot arch at work at Messrs. Moncrieff's works at Perth, where during the first stage of burning, a low fire was kept on the grate, fed through the ash door. The secondary air slide was closed, and the furnace was in other ways directly-fired. For the purpose of driving out the natural and the combined water without producing surface cracks, water was kept dripping on the firebars, as well as on a plate arranged in front of them, thereby producing a certain amount of steam, which helped to prevent the surface parts from drying too quickly and allowed the moisture in the inside to evaporate at the same rate as that in the outside. That type took up little space and gave satisfactory results.

A paper entitled "Notes on the Ashley Bottle Machine" was read by Mr. S. English, who remarked that to one familiar only with modern glass-forming machines it might be surprising to hear that the home of bottle-making machinery was on this side of the Atlantic; but such was the case, and it was only after the possibility of making narrow-mouth bottles satisfactorily by machines had been proved here, that such bottle-making machinery was introduced in America. The first machine to make narrow-mouth bottles at all satisfactorily was designed and built by H. M. Ashley at Ferrybridge (Yorkshire), and it came to be developed in the following way. About 1866, the postmaster at Ferrybridge, Josiah Arnall, had occasion to go to the bottle works, which were situated within his district, and after seeing the way in which bottles were gathered, marvered and blown, he conceived an idea, which he thought might enable bottles to be blown by machinery. He submitted his idea to a prominent South Yorkshire bottle manufacturer, but apparently it was too crude or too revolutionary to be taken up. Nearly twenty years later H. M. Ashley, the manager of an iron foundry near the post office, went to live with Arnall, and there can be no doubt that Arnall discussed with Ashley his ideas concerning the possibility of blowing bottles by machinery. As a result of such discussion Ashley built an experimental machine in which glass was poured into an inverted mould, which was fitted with a plug to form the inside of the neck and with a movable top plunger. When a charge of glass had been placed in the mould, the sliding plunger was brought down on top of it, thus pressing it down around the fixed plug and forming the neck. Compressed air was then admitted through the plug, blowing up the bottle and at the same time raising the sliding plunger to the desired extent. Such an arrangement was very simple, and was naturally unsuccessful, but it had sufficient good points to cause Ashley to try to develop it into a useful machine. The first step in its improvement appeared to have been an appreciation of the fact that three moulds were necessary, one for forming the neck of the bottle, the second for giving a preliminary form to the main body of the glass, and the third for blowing the finished bottle. This provision of a ring mould, parison mould and blow mould was the foundation on which all Ashley's experimental machines were built, and has been incorporated in every successful machine since.

CHEMICAL SOCIETY

Eight papers were announced for reading at the meeting of the Society on June 21. For the presentation of these the time requested by the authors totalled two hours ten minutes apart from any time occupied by discussion or reply. The President, Prof. Wynne, therefore limited the time for the reading of each paper to fifteen minutes, expressing the hope that in reality ten minutes might suffice. One author took at least his full quantum; the rest, it is to be feared, sacrificed lucidity to brevity.

(1) In "The Constitution of the Higher Oxide of Nickel," Mr. O. R. Howell dealt with the composition of the precipitate formed when nickel sulphate is precipitated with alkaline hypochlorite. The higher oxide formed is unstable, and on decomposition the mean composition falls below that of the sesquioxide. The main reactions are :—

$$\begin{array}{lcl} 2\ \mathrm{NiO_2} & \overset{\mathrm{NaClO}}{\longrightarrow} & \mathrm{Ni_2O_3} \\ \mathrm{NiO} & ,, \ \rightarrow & \mathrm{NiO_2} \end{array}$$

intermediate combinations such as $\mathrm{NiO_2,3\ NiO}$ being formed. The formation of the higher oxide $\mathrm{NiO_2}$ has its counterpart in the oxide of cobalt $\mathrm{CoO_2}$, which explains the action of cobalt oxide CoO as a catalyst in the production of oxygen.

(2) "The Relationship of the Tautomeric Hydrogen Theory to the Theory of Induced Alternate Polarities," by F. Allsop and J. Kenner. Dr. Kenner criticised the reaction of Macbeth and Pratt, *e.g.*, $2\mathrm{XC\ (NO_2)_3 + N_2H_4 + 4KOH = 2C\ (NO_2)_3K + N_2 + 2KX + 4H_2O}$. He considered the ordinary theory of induced alternate polarity gave only a partial explanation of such reactions, and that the tendency to acquire a tautomeric hydrogen atom provided a better explanation. Prof. Thorpe pointed out that not any one condition determined the course of a reaction, and to any one explanation there were many contradictions.

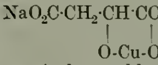
(3) "The Relative Influences of Water Vapour and Hydrogen Upon the Combustion of Carbon Monoxide—Air Mixtures at High Pressures," by W. A. Bone, D. M. Newitt and D. T. A. Townend. Prof. Bone showed the result of combustion of carbon monoxide with air, dry, saturated with moisture or with actual excess water present or with hydrogen in addition, in a special bomb apparatus employing an initial pressure of 50 atmospheres. Curves were given to show the pressure readings at intervals after combustion or explosion. The author explained that his results appeared at first sight to be at variance with those of Dixon and of Wheeler, but that in reality they were not so, the apparent non-agreement being due to different conditions in the respective experiments. The contention that nitrogen is made "active" by radiation was merely mentioned, the proof of this being left for a subsequent paper. Interesting spectroscopic evidence in conjunction with Prof. Fowler was given that complexes were formed when carbon monoxide burns in moist air.

(4) "Electron Valency Theories and Stereochemistry," by S. Sugden. The author pointed out that difficulties arose in applying either a static or dynamic theory of valency to the facts of stereochemistry. Replacing a double bond by a covalency and an electrovalency will not account for the existence of geometrical isomerides. Dr. Ingold pointed out that the facts of chemistry given by van't Hoff were vital, and modern theories must take account of them.

(5, 6) Two papers were communicated by Mr. I. W. Mark : "Metallic Hydroxy-acid Complexes." Part I., Cuprilactates. "Metallic Hydroxy-acid Complexes." Part II., Cuprimalates, their formation, properties and composition. The importance and number of metallic complexes with hydroxy-acids and polyhydric alcohols was shown. Any attempt at classification must account for points of similarity or dissimilarity between these compounds and the esters formed between compounds containing hydroxyl groups and, say, boric and phosphoric acids. Normal cupric malate underwent a peculiar change when dehydrated ; thus :—

$$\mathrm{CuC_4H_4O_5 \rightleftarrows HCuC_4H_3O_5}$$

Six metallic salts of the latter (cuprimalic acid) had been isolated and analysed. For the sodium salt



$$\begin{array}{l} \mathrm{NaO_2C{\cdot}CH_2{\cdot}CH{\cdot}CO} \\ \qquad\qquad\qquad\quad\ |\qquad\ | \\ \qquad\qquad\qquad\quad \mathrm{O{-}Cu{-}O} \end{array}$$

was suggested.

The comparatively stable nature of the compound was perhaps due to ring formation. When such a ring formation was impossible, *e.g.*, in the case of sodium cuprilactate, the compound was readily hydrolysed.

(7) "Ring Chain Tautomerism." Part VII. "The Mutarotation of the Sugars." By J. W. Baker, C. K. Ingold and J. F. Thorpe.

(8) The last paper, "New Halogen Derivatives of Camphor." Part III. $\alpha'\beta$ and $\alpha'\pi$ dibromocamphor, by H. Burgess and T. M. Lowry, was held over by Prof. Lowry for want of time.

CORRESPONDENCE

THE OBJECT OF INDUSTRY

Sir,—Among so much that is wholly acceptable in Dr. Armstrong's Presidential Address it may appear hypercritical to direct attention to one phrase in it; my justification for doing so is that it lies so near the heart of the matter.

Is it true that "the object of industry is definitely financial"? If it is, possibly that explains why there are so many chemists judged to be failures; for there will be few who identify finance and life.

Surely the object of industry is something very much larger and better than a merely financial one. Profits, salaries, wages and dividends may be necessary, but in a really successful industrial concern they are among the by-products—the *means* to the end.

An object is always and inevitably an object of life; and the object of industry, it seems to me, is to further the objects of its customers.—I am, Sir, &c.,

Solihull, June 24 Henry L. Heathcote

"LUCIFER" v. "CALORIFER"

Sir,—Why Prof. Bone should seek to make me a co-respondent in this action I do not understand. I seem to be the buffer for all ribaldry in the scientific Press. Not long ago a certain "Age" attributed to me the authorship of sundry beery piscatorial utterances uncomplimentary to worshippers of the hydrogen Ikon. Now I am thought to be calorific, though I am as cool as a cucumber. Next I shall be told I am in orders in a Yorkshire Dale and blamed for my ignorance of lead.

Surely Prof. Bone does not expect me to advise without fee. He mentions none nor does he send a retainer through you. If he be serious in wishing for my opinion, I may say I should charge on distance, at superior surgical rates and extra for my report. Business men tell me they only value opinions when they have paid through the nose for them and I have no wish to waste *my* time; in saving Prof. Bone's, I should be paid at least the value he places upon his—with a *pour boire*. "Calorifer" must have been a simpleton to have attempted to aid him gratuitously; after reading the correspondence I, at least, shall not make the mistake. Still, as a chemist, one has duties to the elements, and, maybe, later on I shall feel called upon to intervene as King's Proctor, if nitrogen be further aspersed—then I shall expect you to raise a subscription on my behalf as a defender of the classical faith.

Prof. Bone seems himself to vibrate to carbonic oxide and to suffer from consequent lag of memory. At his request I paid a gratis visit, some time ago, to his laboratory and studied the linked sweetness of his long-drawn-out records. I well recollect coming to the conclusion that the peculiar lag which he has observed was due to the incidental interaction of azote and oxygen; I also recollect telling him so. If I were "Calorifer" I should refer his speculation, not to the "Liverpool School"—whatever that may be,—but to the department for mental defectives.

Perhaps by the autumn Prof. Bone will have learnt to describe his work in terms which even the oldest of us can understand, and not need to call upon any Daniel to interpret the message before him. I trust the case will be now taken off the list.—I am, Sir, etc.,

Henry E. Armstrong

Lewisham, S.E. 13
June 24

CHEMICAL JOURNALS IN JAPAN

Sir,—Supplementing the interesting letter of Mr. Akira Shimomura on this subject, may I call attention to the publications of the National Research Council of Japan to which he does not allude?

Following conferences in London and Paris in 1918, of the majority of Allied and Neutral Powers, the Japanese Diet passed the necessary Bills in July, 1920, and on August 26 of the same year the Constitution of the National Research Council of Japan was promulgated by Imperial Ordinance. The object was to encourage and facilitate scientific work, and for this purpose the Council is organised in eight divisions, each having its own publication committee. These divisions are:—(1) Astronomy and Geophysics; (2) Chemistry; (3) Physics; (4) Geology and Geography; (5) Botany; (6) Zoology; (7) Medical Sciences; (8) Engineering.

As an hon. member of the Tokyo Chemical Society I have regularly received their monthly journal and frequently have been tantalised by seeing on the cover in English the title of a paper which would have interested me, but being written in Japanese with Chinese characters I have been unable to decipher it. Now, however, the N.R.C.J. is endeavouring on the one hand to encourage authors to write their papers in one of the known European languages, and on the other to make abstracts of those papers which appear in Japanese and print them in either English, French or German. The abstracts are already appearing in the suitable division of the journal of the N.R.C.J., and I am sending you under separate cover for your inspection the first part of the *Journal of Chemistry*.

I also enclose the circular letter issued by the Council from which it will be seen that they are prepared to forward their journals to those institutions which can make use of them and who will state which division they wish. The universities also are very liberal in sending their Memoirs to anyone who desires them. I may instance the Imperial Universities of Tokyo, Kiyoto and Tohoku, Sendai.

I believe only one or two Englishmen are still living who served in Japan in the early days when she was adopting Western sciences. Divers, Ayrton, Perry and Milne are, alas! no more, but what they did for Japan lives after them.—I am, Sir, etc.,

Cardiff R. W. Atkinson

June 23, 1923

[The first part of the *Japanese Journal of Chemistry*, sent by Mr. Atkinson, contains two articles entitled "A Spectroscopic Method of Studying the Formation of Complex Salts in Dilute Solutions" (pp. 1-18) and "On the Chemical Constitution of Squalene" (pp. 19-33), and a number of abstracts covering twenty-two pages. The *Journal* is well printed in clear English and is of convenient size.—Ed.]

LEAD ARSENATE SPRAYS AND BEES

Sir,—I have read with interest Mr. W. F. Reid's letter on the subject of lead arsenate spraying. I am aware that injury to bees has been attributed to the use of this chemical, but have been rather sceptical about it. Has Mr. Reid satisfied himself that the loss in the particular apiary to which he refers was due to the bees absorbing lead arsenate with the nectar from the fruit-blossom? One meets with so many extraordinary superstitions and prejudices among bee-keepers that it is necessary to make quite sure of one's ground. In addition, the reverses of fortune to which bee-keepers have been subjected owing to disease and unfavourable weather have naturally made them suspicious. The loss of bees during the past winter and spring has been exceptionally heavy in this part of the country, owing to the bad weather last summer preventing the accumulation of winter stores, and consequent starvation. The loss, however, is not always attributed to its proper cause. It is, of course, quite undesirable to spray the trees when in bloom. Lead arsenate seems to be the most effective remedy for Codling moth, but the eggs of this moth do not hatch until after the blossom has fallen, and when the apples are setting is the best time.

The problem of rendering the spraying fluid objectionable to bees, if this is really necessary, does not seem to present any particular difficulty. I should suggest the addition of a small quantity of phenol, which is commonly used for subduing bees when examining the hive.

Mr. Reid's ingenious theory to account for the survival of blue-tits in his orchard is admirable, but has he ever offered a dead caterpillar to a small bird? There is something peculiarly unappetising about it. My recollection is of a head held on one side and a beady eye fixed on the inanimate object—and "nothing doing." I might add that I am not interested in the manufacture of insecticides.—I am, Sir, etc., W. S. Gilles

Bocking, Braintree, Essex

June 26

PERSONALIA

Mr. E. C. Williams, M.Sc., Vict., has been appointed to the New Ramsay Memorial Chair of Chemical Engineering at University College, London. Mr. Williams, who graduated in 1914, was a member of the staff of the British Dyestuffs Corporation, and since 1921 has been research chemist to the Joint Research Committee of the University of Leeds and the National Benzol Association.

Dr. R. J. S. McDowall has been appointed to the University Chair of Physiology, tenable at King's College, London.

Dr. H. S. Raper, at present professor of physiology and biochemistry in the University of Leeds, has been appointed Brackenbury Professor of Physiology in the University of Manchester.

Mr. A. B. Weir, B.Sc., A.I.C., has been appointed City Analyst at Aberdeen.

The first award of the Paternò Medal, founded to commemorate the 75th birthday and scientific achievements of the eminent Italian chemist, Senator Prof. E. Paternò, has been made to Dr. F. W. Aston. The award was made during the recent meeting of the International Union of Pure and Applied Chemistry at Cambridge.

Mr. W. Randerson, M.Sc., has been elected to the Albert Kahn Travelling Fellowship for 1923.

An anonymous gift of £20,000 has been made to the Sheffield University for the purpose of establishing an undergraduate scholarship in pure science, and several post-graduate scholarships for research in ferrous and non-ferrous metallurgy.

Sir David O. Masson, K.B.E., D.Sc., F.R.S., professor of chemistry at the University of Melbourne, was entertained to dinner on March 27, by the members of the Victorian Branch of the Australian Chemical Institute, to congratulate him upon receiving the honour of Knighthood. Speeches were made by several of the speakers describing Sir David Masson's work, which includes papers on the ionic theory of Arrhenius, the constitution of the atom, etc.

FORTHCOMING EVENTS

July 2. * The Faraday Society. Ordinary meeting in the Rooms of the Chemical Society, Burlington House, W., at 8 p.m. (1) "On a Relation Between Surface Tension and Density," by A. Ferguson; (2) "Concentration Cells in Methyl Alcohol," by J. Grant and J. R. Partington; (3) "The Law of Definite Proportions in the Light of Modern Research," by U. R. Evans; (4) "Determination of the Density of Charcoal by Displacement of Liquids," by J. B. Firth; (5) "The Formation of Anomalous Liesegang Bands," by F. G. Tryhorn and S. C. Blacktin.

NEWS AND NOTES

CANADA

Prospects for an Artificial Silk Industry

As imports of artificial silk, yarns and thread into Canada reached a value of $2,013,429 ($1,071,255 from the United Kingdom, $397,429 from the United States, and $377,136 from Belgium) in 1922, and purchases of manufactured goods, wholly or mainly of artificial silk, from the United States and the United Kingdom alone reached a total value of nearly $1,000,000, the National Resources Intelligence Bureau of the Department of the Interior has prepared a memorandum on the possibility of establishing the artificial-silk industry in Canada. Should acetate silk be chosen, a special advantage would be the low cost at which synthetic acetic acid can be made by cheap electric power, and a plant situated either in Ontario or in Quebec, where most of the textile plants are situated, would be favourably placed for the domestic market, labour conditions, proximity to raw materials, and also for transport facilities.—(*Ch. Comm. J., June* 15, 1923.)

AUSTRALIA

Metal Production in 1922

The Imperial Mineral Resources Bureau has received from its corresponding member in Australia (the Secretary of the Australian Metal Exchange) the following statistics of the production of refined lead, zinc, silver, copper, tin and iron, and the estimated metal content in ores, concentrates and other partially refined products in 1922 as compared with 1921 :—

			1921		1922
Lead	..	Tons	62,777	..	130,187
Zinc	..	„	21,297	..	159,414
Silver	..	Oz.	5,304,950	..	11,746,295
Copper	..	Tons	18,634	..	11,850
Tin..	..	„	2,990	..	2,657
Pig iron	..	„	352,365	..	83,535

The output of lead, zinc and silver has thus largely increased, but there is a decrease in the production of copper, tin and pig iron, due, in the last case, to the closure of the Newcastle steel works during almost the whole of 1922.

BRITISH INDIA

The New Mysore Distillation and Iron Works

The Mysore Distillation and Iron Works, which commenced operations on January 18, possesses 12 retorts capable of carbonising 240 tons of wood per day; a distillation plant for the recovery and manufacture of methyl alcohol, acetate of lime, and wood tar; and a charcoal blast furnace, with a daily output of 60 tons of charcoal pig-iron, low in phosphorus and sulphur. The wood for the retorts is supplied by the Mysore forest department from 350 square miles of well-wooded State forest, within easy reach of the works by a system of forest railway. Two qualities of wood tar will be recovered :—a "soluble" tar which will make a good disinfectant; and the "settled" tar, which possesses wood-preserving properties. The Mysore Government is considering a large scheme for the antiseptic treatment of railway sleepers with this wood preservative.—(*U.S. Com. Rep., June* 4, 1923.)

Final General Memorandum of the Winter Oilseeds Crop of 1922-23

Estimates based on reports received from provinces containing 98·7 per cent. of the total area under rape and mustard and 99·2 per cent. of the total area under linseed in British India, indicate that the acreage under rape and mustard totals 6,213,000 and under linseed 3,358,000. These figures represent a decrease of 2 per cent. below the areas of rape and mustard estimated at the same time last year, and an increase of 11 per cent. above the areas of linseed estimated in 1921-22. The condition of the crops is reported to be generally good, except in Bengal where the plants were adversely affected through continued absence of rain.—(*Ind. Tr. J., May* 31, 1923.)

UNITED STATES

Peat in 1921 and 1922

There was general depression in the peat industry in the United States during 1921, and many producers closed their works during the whole year. The production decreased by 58 per cent. in quantity, and 72 per cent. in value, to 42,798 short tons valued at $661,613. Despite the fact that the number of producing plants increased by 3 to 21, peat used in the manufacture of fertilisers decreased by 53 per cent. to 29,460 t., and that used in the manufacture of stock food decreased 93 per cent. to 946 t. in quantity. Imports, amounting to 3450 t., showed an increase of 25 per cent., but the price per ton fell from $13·11 to $6·60. Substantial progress was made, however, by the industry in 1922. The number of producing plants increased to 23, and the output increased nearly 100 per cent. in quantity and 52 per cent. in value to 60,680 t. valued at $397,729. Peat used in the manufacture of fertilisers showed an increase of 96 per cent. in quantity, a large increase also being shown by sales of peat used as fuel or as an ingredient of stock food. Imports of peat moss decreased by 1 per cent. to 3394 t., and no exports of peat or peat products were reported.

Fuel Briquets in 1921

Large stocks of coal were on hand at the beginning of the year, and the industrial demand was generally poor, so that the production of fuel briquets fell by 30 per cent. to 398,949 net tons, valued at $3,632,301. This represented a decrease in value of 21 per cent., although the average value per ton increased from \$8·15 to \$9·10. Of the plants that operated, 7 used anthracite culm as the fuel constituent, 2 semi-anthracite, one a mixture of anthracite culm and bituminous slack, one a semibituminous slack, one a mixture of bituminous slack and subbituminous coal, 2 carbon residue from the manufacture of oil gas, and one bituminous coal after low-temperature carbonisation; of the 401,129 tons of raw fuel used, 48 per cent. was anthracite and semi-anthracite, 21 per cent. sub-bituminous coal and gas residue, and the rest bituminous slack and coke. Asphaltic pitch and coal-tar pitch were used as binders for about 61 per cent. of the total output.

Argentojarosite, a New Silver Mineral

In a note in the *Journal* of the Washington Academy of Sciences (Vol. 13, No. 11), W. T. Schaller describes under the above name a new silver mineral from the Titanic Standard Mine at Dividend, Utah. The mineral, which forms small hexagonal scales of a yellow to brown colour and optically is uniaxial and negative, closely resembles jarosite, and has even been mistaken for it. From the average of several analyses its percentage composition is approximately, Ag_2O, 18; Fe_2O_3, 43; SO_3, 28; H_2O, 10; K_2O and PbO traces, corresponding to the formula: $Ag_2O.3Fe_2O_3\ 4SO_3.6H_2O$. Argentojarosite is the first silver mineral recorded which contains oxygen and is apparently sufficiently abundant to be mined as an ore.

GENERAL

Research in the Woollen and Worsted Industries

We have received a list of conditions of award of Research Fellowships and Advanced Scholarships by the British Research Association for the Woollen and Worsted Industries.

The Fellowships are of the annual maximum value of £200 and are granted for one year only, but may be renewed for a second year. It is contemplated that the Fellowship may be held at an educational institution but it is not intended to exclude individuals who dispose of other resources, *e.g.*, in factories. Publication of any research is subject to permission by the Research Association.

The Advancd Scholarships are intended to enable a scholar to carry his education a step further by way of specialisation and not to supplement or substitute county or other scholarships. In awarding these scholarships, the probability that the scholar could eventually undertake research work, would be taken into consideration. Among the subjects suited for textile students in this scheme would be zoology, physics, chemistry, economics, foreign languages, designing, etc. Applications for Fellowships or Advanced Scholarships must be made to the Secretary, Mr. A. Frobisher, B.Sc., at Torridon, Headingly, Leeds.

Radium in Soviet Russia

The Soviet Council of Labour and Defence has enacted that the mining of radium ore and the production of radium are to be controlled by the Supreme Council of National Economy. The Radium Institute of the Academy of Science is to store all the future production and to record the output and supplies on hand in Soviet Russia. It is estimated that the production of platinum in Soviet Russia during the last three months of 1922 was 1924 oz.

Assistance for the Beet Sugar Industry

At present the factories of Home Grown Sugar Limited and the English Beet Sugar Corporation Ltd., are working at capacity and offers for the further production of beet could not be accepted. As these companies have no capital available for building new factories, the British Sugar Beet Growers' Society, in response to inquiries from various sources, has got into touch with persons willing to assist in financing new factories and who can dispose of the necessary technical qualifications and expert staff. As a result of these negotiations, it is stated that the promoters of any scheme in a suitable district can be placed by the Society in touch with people willing to assist a limited number of such schemes subject to certain conditions. Further particulars can be obtained from the British Sugar Beet Growers' Society, 6 Lancaster Place, Wellington Street, Strand, W.C.

"Condensed Smoke"

To many people the idea that "condensed smoke" has a commercial value will seem absurd, yet it is actually in use on a fairly large scale in the United States, especially as a means of flavouring "smoke-cured ham." Smoke from hard-wood is preferred for this purpose, and, in the process used by E. H. Wright—who is the pioneer in this field—about 60 ℔. of smoke is produced from 100 ℔. of wood.

The business, which was founded in 1895, now makes an annual profit of half-a-million dollars. The process is not patented, but kept as a trade secret, and all that is known about it is that the smoke from hard-wood is condensed in an ordinary worm, and is "aged" before placed on the market. In appearance it resembles rye-whisky. No wood alcohol is present, the manufacturer having successfully won a law-suit brought against him by the United States Excise Authorities on this point. The sales are chiefly to farmers and other ham-curers, who are able, by means of "condensed smoke," to impart a desirable flavour to meat which would otherwise lack it. Incidentally, the business is another illustration of the benefits of some form of co-partnership, for, without the enthusiasm and loyalty of the workpeople, which the owner of the works attributes to their having a definite share in the business, it would not have weathered the storms to which it was subjected in its early days.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for June* 21)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia	Tinfoil, glassware	784
"	Hoop iron, mining equipment	785
"	Plant, etc., for pharmaceutical manufacturers	11446/E.D./C.C./2
British India	Glycerin, ferro-silicon (tender)	*
Canada	Hardware	788
"	Leather goods	11428/E.D./M.C./2
"	Smoke-abatement equipment	11427/E.D./E.C./2
Egypt	Builders' tools, pipes	803
France	Metal goods	795
"	Sugar, linseed, copper sulphate, tinplate	796
Netherlands	Sugar	798
Netherland E. Indies	Paint, asbestos sheets, medicines	809
Norway	Sugar	800
Rumania	Spring steel (tender)	10946/F.E./E.C.
"	Foundry coke (tender)	10943/F.E./T.C.
South Africa	Linseed oil, white lead, soap, artificial silk	789

* The Director-General, India Store Department, Branch No. 10, Belvedere Road, S.E. 1.

TARIFF CUSTOMS EXCISE

France.—An import licence is now required for benzol, benzine, toluene and spirits derived from coal tar.

Italy.—Exports of iron ores, except pyrites and scrap of copper, brass, bronze, cast and pig iron and steel are prohibited.

New Zealand.—A new tariff of classification, including copper and iron sheets, tinsmith's materials, etc., has been issued. A primage duty of 1 per cent. *ad valorem* is to be levied on these goods.

Norway.—The duty on sugar has been increased by 10 per cent.

South Africa.—Footware has been excluded from the operation of the Adulterated Leather Act.

Tunis.—Prohibition on the export of ammonium sulphate has been reimposed.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Merchandise Marks Bill

In reply to Lieut.-Col. Hilder, Sir P. Lloyd-Greame said he had received from the Co-operative Congress a resolution objecting to the Merchandise Marks Bill as being "unworkable, vexatious and protectionist in character."—(June 19.)

Applications for Patents

Sir P. Lloyd-Greame, answering Mr. Ede, said that the numbers of complete specifications still under consideration were as follows:—Received within the past 3 months 3157, received from 3 to 6 months ago 1650, from 6 to 9 months ago 600, from 9 to 12 months ago 120, over 1 year ago nil.—(June 19.)

Motor Spirit

Answering Mr. Hardie, Sir P. Lloyd-Greame gave the following figures of the consumption of motor spirit in 1922, the figures for 1914 being given in brackets:—Motor spirit, including benzol, 306,507,753 gallons (141,723,127 galls.), home produced benzol 11,155,756 galls. (17,713,227 galls.). In 1913 the figures were:—Motor spirit 117,524,421 galls., benzol, etc., 12,265,411 galls.—(June 19.)

Cost of Transporting Coal

Col. Ashley, replying to Commander Bellairs, said the average distance over which coal, coke and patent fuel was conveyed by rail in Great Britain in December, 1922, was 42·13 miles at an average rate of 3s. 9d. per ton, the average rate per ton mile being 1·07d.—(June 19.)

The Udi Coalfield (Nigeria)

Mr. Ormsby-Gore, in answer to Mr. A. T. Davies, said that the Udi coalfield was discovered by the Nigerian Government geologist in 1909, but it could not be worked until transport facilities were provided by building a railway of 150 miles from Port Harcourt. That railway reached the coalfield in 1916, and the Government colliery was now producing over 190,000 tons per annum. It was considered inadvisable to admit private enterprise to the field at present because: (1) The Government colliery was already producing more coal than is required in Nigeria and could now considerably increase its output with a corresponding reduction in the pit-head cost, and (2) the labour supply was limited. A private company would experience great difficulties in obtaining sufficient native labour, and competition by private enterprise at present could not fail to increase the cost of labour and therewith the pit-head cost of coal. Increased output and development depended on the possibility of marketing the surplus coal outside Nigeria, and the Nigerian Government would be glad to consider offers by private enterprise to undertake such marketing on an agency or contract basis.—(June 22.)

REPORTS

Report on the Economic and Financial Conditions in Mexico, dated September, 1922.

By N. King, *H.M. Consul-General, Mexico City. Department of Overseas Trade. Pp.* 25. *H.M. Stationery Office,* 1923. *Price* 9*d.*

The economic situation in Mexico still remains unsatisfactory (see *J.*, 1921, 438 R), and trade has been very depressed in sympathy with world conditions. Agricultural enterprise has suffered setbacks from legislation, providing for the partition of large estates into smallholdings; the maize harvest, however, a guide to the economic condition of the country, was good last year.

Data concerning mining are scanty, but the production of a few metals in 1921 (*cf. J.*, 1922, 374 R) was as follows :—Gold, 684,084 fine oz.; silver, 64,474,000 fine oz.; copper, 15,228 tons; lead, 60,513 t.; zinc, 1257 t. The mining industry is improving, and the increased price of silver gives producers more scope for extensions, whilst the Government has recently shown a desire to help the industry which may attract capital. The production of petroleum amounted in 1921 to 30,139,727 t. (24,061,846 t. in 1920); about 70 per cent. of the export is taken by the United States.

In 1920 imports into Mexico were valued at 357,550,442 pesos (1 peso = 2s. 0½d. at par), including chemical and pharmaceutical products, $24,041,724, and minerals, metals, and manufactures thereof, $83,778,834. Of the imports Great Britain supplied about 9 per cent., and the United States about 75 per cent. Exports in the same period amounted to $406,546,900, of which Great Britain took about 3·6, and the United States 88 per cent. British trade in Mexico is handicapped by severe competition from American and German merchants, but there is no reason why this difficulty should not be overcome.

Report on the Commercial, Industrial and Economic Situation in Italy, December, 1922.

By J. H. Henderson *and* C. H. A. Carpenter, *H.M. Commercial Secretaries, Rome. Department of Overseas Trade. Pp.* 73. *H.M. Stationery Office,* 1923. *Price* 2*s.*

Under the new régime in Italy efforts are being made to establish conditions favourable to trade. The worst feature of the outlook is, as in last year, the difficulty in balancing the budget (*cf. J.*, 1922, 223 R).

In 1922 Italian industries were still affected by trade depression, and those dependent on hydro-electric power suffered from a shortage of current owing to the drought of 1921. The total hydro-electric power developed in 1920-21 amounted to 4000 million kw.-hrs. During 1922 a tunnel was opened which enabled the iron ore of the Coque mines to be brought to the electric furnaces of Ansaldo at Aosta; this ore is as good as the best Swedish magnetic ore and will last for 30 years at the present rate of working, *i.e.*, 1000 tons a day. The accession of the mercury mines of Idria has made Italy the largest producer in the world of this metal. Petroleum production is still experimental, the total output for 1921 amounting to 4780 t. The sulphur industry has been almost extinct, but efforts are being made to revive it. The chemical industry in general is in a poor way, though some branches are doing well. Fertilisers have found increased demand, as have also home-produced dyestuffs, though the output of the latter is not yet up to full capacity. A plant has been established at Bordighera for the distillation of essential oils. The glass and pottery industries are suffering, perhaps more than any others, from Czechoslovakian, German and Austrian competition, and some factories have had to close.

Since July 1, 1922, trade returns have been compiled on a new system, and no comparison of the latest figures for imports and exports with those of previous years is possible. In 1921 imports amounted to 15,348·4 million lire, and exports to 7903·2 million lire. Thus exports formed 51·4 per cent. of exports, compared with 43·8 per cent. in 1920. For the first six months of 1922 this figure improved to 54·2 per cent.

The chief imports continue to be wheat, coal, and raw cotton, and the principal semi-manufactured imports are still mineral and other industrial oils, chemicals, and various forms of iron and steel. The main import from Great Britain is coal, 65·4 per cent. of the total import of 1,740,420 t. in 1922 coming from this source, whilst Germany supplied 27·2 per cent. principally on account of reparations. The principal chemicals imported are caustic soda, ammonium sulphate, copper sulphate, sodium sulphide, Glauber's salt, antimony and chromium salts; here, in addition to Great Britain, Belgium, Germany, France, and the United States are in the field, and Italian production meets part of the demand.

Report on the Economic and Financial Conditions in Bulgaria, January 31, 1923.

By D. MacKillop, *H.M. Commercial Secretary, Sofia. Department of Overseas Trade. Pp.* 15. *H.M. Stationery Office,* 1923. *Price* 6*d.*

Bulgaria made steady, and even remarkable progress during 1922. Reduced imports, especially of luxuries and non-productive articles, and increased exports have given the country a trade balance, which, though unfavourable, is comparable with that of an average pre-war year (*cf. J.*, 1922, 335 R). On the other hand, the general uncertainty as to the future in the Near East is unfavourable to trade, as is also the policy of the Bulgarian government, which acts in the interests of the peasant rather than those of the industrialist.

Of the natural resources of the country cereals and tobacco are the most important. The production of rose oil has decreased since 1915. The average annual output before the war was 4000 kg., but in 1921 and 1922 only 1500 kg. and 2000 kg. respectively, were produced. The sugar industry has never been in a strong position, owing to disputes between the beet-growers and sugar-manufacturers, and the 1922 production, 15,000 tons of sugar, was less than half the home demand. The output of coal from the State mines amounted in 1922 to 944,858 t., compared with 871,793 t. in 1921, a year in which 13,968 t. of copper, and 2534 t. of lead were produced. The growth of industry in 1922 was inconsiderable, and is not likely to become important in the near future.

The compilation of trade returns is slow, and the latest complete figures are for 1921. During this year exports were valued at 2,313,827,269 leva (the sterling value of the lev varied in 1922 between 604 and 765) and imports at 2,921,092,269 leva. For the first three months of 1922, however, exports increased and imports decreased, compared with the corresponding period of 1921. Of the imports in 1921 Italy supplied 20·9 per cent; Germany, 18·4 per cent., and Great Britain, 15·3 per cent. In view of the obstacles to British trade, namely, the depreciation of Bulgarian currency, cost of freights and customs dues, the trading position of Great Britain is not unsatisfactory. The British trader does not so willingly risk default in payment as some others and for this reason some Government offers for tenders have been passed by.

REPORT ON THE ECONOMIC, FINANCIAL AND INDUSTRIAL CONDITIONS OF THE UNITED STATES OF AMERICA IN 1922. *By* J. J. BRODERICK, *H.M. Commercial Counsellor, Washington. Department of Overseas Trade. Pp.* 204. *H.M. Stationery Office,* 1923. *Price* 5*s.* 6*d.*

The report opens with an historical survey of American trade conditions during the last century, tracing the transition, through the war, of the United States from a "debtor" country (in the sense of owing large sums as interest on foreign capital, etc.) to a "creditor" country, with exports largely in excess of imports. As a coal producer America holds the foremost position in the world. The output capacity is very elastic, as many small mines produce only when the demand is large. In 1921–22 the output of bituminous coal was 434,279,000 tons, but in 1918–1919, a period of heavy demands, 552,041,000 t. was produced. Coke is now mostly obtained from by-product ovens, and the total output reached high figures between 1916 and 1920. In 1920 51,888,000 t. was produced (60 per cent in by-product ovens), but this figure fell to 25,571,000 t. in 1921 (78 per cent. in by-product ovens). Very little coke is exported, and the production is a rough guide to steel manufacturers' demands. The chief products obtained in 1919 in the manufacture of 25,143,542 t. of by-product coke, were 289,000,000 galls. tar, 544,000,000 lb. ammonium sulphate, 50,000,000 lb. anhydrous ammonia, 415,642,000,000 cb. ft. of gas, and 92,000,000 galls. crude light oil. In 1921 the output of petroleum reached 469,639 thousand barrels (42 galls.) of crude petroleum. The home demand is greater than the home supply, but imports have been unnecessarily large, and big stocks are on hand.

Refined products comprise one of the chief exports of the country. The iron and steel trade experienced in 1922 a revival from the slump which commenced in the autumn, 1920, and steel production increased steadily in May. The copper industry experienced a serious slump when war demands came to an end. An association was formed in 1920 to hold for future export 400 million lb. of copper. The position improved greatly in 1922; most mines are now at work but the demand is still largely met by existing stocks. Spelter production, which had risen from 1150 million lb. in 1914 to 1909 million lb. in 1918, fell by 1921 to 461 million lb. The total zinc production in 1921 was only 200,500 t. (463,377 t. in 1920); but in 1922 there was a slow improvement, and surplus stocks were reduced and prices improved. Exports amounted to 48 million lb. of spelter and zinc sheets in the first seven months of 1922, compared with 4,000,000 lb. for the corresponding period of 1921. The magnesite, manganese, chrome and tungsten industries are in a weak state.

A detailed analysis of the textile, leather, chemical, vegetable oil and some other industries is postponed till the next report. The newly-established dye industry is now in a state of suspense, as a new tariff, although protecting lower grades, leaves competition in the higher grades open to foreign merchants. The chemical export trade has become important, having risen from 22,000,000 dollars in 1914, to 155,000,000 dollars in 1920.

The extensive exploitation of native sulphur beds in Louisiana and Texas has come within this period, and although war conditions were the primary cause of this the output has continued to increase; at present, however, production is in excess of demand. In 1921 1,879,000 t. of sulphur were mined. (For exports of chemicals from U.S.A. in 1922, see *Chem. and Ind.*, 1923, p. 444.)

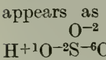
The total imports of merchandise into the U.S.A. in 1921 were valued at $2,509,000,000, and in the first ten months of 1922, at $2,570,000,000. In the same periods exports were valued at $4,380,000,000, and $3,107,000,000, respectively.

REVIEWS

The Chemistry Tangle Unravelled. *By* F. W. Gray, M.A., D.Sc. *Pp.* $x+148$. *London: Longmans, Green and Co.*, 1923. *Price* 6s.

The title of this book is one that invites challenge. The purpose which the author has in mind involves two distinct factors, and demands in the author two totally distinct types of qualification. The first is that he must be so clear-sighted as to be able to form a bold mental picture of the facts of chemistry, in which every detail is sharply focussed, so that there are no concealed ambiguities even at the back of his mind. The second is that he must have the faculty, possessed in an eminent degree by great evangelists and great music-hall artists, such as Gipsy Smith and Harry Lauder, of transmitting their own clear picture "across the footlights" to the crowds in front. These two faculties were undoubtedly combined in many of the great chemists of earlier days, and in a notable degree by Dalton and by Kekulé, both of whom found in a new nomenclature the means for conveying a new idea in so simple a form that it could be accepted even by chemists of a much smaller average mental calibre. It is possible that Dr. Gray possesses the first of the two essential qualifications, and that he himself has formed a sharply-focussed picture of the facts of chemistry; but his attempt to convey his message to the world at large is so unattractive that it would certainly drive away the "man in the street," although an earnest and diligent student might, perhaps, acquire, after careful study, a working knowledge of the author's point of view.

A nomenclature in which carbon dioxide appears as $C^{+4}\,O_2^{-2}$, and sulphuric acid as



$$\begin{array}{l} \quad\;\; O^{-2} \\ H^{+1}O^{-2}S^{-6}O^{-2}H^{+1} \\ \quad\;\; O^{-2} \end{array}$$

, may possibly be correct; but it will never come into general use, if only because it makes chemistry appear more than ever like a debased form of algebra. The ultimate effect of the author's "unravelling of the chemistry tangle" is to leave so many loose hairs, threads and strands lying about that his equations demand ten times as much thought as those which have, by sheer force of merit, established themselves in universal use amongst chemists; and it is amusing to note that, when he has to deal with a relatively complex equation, such as the reduction of potassium dichromate by sulphurous acid or by sulphuretted hydrogen, the author drops his nomenclature, and falls back on the "unravelled tangle" of the old formulæ and equations, to the immense relief, it must be confessed, of the reader. One of the causes of his lack of success is perhaps that, following Kossel, he bases almost all his formulæ on electron-transference, rather than on electron-sharing; indeed, he does not appear to possess any specific nomenclature for representing the latter, and, therefore very wisely confines himself almost exclusively to inorganic compounds and formulates even the few carbon compounds, which he discusses as united by electrovalencies.

Since his story is not naturally attractive, the author seeks to hold the attention of his readers with the help of italics and heavy type; but these are on the whole rather a drawback than otherwise, as when the author asserts that:—

"*The kernel cation of a complex anion may, then, be of so weak clustering capacity, that it is only by* **multiplexing** *that it can prevail against the competing cation.*"

"*On the other hand, the clustering capacity of the kernel cation may be so strong that it can prevail against several competing cations. We then have the* **reverse of multiplexing** *or what may be called the forming of a* **submultiplex**."

If the above criticisms err on the side of frankness, it may be urged that the author lays himself out to attract such criticisms by the lack of modesty of his title, which is in effect a claim that chemistry in less competent hands has become involved in a tangle, which needed, and has found, a super-chemist to unravel it.

Handbuch der Saccharin Fabrikation. *By* Dr. Oskar Beyer. *Pp.* 143. *Zurich: Rascher and Co.*, 1923. *Price*, .

This book, in the original German, follows an earlier publication by the same author, entitled "Uber die Kontrolle und Herstellung von Saccharin" (1918), and certain portions of the present volume are written as supplements to the first volume. The book is intended particularly to help those who are responsible for the control of works' processes of saccharin manufacture, and in this respect it is most comprehensive. It is clear that the author has carried out the operations which he describes, and he has contrived to publish in a small space a valuable collection of what are really distinct reports covering the whole range of the technical processes involved in the manufacture of saccharin.

The author deals with the synthesis from toluene through the sulphonchloride and sulphonamide to saccharin. Each section (or report) from the first one dealing with the manufacture of chlorsulphonic acid, up to the pressing of the saccharin tablets, is a description of large-scale plant and operations, and the results that can be expected from them. There is a wealth of technical detail of a kind usually difficult to obtain, and the text is freely interspersed with tables, balance sheets of material in and out, diagrammatic sketches and photographs of plant. An inventory is given of the items of plant required for a complete unit, its disposition and the factory buildings necessary to cover the plant. The yields obtained in practice and the amount of materials consumed, including power and other services, are collected in a clear and concise quantity statement, which in turn is developed into an outline cost statement, although no actual prices are entered.

As to the processes described, the author records that from 100 parts of toluene, from 40 to 46 parts of saccharin can be produced, which is a yield figure that manufacturers in this country at any rate would have been glad to reach a year or two ago. In the laboratory, using glass apparatus, is is not difficult to obtain a 60 per cent. yield from toluene, but the elevation of the process, especially the oxidation stage, from the laboratory to the technical scale can provide a good example of the waywardness of things. The oxidation process, the most difficult in the saccharin synthesis, and in which most of the loss occurs, is treated at length, particularly with reference to the use of permanganate as the oxidising agent. Other methods using bichromate and electrolytic oxidation are described, but not in detail. It is interesting to note that the author considers that one of the most important factors for obtaining a successful oxidation is to use only the purest ortho-amide, such as is produced by crystallisation of the crude amide from alcohol. Also, in the process described only 85 to 90 per cent. of the theoretical requirement of permanganate reckoned on the amide is added, and consequently, from 12 to 15 per cent. of the amide is afterwards recovered and returned to the process. This method avoids too energetic an oxidation, which is generally considered to influence the closing of the imido ring unfavourably, but unfortunately, permanganate is not always used as profitably as this work would indicate.

After the oxidation the next most difficult problem is the separation of the ortho and para isomers. The author does not press the separation of the sulphonchlorides, and makes no attempt, by continued freezing, to approach the eutectic mixture of the sulphonchlorides, which contains between 10 and 15 per cent. of the para isomer. The distillation method of separation is mentioned, but is dismissed as irrational. The finished ortho oil contains 20 to 30 per cent. of the para isomer, and is amidated in that state. The various methods for the purification of the amide, namely, the partial precipitation from the sodium salt by acid, crystallisation from water and crystallisation from alcohol are fully treated. All these processes, however, are built upon slight differences in some property such as solubility, and in consequence the most rigid and careful control is required to secure such results as the author indicates.

The book also deals with the physiological action of saccharin and related bodies, new work and various general matters connected with saccharin, its derivatives and other sweetening agents of varying constitution.

L. A. Jordan

X-Rays. *By* G. W. C. Kaye, D.Sc. *Fourth edition. Pp. xxi+320. London: Longmans, Green and Co.,* 1923. *Price* 16*s.*

Les Rayons X. Recuil des Conférences-Rapports de Documentation sur la Physique. *By* M. Maurice de Broglie. *Vol. I. Pp.* 164. *Paris: Albert Blanchard,* 1922. *Price* 13·80 *francs.*

It is some time since the reviewer had the pleasure of reading a scientific treatise so thoroughly informative and yet of such fascinating interest as M. de Broglie's little volume, which forms the first of the series of "Conférences-Rapports" to be published by the *Journal de Physique.* With a boldness which is quite justified by the event, M. de Broglie takes the unusual course of beginning with the explanation and of dealing with the phenomena themselves at a later stage. Both the emission and absorption of X-rays are atomic phenomena and depend on the structure of the atom concerned. Thus a knowledge of the structure of the atom should enable us to predict its behaviour towards X-rays, and conversely a knowledge of the X-ray phenomena throws much new light on the vexed questions of atomic structure. The nuclear theory of the atom first suggested by Sir Ernest Rutherford in 1912 provided a convenient framework into which the new phenomena could be built, and, as developed by Bohr, Sommerfeld, and others, this theory has been found capable of accounting in a most convincing and numerical fashion for the minutest details for X-ray phenomena.

M. de Broglie, then, commences with an excellent account of the atomic theories of Bohr, which he uses as a string on which to thread the varied facts with which he has to deal. He proceeds forthwith to a discussion of the diffraction of X-rays by crystals, and the methods thus provided of determining the wave lengths of X-radiations. An exceptionally illuminating chapter on the absorption of X-rays intervenes, and is followed by a very full account of the various types of X-ray spectra, and the important information to be obtained from them on the subject of atomic structure. The chapter on X-ray spectrometers, which follows, is of great value to anyone who may desire to use this very powerful method of analysis, as the author is an acknowledged expert in the art. The final chapter deals with problems raised by the emission of secondary cathode rays when X-rays are absorbed.

It will be seen from this brief summary that M. de Broglie has marked out for himself a very important, but strictly limited portion of the whole subject. Within these limits he has done admirably, and his account is authoritative and complete. The value of the book to workers in the subject is enhanced by the full and numerous tables which the book contains, and by the excellent bibliographies which are appended to each chapter. M. de Broglie's exceptional clarity both of thought and style, and the skill with which he has evaded mathematical difficulties and complexities allow one to recommend the book with equal confidence not only to experts, but to all who wish to obtain a real understanding of this new and important branch of physics. The book is well got up, and the many plates are excellently reproduced. At the present rate of exchange its price is most moderat.

Dr. Kaye's book on "X-Rays," of which the fourth edition has recently appeared, is too well known to need extensive notice. The fact that new editions are called for with such frequency and regularity shows how indispensable the book is to all X-ray workers in this country. Unlike M. de Broglie, Dr. Kaye attempts to cover the whole subject, including not only the physics, but also the technique and in some measure the practical applications of X-rays. On all matters pertaining to the technique of the production and measurement of X-rays Dr. Kaye is one of our greatest authorities, and his chapters on these subjects will well repay the closest study on the part of those—an ever-increasing number—who find that X-rays are becoming a more and more important tool for their everyday work. The whole book, in fact, is a mine of information for all X-ray workers.

The arrangement of the book seems hardly so satisfactory as its contents. As is perhaps natural in a work, the first edition of which appeared within a year or so of Laue's great discovery, the historical method of development is followed in the main, and the reader lives again through the half-lights and uncertainties of the early stages of the subject, now so happily resolved. Though hints of it are given earlier, it is only in the very last chapters that the reader is initiated into the full solution of the problems presented to him in the previous pages. Dr. Kaye has chosen well from the large amount of new matter which has accumulated, and the new edition is well up-to-date in its facts. The constant additions and revisions have, however, necessarily blurred somewhat the clearness of the presentation of the subject. It would greatly increase the comfort of the reader if Dr. Kaye could find time, in the short interval which may remain before the publication of a fifth edition, to re-write the book from the standpoint of modern theory.

This is, perhaps, too much to ask; and in all other respects the author is to be congratulated on having maintained the high standard of accuracy and information which he himself set in his earlier editions. The reviewer fears he cannot congratulate the publishers on the appearance of this edition, which, in spite of its price, is distinctly inferior to that of its predecessors.

J. A. Crowther

Confectioner's Raw Materials. *By* James Grant, *M.Sc., F.I.C. Pp.* 165. *London: Edward Arnold and Co.,* 1922. *Price* 8*s.* 6*d.*

The object of this little book is to give a brief account of the sources, methods of manufacture, chemical composition and chief uses of the raw materials used by confectioners, and of likely adulterants and the means for detecting them. It is intended mainly for those having but a slender acquaintance with science. The author rightly but optimistically insists that the ideal modern confectioner should, in addition to his practical training, be equipped with a good general knowledge of chemistry, physics, botany and machinery.

A general introduction gives a short but clear explanation of the scope and meaning of chemistry. Subsequent chapters deal with the different classes of substances employed by the confectioner—alcohols and alcoholic beverages, fats, carbohydrates, dried and preserved fruits, essential oils, egg products and colouring matters, organic acids, and the proteins. There are also chapters on baking powders and methods of aeration, the general methods of using the raw materials, and finally some fourteen pages are given up to methods of analysis.

It is obvious that the task of covering so much ground in the limited space available is beset with difficulties, not the least of which is to hit the happy medium between being too popular and too scientific. Assuming a reasonable use of the short but excellent bibliography, the reader will have little cause to complain in this respect. The chapter on analysis is the least satisfactory. If, as it appears, the author assumes that the confectioner is going to carry out the analyses himself, it is far too scrappy and unequal. On the other hand, if the aim is only to give an idea of the general nature of the processes adopted, there is much unnecessary detail. Further, some of the methods suggested, *e.g.*, those for the examination of water, are not only valueless but likely to mislead.

In dealing with some of the manufactured articles more and more accurate information might have been given as to penalties, under various Acts of Parliament, which await the ignorant and the careless, as well as the unscrupulous. It is to be regretted that the author should acquiesce in, if he does not recommend, the use of preservatives, such as boric and salicylic acids and the addition to jams of such stiffening materials as apple pulp.

The book as a whole is clearly and interestingly written, contains for its size much useful information, and should stimulate the practical confectioner to acquire a more scientific interest in and understanding of his work. The illustrations, type and binding are alike excellent.

Cecil H. Cribb

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Prices are practically unaltered in all classes of products, and transactions, except in the really "heavy" chemicals, have been on a small scale. The lateness of the advent of summer weather is undoubtedly delaying purchases by the general public, and this ultimately reacts on every trade—even that in chemicals.

Acetic Acid, 40% tech.	£24 per ton. Still firm, but rather less inquiry.
Acid Hydrochloric	3s. 9d.-5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw.	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Demand steady, export inquiry good.
Arsenic (White)	About £71 per ton.
Bleaching Powder	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Business much below normal.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand.
Copper Sulphate	£27 per ton.
Potash Caustic	£33-£34 per ton. Little moving.
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Potass. Chlorate	3d. per lb. Very dull.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76%	£20-£21 per ton. Steady demand.
Soda Crystals	£5 5s.-£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£26 per ton. Very scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	2¾d.-3d. per lb. Very dull.
Sod. Nitrate refd. 96%	£13 5s.-£13 10s. per ton ex Liverpool. Steady demand.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	£15-£16 per ton carr. paid. Very quiet. Prices unstable.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25-£29 per ton according to quantity.
Carbon Black	1s. 1½d.-1s. 3d. per lb. Ample supplies now coming forward.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb. Firmer on advance in price of Rape Seed Oil.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood distillation products.

Acetate of Lime—	
Brown	£10 15s. per ton d/d. Very scarce. Higher prices would be paid for immediate delivery.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8 5s. to £10 15s. per ton, according to locality of market and type of charcoal.
Iron Liquor	1s. 5d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 8d. ,, ,, 60% O.P.
Solvent	5s. 9d. ,, ,, 40% O.P. Demand increasing.
Wood Tar	£5-£6 10s. per ton, according to grade.
Brown Sugar of Lead	£43 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 4d.-1s. 5d. per lb.
Crude 60's	3s. 4d.-3s. 6d. per gall. Not much business.
Acid Cresylic—97/99	2s. 1d.-2s. 4½d. per gall. More inquiries. Market firmer.
Pale 95%	1s. 11d.-2s. 4d. per gall.
Dark	1s. 11d.-2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	8¾d.-11d. per gall. Supply short.
Unstrained	8¼d.-9d. per gall.

Benzole—	
Crude 65's	1s. 1d.-1s. 1¼d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.
Pure	2s. 1d.-2s. 3d. per gall.
Toluole—90%	1s. 9d.-2s. per gall. Quiet.
Pure	2s.-2s. 5d. per gall. Not much inquiry.
Xylol	2s. 6d.-3s. 3d. per gall., according to quality. Good demand.
Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil Heavy Standard Specification	8d.-10d. per gall. Market steady. Good demand.
Naphtha—	
Crude	9d. per gall.
Solvent 90/160	1s. 7d. per gall. Business slightly better.
Solvent 90/190	1s. 5d.-1s. 7½d. per gall. Market moderately active.
Naphthalene Crude—	
Drained Creosote Salts	£7-£8 per ton. Fair demand. Supply short.
Whizzed or hot pressed	£11-£13 per ton. Plenty of inquiries.
Naphthalene—	
Crystals	£18 10s. per ton.
Flaked	£17 per ton.
Pitch, medium soft	Market firmer. Plenty of inquiries. Prices from 110s.-135s. per ton, according to delivery.
Pyridine—90/140	16s. 6d.-18s. 6d. per gall. Dearer. Demand good.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Business in dyestuffs is moderately good. Depression in the textile trade continues, and until this improves there is not much chance of better business, at least in the home trade. Prices remain firm.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 6d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Dinitrobenzene	11d.-1s. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 9d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. 6d. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market has been quiet, and prices weaker in consequence of lack of business.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s.-3s. 3d. per lb. The tendency is to ease somewhat, but the strong demand prevents any marked lowering of prices.
Acid, Benzoic	3s 6d. per lb. Still very scarce.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8¾d. per lb., less 5%.
Acid, Gallic	3s. per lb. Steady demand.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d. per lb. for quantity.
Acid, Tannic	3s. 6d. per lb. Firmer tendency.
Acid, Tartaric	1s. 4d. per lb. Demand improved on account of warmer weather.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 6d. per lb. Slow of sale.
Amidopyrin	14s. per lb. Still neglected.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. per oz.
Barbitone	22s. per lb. In very short supply.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Owing to the fluctuation in marks, Hamburg dealers are offering all bromides on this market at very low rates, but British makers maintain their prices without difficulty.
Calcium Lactate	2s. 9d. per lb. for best makes.
Chloral Hydrate	4s. per lb., duty paid.
Chloroform	2s. 2d. per lb. for cwt. lots.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	£90-£92 per ton. Very firm.

Guiacol Carbonate	8s. 6d. per lb.
Hexamine	4s. per lb. down to 3s. 10d. for ½ ton lots. Tendency rather weaker.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Market good with considerable inquiry.
Magnesium Carbonate—	
Light Commercial	£37-£38 per ton net, according to quantity.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	1s. 9d.-2s. per lb. Good demand.
Menthol	40s. per lb. spot.
Methyl Salicylate	2s. 6d. per lb. for carboys. Somewhat weaker in common with other salicylates.
Methyl Sulphonal	15s. per lb.
Paraformaldehyde	3s. 6d. per lb. Weak.
Paraldehyde	1s. 6d. per lb. accepted for large orders. In better supply.
Phenacetin	6s. 6d. per lb. spot value. Very steady.
Phenazone	7s. 6d. per lb. Very firm.
Phenolphthalein	6s. 6d. per lb. now wanted by most holders. Considerable advance in view of shortage.
Potass. Bitartrate— 99/100% (Cream of Tartar)	96s.-98s. per cwt., less 2½%.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. In very strong demand, with no offers from Japan, where there seems to be a great shortage.
Potass. Permanganate	10½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	6s. per lb. still quoted without inquiry.
Salol	2s. 9d. per lb.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 6d. per lb. now wanted by holders. Still in short supply, fresh stocks being quickly absorbed.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality.
Sod. Hyposulphite— Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.-85s. per cwt. Fairly good demand.
Sod. Salicylate	Demand not so good. Powder is slightly weaker at 2s. 7d. per lb., with crystal at 2s. 9d. per lb.
Sod. Sulphite, anhydrous	£27 10s.-£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	15s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.
Thymol	16s. per lb. would now buy finest white crystals. Demand very slow.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.	
Aubepine	14s. ,, ,,	
Amyl Acetate	3s. 6d. ,, ,,	
Amyl Butyrate	7s. 3d. ,, ,,	
Amyl Salicylate	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	2s. 9d. per lb.	
Benzyl Benzoate	3s. 3d. ,, ,,	
Cinnamic Aldehyde	17s. 6d. ,, ,,	
Coumarin	18s. 6d. ,, ,,	
Citronellol	19s. 6d. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate	18s. 6d. ,, ,,	
Ethyl Phthalate	4s. 3d. ,, ,,	
Eugenol	11s. 6d. ,, ,,	
Geraniol (Palmarosa)	30s. ,, ,,	
Geraniol	5s. 6d.-12s. 6d. per lb.	
Heliotropine	8s. per lb.	
Iso Eugenol	16s. 6d. per lb.	
Linalol ex Bois de Rose	21s. ,, ,,	
Linalyl Acetate	21s. ,, ,,	
Methyl Anthranilate	7s. ,, ,,	
Methyl Benzoate	8s. 6d. ,, ,,	
Musk Xylol	11s. ,, ,,	Dearer.
Phenyl Ethyl Acetate	10s. ,, ,,	
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,	
Rhodinol	45s. ,, ,,	
Safrol	2s. 4d. ,, ,,	
Terpineol	3s. 1d. ,, ,,	
Vanillin	23s. 6d. per lb.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.	
Anise Oil	2s. ,, ,,	
Bergamot Oil	12s. 6d. ,, ,,	spot.
Bourbon Geranium Oil	29s. ,, ,,	
Cananga Oil, Java	9s. ,, ,,	
Cinnamon Oil, Leaf	4¼d. per oz.	
Cassia Oil 80/85%	13s. 6d. per lb.	Further advance.
Citronella Oil—		
Java 85/90%	4s. 2d. ,, ,,	
Ceylon	3s. 8d. ,, ,,	
Clove Oil	8s. per lb.	
Eucalyptus Oil 70/75%	1s. 10d. per lb.	
Lavender Oil, Mont Blanc 38/40%	13s. ,, ,,	
Lemon Oil	3s. 1d. ,, ,,	
Lemongrass Oil	2¾d. per oz.	
Orange Oil, Sweet	13s. 7d. per lb.	
Otto of Rose Oil—		
Anatolian	24s. per oz.	
Bulgarian	30s. per oz.	
Palma Rosa Oil	19s. per lb.	
Peppermint Oil—		
English	80s. ,, ,,	
Wayne County	13s. ,, ,,	
Japanese	6s. 7½d. ,, ,,	
Petitgrain Oil	7s. 3d. ,, ,,	

TRADE NOTE

Swiss Exports of Coal-tar Dyes

The exports of coal-tar dyes from Switzerland in 1922 totalled 3872·8 metric tons, valued at 55,257,000 francs, compared with 3706·7 tons and 57,676,000 francs in 1921. The following table shows the destination of exports in 1922:—*Aniline and other coal-tar dyes:* United States, 711·3 metric tons; Belgium, 328·2 t.; France, 977·7 t.; Great Britain, 786·6 t. Artificial indigo: China, 3094·8 t.; Japan, 165 t. The decrease in exports to the United States is due to the application of the new Customs Tariff in September. Swiss dye manufacturers are reported to complain of German competition and the effect of German Reparation Dyes on trade.—(*U.S. Comm. Rep., Apr.* 9, 1923.)

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JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

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EDITORIAL

SOME vast amount of years ago, ere all our youth had vanished from us, we had an unpleasant habit of trying to confirm or verify many statements of fact repeated from one book to another until they became accepted as matters of gospel. We were reminded of one such search by an obiter dictum of Professor Partington in his article on "Bygone Chemical Technology" in our last week's issue: "The Cassiterides, doubtless the British Isles, appear as sources of tin, first in Herodotus about 550 B.C." We do not doubt that tin exists in the British Isles, and that it has been worked here from a time whereof the memory of man runneth not to the contrary. Nor do we doubt that some writers in bygone days believed the Cassiterides were the British Isles but, when we look to the contemporary writers, Posidonius (as quoted by Strabo and Diodorus Siculus), Mela, Strabo, Cæsar and Pliny, we find no certain reference to Britain, and a good many hints that the Cassiterides were islands off the west coast of Spain. Diodorus says: "Above Lusitania there is much of this metal in the little islands, lying off Iberia in the Ocean, which are therefore called Cassiterides"; and Pliny, in his *Natural History,* states: "Opposite to Celtiberia are a number of islands, which the Greeks called Cassiterides, because of their abundance of tin." The identification of the Cassiterides with Britain or the Scilly Isles is of a later date, and we are not aware that it has any sure foundation, but the statement has been made so often and copied from one book to another that it will now persist nearly for ever. We do not doubt that if careful search were made, some equally well authenticated facts in science could be found which study would show to deserve little acceptance.

* * *

At the Brunner Mond Anniversary Dinner there were some notable speeches; that of Sir J. J. Thomson dealt with education and democracy, not in too serious a fashion, but with that due proportion of the light and heavy which befits an after-dinner speech or an editorial. Let no one despise the editorial; Mr. James Gordon Bennett considered a good editorial to be the highest achivement of the human intellect! Democracy, so far as government is concerned, is a very secure and equitable basis; all are equally compelled to obey the laws, all should share in the responsibility of making them. It is more important to the commonwealth that the laws should be acceptable than that they should be wise; what an infinite number of foolish laws and customs do we cheerfully submit to; we are even proud of them, as of our faults. But democracy as applied to art, to science or to literature is mischievous. For these we do not want a system of education adapted to the great mass of the population; nine-tenths of us are by nature not fitted to become musicians, writers, chemists or even cricketers. It is a very small proportion of mankind which is capable of contributing largely to human knowledge; the highest education is wasted on all except the few and this statement we believe to be true of all classes. On the other hand the exceptional men of genius return a thousand fold the time and trouble spent on their education. One Sir J. J. Thomson, one Dr. Leaf, one Bentley, one Cayley, or one Pasteur is, in the advancement of science, literature or industry, worth more than a very large number of men of rather more than average ability. *Ne e quovis ligno Mercurius fiat*; it is not every piece of wood you can carve into a statue. Progress is very largely due to a small number of men who in genius or character stand head and shoulders above the average. Among such exceptional men we may reckon each in his own sphere those who built up the business we were celebrating, Sir John Brunner and Dr. Ludwig Mond.

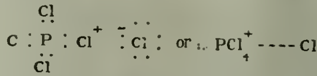
THE STRUCTURE OF THE HALIDES AND OXIDES OF THE 5th, 6th AND 7th GROUPS

BY E. B. R. PRIDEAUX, M.A., D.Sc.

By the earlier electronic theories of valency which contained only the idea of electrovalency, or the passage of an electron from one atom to another, the higher valent compounds of the elements of the 4th to the 7th groups were naturally represented in the same way as the salts of the 1st to the 3rd groups. Thus in such compounds as PCl_5 and $POCl_3$ the phosphorus, as the more electro-positive element, was considered to have lost 5 electrons to the chlorine, etc. Such an idea is not excluded by later theories, and in the compounds of the non-metals with fluorine, oxygen, chlorine which exhibit the maximum typical or group valency the non-metal can be represented as stripping its sheath. Such compounds do not show evidence of electrolytic dissociation, but this might be accounted for, on the one hand, by the difficulty of opening up strong closed fields of force (a difficulty which is already shown by the existence of salts in the non-ionic state in solution), and, on the other hand, by the fact that ionising solvents are decomposed with metathesis of the halogen (hydrolysis, etc.). A more serious difficulty in the way of considering these substances as salts is the fact that in the pure state as liquids they are not associated and have no appreciable conductivity. The two phenomena are connected, since auto-ionisation of a substance appears to depend upon its degree of association. (See Turner, "Molecular Association," p. 102.)

From group IV onwards, then, the compounds of the non-metals with chlorine, etc., are generally considered to be formed mainly by covalent linkages. Simple covalencies in which one electron is contributed by each element suffice for the maximum valency compounds of group IV, but in the succeeding groups, lead to chain or cyclic formulæ, because the maximum members of covalencies required to make up the octets are only 3, 2, 1 in groups V, VI and VII respectively. It may be remarked that the use of the Langmuir equation does not enable us to decide whether a compound is formed with electrovalencies only, or with the maximum possible number of covalencies. For we start with an assumption; if this is to the effect that one of the elements behaves as a metal we do not include it as an "element forming octets," and, *e.g.*, in the case of PCl_5, $2p=5\times8-\{(5\times7)+5\}=0$, but if the element is included as one forming octets, on the assumption that it will tend to take up, rather than lose, electrons, then $2p=6\times8-\{(5\times7)+5\}=8$ and there are 4 duplets.

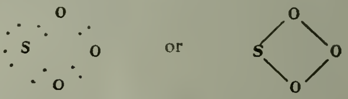
It has been already noticed by Holroyd (*Chem. & Ind.*, 1923, p. 348) that phosphorus pentachloride should have an electrovalency, and accordingly it may be written similarly to NH_4Cl, etc.



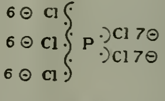
It does not seem very probable, however, that this ionisation will be experimentally verified for the reasons mentioned above. The application of the equation to halogen compounds of groups VI and VII leads to formulæ which appear somewhat improbable. Thus in the case of SF_6 the properties of which are fairly well accounted for by electrovalency alone—$2p=56-48$; $p=4$. There are 4 duplets and two electrovalencies, the formula being—

$$F_4{\equiv}S^{+}_{+}\quad F^-,F^-.$$

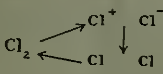
This compound is highly unsymmetrical and might be expected to split off a fluorine molecule rather easily. SO_3 demands 4 duplets, and would be (oxygen octets not shown)



whilst the formula for sulphuric acid, HO—O—S—O—OH, suggests the properties of persulphuric acid. We seem compelled to some disposal of the electrons different from either complete electrovalencies or covalencies. In comparing the possible NCl_5 with the impossible NH_5. Sir J. J. Thomson (*Phil. Mag.*, 41, 243 1921) suggested a structure in which three of the chlorine atoms (considered as cubes with electrons on the corners) are united by an edge to the phosphorus, *i.e.*, by duplets, and the two remaining chlorine atoms are united by a corner, *i.e.*, by half a duplet. These half bonds or partial valencies have been widely employed in the representation of organic compounds (see recent numbers of this *Journal*). In these

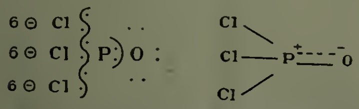


representations it is convenient to divide the electrons belonging originally to each of the elements in order to see at a glance the nature of the charges on each, or the direction of the bipole linkages considered later. Such a formula accounts for the easy detachment, by gaseous dissociation, of two chlorine atoms. When the two chlorines are replaced by oxygen, the $POCl_3$ is not easily dissociable, since the oxygen cannot complete its octets at the moment of dissociation, nor at all except by contact with another atomic oxygen or by an oxidation. Conversely molecular oxygen does not, like chlorine, easily add on to the unsaturated PCl_3, whereas atomic oxygen in the form of ozone does so. The fact that PCl_5 in some reactions is a more powerful chlorinating agent than chlorine itself may perhaps be related to the presence of atomic chlorine having a higher concentration than that derived from the dissociations



The hypothesis of the single shared electron has been applied by the author to many compounds. It is powerfully reinforced by a somewhat similar one suggested by Lowry (*Chem. & Ind.*, 1923, p. 412). "It is a general rule that if one atom shares two electrons with another, but contributes both electrons to the common stock instead of only one, it acquires a positive charge, whilst its neighbour (which has acquired a half-share in two electrons not originally belonging to it) becomes negatively charged." This phenomena was illustrated by amine oxides but is equally applicable to $POCl_3$, and in fine to all the compounds the representation of which meets with the difficulties mentioned above.

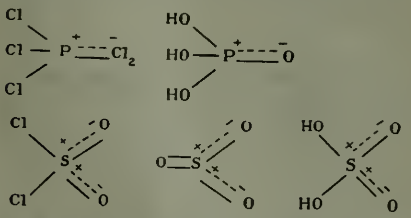
Thus $POCl_3$ may be written :—



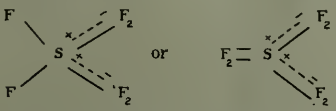
in which, as the dividing lines show, both electrons are contributed by the phosphorus atom, which only has a half share in a pair originally belonging wholly to it and is therefore positively charged, whilst the oxygen atom having a half share in this pair to which it has not contributed is negatively charged. By regarding the PCl_5 molecule in this manner we see that the pair of chlorine atoms are both united to the phosphorus by a single duplet, and thus completely take the place of an oxygen or sulphur atom, and may be replaced by these but not by OH groups. The fifth phosphorus valency is an electrovalency, but is not quite the same as an ordinary electrovalency: no electron has passed across and there is no ionisation possible, except by passing into the tautomeric form of NH_4Cl type. That this mode of union may be a strong one is shown by the fact that PF_5 does not behave as a fluorinating agent.

In the case of all halogen compounds which show the maximum valency of the element, halogen atoms equal in number to the hydrogen (or alkyl) valency in each case and replaceable by OH are shown to be united in a different manner from the remaining halogen atoms which are replaceable by oxygen or sulphur, or are left free in the lower valent compounds.

The formulæ of some compounds of maximum valency will be—



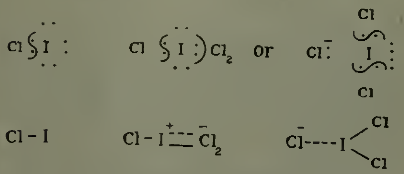
The series SF_6 and its analogues will be represented either by the combination of two fluorines in a covalent manner and the remaining two in a mixed electro- and co-valent manner or by a more symmetrical structure analogous to that of SO_3 :—



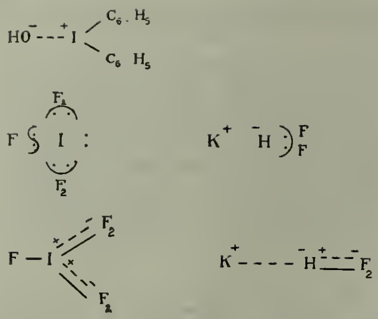
If any fluorine atoms can be replaced by OH, as can happen in TeF_6, they will be the pair united by the two covalencies, as in the case of SO_2Cl_2 and H_2SO_4.

The compounds of the seventh group with one another or with oxygen and hydroxyl cannot be explained by the ordinary kind of covalencies unless chains of atoms are introduced.

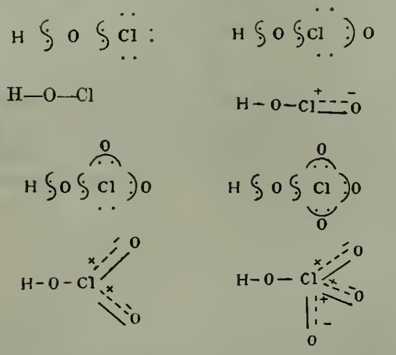
If electrovalency alone is used it is only complete for the heptavalent compounds, otherwise the element is left in a state between the stripped and complemented stable states. The chief types will be represented by



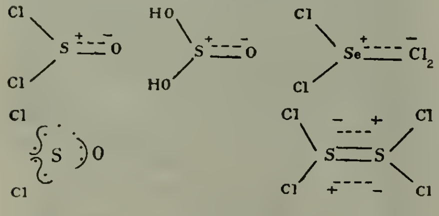
It seems unnecessary to assume that in this compound, which is sometimes ionised (see T. S. Moore, *Chem. & Ind.*, 1923, p. 427), there are any chlorine atoms which are not directly united to iodine. The analogous formula of diphenyl iodonium hydroxide will be



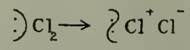
and the fluoride of iodine, the bifluoride of potassium, and the oxyacids of chlorine will be represented by—



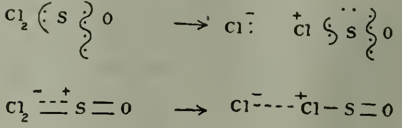
The quadrivalent compounds of the 6th group still have one of these bonds thus :—



The number of halogen or oxygen ions which can theoretically be given by any of the abovementioned compounds is determined by the requirement that an electro-covalency shall be converted into an electrovalency and a co-valency, thus :—

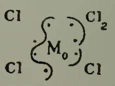


Therefore RCl_5, as already stated, can give RCl_4^+ and Cl^-, RCl_6 can give RCl_4^{++} and Cl^-, Cl^-. Oxygen from oxychlorides cannot ionise in this sense, but the duplets can shift round from the chlorines to the oxygen and the one electro-covalent bond gives one univalent ion as before :—

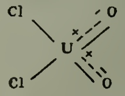


Similarly $SeCl_4$ could theoretically give $SeCl_3^+$ and Cl^- an ionisation which has been already attributed by T. S. Moore (*loc. cit.*) to the unstable SCl_4, which, however, on account of the fact that it can only exist at high chlorine pressures is more likely to have the form given above for $SeCl_4$. With $TeCl_4$ there seems a better probability that this ionisation will be experimentally verified.

Similar considerations apply to the sub-group VIA. Thus WCl_6 can give at the most two chlorine ions and WCl_4 one halogen ion. The constitution of quinquevalent compounds such as $MoCl_5$ would seem to require the hypothesis of the single shared electron first mentioned.

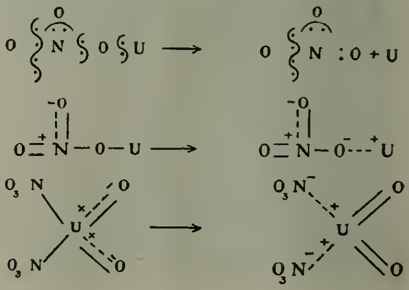


This could give only one halogen ion. The uranyl salts with their formal resemblance to sulphuryl chloride would probably have a similar formula in the case of the chloride



But the nitrate when ionised would pass over into a structure in which all the oxygen is combined by covalencies. The NO_3 group according to the above hypotheses is written :—

Non-ionised Ionised



The other method of writing this compound with the correct number of duplets is

$$O_3N{-}O{-}\underset{\cdot\cdot}{\overset{\cdot\cdot}{U}}{-}O{-}NO_3$$

Numerous other examples which might have been given show that the electro-covalent bond abolishes a good many incongruities and awkward formulæ. In the lower valent compounds of the 4th and 5th groups, however, great difficulties are encountered. It is hoped that these will form the subject of a further communication.

University College, Nottingham
April 30, 1923

THE BANQUET OF MESSRS. BRUNNER MOND & CO., LTD.

The Chairman and Directors of Messrs. Brunner, Mond and Co., Limited, gave a dinner at the Hotel Victoria, London, on Friday, the 29th June, to celebrate the Fiftieth Anniversary of the founding of their works at Winnington. The occasion was a great one, and the banquet was worthy of it. Mr. Roscoe Brunner presided; with the exception of Mr. Robert Mond, whose health did not permit him to be present, all the directors were present. The guests included Sir William Alexander, Dr. Walter Leaf, Sir J. J. Thomson, the Vice-Chancellor of the University of Cambridge, the Rt. Hon. J. R. Clynes, Sir Edward Brotherton, Bt., Sir Max Muspratt, Bt., Sir William Pope, Sir John Russell, Sir Richard Threlfall, Sir George Beilby, Dr. E. F. Armstrong, Sir Robert Robertson, Sir Frank Heath, Sir Arthur Colefax, and many other men distinguished in the profession of chemistry, in the manufacture of chemicals, in politics, in the law, and in a variety of other walks of life. The great majority of the guests met, not only a number of old friends whom they saw fairly frequently, but many others whom they had not seen for a long time; probably this was due to the fact that the guests were drawn from many sections of society.

Sir William Alexander proposed the toast of Messrs. Brunner, Mond and Co., Ltd. After alluding to soda as the badge or coat-of-arms of domestic cleanliness, he contrasted the histories of two British discoveries, the Ammonia Soda process of Dyar and Hemming of 1838, and the making of mauve by Perkin in 1856. The founders of the company had worthy successors, and the chairman, with ever-increasing success, was upholding the traditions of enterprise, courage and service. The firm were pioneers in the reduction of hours of work, in granting holidays with double pay, housing for workers, pensions for the feeble and disabled, and long-service awards for merit. Mr. Roscoe Brunner, in his reply, referred to Dr. Leaf as a representative of the bankers who, in the early days of the firm, had rendered such valuable assistance; he mentioned the lofty standards of integrity, determination, and scientific knowledge which characterised those who founded the firm, and rightly claimed that the firm had succeeded and continued to succeed because of such standards. Sir Alfred Mond who also responded to the toast gave some interesting sketches of the early history of the works, and his informal and pleasant reminiscences helped his audience to appreciate the many difficulties and the genius of the two men who overcame them.

Sir John Brunner proposed Science in very appropriate terms, alloying the soft metal of research with that due proportion of harder business instinct which is necessary to the permanence of prosperity. On behalf of Science Sir J. J. Thomson replied, reminding us that it was not everyone who could be trained to the highest pitch in science, that in America the very best athletes were trained with incessant care, the next best being sent out to applaud. Mr. Gerald Balfour proposed the Guests; Dr. Walter Leaf and the Vice-Chancellor of the University of Cambridge responded. Sir Max Muspratt, in proposing the health of the chairman, spoke of the days when both of them, *arcades ambo*, were lively boys, all unconscious of their fate.

Mr. Roscoe Brunner replied, and so concluded a delightful evening. Without a single exception the speakers spoke out, in both senses; they were easily heard and they spoke in a natural and sincere manner the thoughts which occurred to them on this historic occasion. There were no purple patches of sonorous eloquence, but all the speeches had a true ring about them, they were of the right length, in the right key, and made by men, to whom, both on account of the good sense they spoke, and their own intrinsic merits, all were glad to listen.

THE WOOD-PULP INDUSTRY IN QUEBEC

The Agent-General for Quebec informs us that a new groundwood pulp mill, with a daily capacity of 100 tons, will be built this summer at Sillery, near the City of Quebec. The plans include provisions for expanding the plant to produce sulphite pulp and newsprint paper whenever it is desired to make the necessary additions. The mill will be exceptionally well located for shipping facilities, having both rail and water connexions and favourable arrangements for its supply of pulpwood.

THE MECHANISMS OF OXIDATION IN THE LIVING BODY*

By Prof. F. GOWLAND HOPKINS, F.R.S.

The explanation of how the oxidation of foodstuffs occurs in the living body is a fundamental problem of biochemistry, for such foodstuffs are stable in the presence of molecular oxygen at the temperature and hydrogen-ion concentration proper to living tissues. It is probable that carbohydrates, fats and proteins may undergo preliminary non-oxidative changes yielding autoxidisable derivatives, but no autoxidisable product has yet been isolated which can be shown to represent a stage in the line of change. Special catalytic agents or systems maintained as constant constituents in the living cell control the processes involved.

The evidence for the "oxidase" theory of catalysis is mainly indirect, and although such systems may exist in many plant and animal cells, yet no organic peroxidase has been isolated, nor has the chemical nature of any naturally occurring peroxidase been made clear. It appears, however, that oxidative systems of this type would seem to play only a subsidiary part in metabolism. Much progress has followed upon the work of Bach and others, who have shown that many biological oxidations occur in aqueous solution in the complete absence of free oxygen so long as a reducing substance is also present. In fact, living tissues contain enzymes which actively catalyse those simultaneous and correlated processes of oxidation and reduction which may occur anaerobically in aqueous solutions. According to the established nomenclature, a substance which under these conditions suffers reduction, is called the hydrogen acceptor, the substances simultaneously oxidised being called the oxygen acceptor.

Experimental studies of anaerobic oxidations by Thunberg and others have shown that many substances, some of which occur in metabolism, are freely oxidised anaerobically by tissue catalysts when a suitable hydrogen acceptor is provided. Although reducible substances naturally present in the living cell may act as hydrogen acceptors, so that biological oxidations may occur anaerobically, the fact of most significance is that molecular oxygen can itself act as the hydrogen acceptor, so that tissue catalysts capable of controlling oxidations of the type under discussion can function in true respiratory processes. Many substances, including fatty acids, certain amino-acids, purins, etc., are oxidised *in vitro* under the influence of catalysts derived from living tissues, and this, under suitable conditions, *either* anaerobically or aerobically. The catalysts involved may display specificity in relation to the substrate, but there is no reason to suppose that in the case of a given substrate the aerobic and anaerobic oxidations are controlled by different catalysts.

According to Bach the essential happening is the uptake of hydroxyl groups by one acceptor and of hydrogen atoms by the second acceptor, and a modification of the water molecules leading to the formation of a peroxide hydrate and oxygen perhydride. But H. Wieland holds that many typical biological oxidations are in reality processes of dehydrogenation, the catalytic action of the enzymes concerned consisting in activating certain hydrogen atoms in the substrate, so that these are readily taken up by appropriate acceptors. In cases such as the oxidation of succinic acid to fumaric acid, this view permits of a simple application. In other cases the participation of a hydrate is proven or must be assumed.

Whatever the precise nature of the chemical mechanism of these anaerobic or aerobic oxidations, it is sure that many biological events belong to the class represented. On the other hand, the catalytic systems responsible for their control in the living cell must be diverse. Apart from the marked specificity of these in relation with the substrates oxidised, they cannot be uniform even in type, because such great differences are found in their relative stability. Some seem to belong to the fluid phases of the cell-structure and display the characters of enzymes in ordinary colloid solution. Others are more closely associated with the solid structures in the cell, perhaps because special surfaces form an essential part of the catalytic system. Of these some, like that which is responsible for the oxidation of succinic acid, are relatively stable; whilst others, such as that which induces the oxidation of citric acid, are so unstable that brief exposure of a tissue to alcohol or acetone removes their activity. In the living cell there are certainly agents able to constitute oxidising systems which are not only more stable than those hitherto mentioned, but which, being also thermostable, are not to be classed as enzymic systems in any accepted sense of the word; thus, certain compounds of iron undoubtedly exercise a direct catalytic function in cell oxidations; respiration, indeed, has been defined as "a surface phenomenon catalysed by iron" (Warburg).

Of great significance are disulphide and thiol groups, which in the cell suffer reversible oxidations and reduction. In 1907 A. Heffter pointed out that the reducing powers of such substances as cystein, thioglycollic acid and thiolactic acid resemble those displayed by animal tissues. He showed that the tissues probably contain some constituent carrying an active sulphydryl group, and suggested that this might play a part in the respiratory changes of the cell. In 1918 O. Meyerhof showed that the thioglycollic and thiolactic acids acted as oxygen carriers, and when added to acetone yeast restored to the dead cells a part of their "respiratory" activity, which had previously been removed by washing with water.

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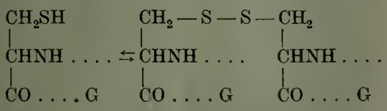
*Report presented at the Meeting of the International Union of Pure and Applied Chemistry at Cambridge.

In 1921 Hopkins (*Bioch. J.*, 15, 286) separated from yeast and from mammalian muscle and liver a substance which he called *glutathione*. It is present in most, if not all, actively living tissues, and is a dipeptide in which glutamic acid is condensed with cystein, or (in the oxidised form) with cystine. The reduced form of glutathione (corresponding to cystein) and the oxidised form (corresponding to cystine) may be represented as follows, G standing for a glutamic acid nucleus attached *either* to the amine or carboxyl groups of the cystein (or cystine) :—



$$\begin{array}{lll} CH_2SH & CH_2-S-S- & CH_2 \\ | & | & | \\ CHNH\ldots\ldots \leftrightarrows & CHNH\ldots\ldots & CHNH\ldots\ldots \\ | & | & | \\ CO\ldots\ldots G & CO\ldots\ldots G & CO\ldots\ldots G \end{array}$$

In the case of the dipeptide, the disulphide as well as the thiol form is freely soluble in the tissue fluids, whereas cystine is not. Hence the capacity of glutathione to suffer reversible oxidations and reductions offers a more efficient chemical mechanism than the system cystine $\rightleftarrows$ cystein. In the tissues, the equilibrium is usually such that the greater part of the substrate is in the reduced form, and its thiol group contributes to the reducing power exhibited by fresh tissues. To appraise properly the significance of the substance in respiratory processes, it should be remembered that in the living tissues the thiol group of glutathione is autoxidisable, though the dipeptide structure as a whole is stable. On the other hand, the disulphide form which arises on oxidation is under similar conditions freely reducible to the thiol form by factors present in the tissues. For example, if fresh muscular tissue is thoroughly extracted with cold water, its previous ability to reduce methylene blue is lost, the treatment having removed the glutathione. If now the washed tissue be suspended anaerobically in a suitable fluid to which the *oxidised* (—S—S—) form of glutathione has been added, even in very low concentration (*e.g.*, M/500), the system thus established freely reduces methylene blue ; this is because the washed tissue first reduces the dipeptide to its thiol (—SH) form. It thus appears that the reducing potential of the extracted tissue-residue is not sufficient to reduce methylene blue or only sufficient to reduce it with a velocity too slow for observation. Yet this same tissue can reduce with much greater velocity the disulphide group of glutathione, which, in its thiol form, at once reduces the dye.

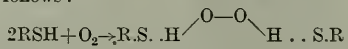
Taking the simplest view, we may look upon the —S—S— group as an intermediate hydrogen acceptor which facilitates the transport of hydrogen from oxidisable substances in the tissue to the methylene blue. The properties of glutathione fit with special readiness into the conceptions of Wieland ; it appears as a catalyst of hydrogen transport. However, the hydrogen transported may really arise, as in Bach's view, from molecules of water, whilst the tissue-constituents act as oxygen acceptors.

Glutathione functions in a similar way in aerobic conditions, when molecular oxygen becomes the final oxygen acceptor. A tissue when extracted with water as described above, and suspended in a fluid at the p_H proper to the living tissue, takes up atmospheric oxygen extremely slowly, if at all. If, however, a little glutathione, in its oxidised form, be added, oxygen is rapidly absorbed until a definite maximal uptake is reached corresponding with the complete oxidation of those tissue constituents which share in the process. A certain concentration of the thiol form is produced and maintained during the course of the oxygen uptake. The glutathione molecule itself suffers no oxidation under such circumstances, except the reversible one relating to the sulphur groups. Even a tenfold increase in its concentration, whilst increasing the velocity of the reaction, is without effect upon the amount of oxygen finally taken up. This is proportionate to the amount of tissue and to that alone.

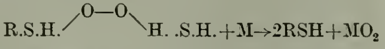
These considerations by no means give a complete picture of the chemical events involved. Even the process of autoxidation of the —SH group (in other compounds as well as in glutathione) requires detailed study. Dixon and Tunnicliffe have shown, for instance, that the reduction of methylene blue by reduced glutathione, cystein or thioglycollic acid involves an autocatalytic reaction, and have established the remarkable fact that the active agent is in each case the disulphide form itself of the compound concerned, R—S—S—R. Indeed, all the disulphides studied catalyse reductions due to the sulphydryl compounds. Moreover, all the disulphide compounds investigated catalyse the oxidation of the sulphydryl compounds by atmospheric oxygen.

Glutathione by no means catalyses all the oxidations which occur in the living cell ; it is not a co-enzyme in the stricter sense of the word and seems not connected with the oxidations due to the enzymes and other unstable catalytic systems referred to. Its function, nevertheless, is to control no small part of the total respiratory events. It is not yet certain what, as a whole, the tissue constituents may be which remain in the water-extracted tissue and while in this residual tissue are oxidised in the presence, but *not* in the absence, of the thio-compound. Unsaturated fatty acids form, however, one known material of which the oxidation is actively catalysed by glutathione, and this as simple glycerol esters or when present in lipoids of the lecithin type. It is noteworthy that such fatty acids are oxidised by glutathione in the absence of tissue elements ; but only when the sulphydryl form is present from the first. A system composed of the glycerol ester of linoleic acid suspended as an emulsion in Ringer's fluid at p_H 6 and shaken with air takes up oxygen very slowly. The addition of a minute quantity of glutathione in its reduced (—SH) form greatly accelerates this uptake, and the amount of oxygen absorbed when equilibrium is reached is greatly in excess of that required to oxidise the —SH group itself. The addition of the oxidised (—S—S—) form of the dipeptide induces, on the other hand, no acceleration of the oxidation of linoleic acid in the absence of a tissue preparation. The reason is that the fatty acid does not primarily reduce the disulphide group. It is clear, therefore, that for the simple autoxidising system (fatty acid *plus* glutathione) the conception of hydrogen transport as outlined above cannot hold.

Otto Meyerhof has studied this matter, using, however, thioglycollic acid (not a natural cell constituent) as the active sulphur compound. He assumes that during the autoxidation of the thiol group peroxide formation occurs, and that this is followed by a transfer of the oxygen molecule as a whole to the unsaturated fatty acid or other organic molecule (M); somewhat as follows :—

(*a*) 

$$2RSH+O_2\rightarrow R.S.\,.H\diagup\overset{O—O}{}\diagdown H\,.\,.\,S.R$$

(*b*) 

$$R.S.H.\diagup\overset{O—O}{}\diagdown H.\,.S.H.+M\rightarrow 2RSH+MO_2$$

On this view the reduced form of glutathione might represent in the living cell a peroxide-forming factor of the kind postulated in the theory of oxidases. Whether the view proves to be justified or not, oxidation in such a system as that constituted by an unsaturated fat and the thiol form of glutathione, without a tissue preparation, never proceeds to completion. In the presence of the tissue residue, the system becomes different : since the tissue contains factors capable of actively reducing the disulphide group, a concentration of the thiol group is continuously maintained. The amount of fat oxidised is limited only by the amount of these reducing factors supplied to the system. These facts illustrate the importance of coupled or consecutive reactions in the chemical organisation of the living cell.

This view of the mechanism of oxidation of unsaturated fatty acids in the presence of the thiol group raises afresh the general question as to whether or not peroxides formed during autoxidations play any more than a subsidiary part in cell oxidations. Belief in their importance is justified by the fact that oxidations by peroxide of hydrogen are especially apt to resemble biological oxidations. But it is difficult to demonstrate directly the occurrence of peroxides in the cell or during oxidations induced experimentally with cell catalysts. The existence in the cell of the agent catalase which must inhibit the formation of any appreciable concentration of hydrogen peroxide seems to suggest that in biological oxidations the influence of peroxides is at most of secondary importance.

OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinions by his contributors, but it must be understood that he does not necessarily agree with them.

Is the Annual Meeting Too Formal ?

seems to be the question asked by the Editor last week, and in supplying the answer to his own question (as editors so often do), he suggests that perhaps we might have a supplementary annual meeting immediately preceding the Annual Dinner. I believe the Editor is as near being wrong in this suggestion as an editor ever can be. In my view the President's Address could and should be discussed the same day as it is delivered, preferably immediately after lunch, when the company has had time to think over what has been said. It should even be possible to supply prints of the address at the close of its delivery. The Annual Dinner should surely be held during the week when the Society is holding its meetings. Indeed, I took it that the Dinner in Trinity College Hall, Cambridge, which we so enjoyed a fortnight ago, was the official Dinner of the Society. If we are to have another, I hope it will be one in which all the scientific societies will join to make it a really representative gathering. Surely we can combine in our social functions, even if there is nothing else in which we are prepared to act together.

About Two Hundred

distinguished people sat down to dinner last Friday to commemorate the fiftieth anniversary of the founding of the Winnington Works of Brunner Mond and Co., Ltd. The eminence of the visitors fortunately did not overshadow the "family" character of the proceedings. I enjoyed hearing the Chairman, Mr. Roscoe Brunner, and then Sir John Brunner and Sir Alfred Mond referring modestly, and yet with real and proper pride, to the work which their fathers had done. Sir Joseph Thomson, in replying to the toast of "Science," seemed to me to have combined successfully a certain amount of worldly wisdom with his great scientific knowledge. He told us that chemical industry could not live on an influx of money but that it wanted a vitamin. I gathered that this is the product the Universities are turning out for us at the moment. His reminiscences of America were most interesting, and the moral was that industry must maintain the Universities in order that they may turn out the men required by industry. The Vice-Chancellor of Cambridge University, in replying for the visitors, confessed that he had a hectic week with the visit of the Society to Cambridge. The speech of Sir William Alexander deserves a fuller comment than I can make this week;

it was something rather more than a mere after-dinner speech.

The Annual Reports

of the Chief Inspectors under the Alkali etc. Works Acts have just been published. There is something about these reports which distinguishes them from the ordinary run of Blue Books and White Papers. Notwithstanding the fact that the reports are sometimes badly arranged, and, as in the case of the Scottish report this time, almost telegraphic in their literary style, yet they are always very welcome. If any other department of the Government were to produce such reports they would be received very differently. The truth of the matter, as I have only discovered recently, lies in the fact that the Alkali Inspectors are a body of men who have very gradually won the respect of chemical industrialists. They started under a severe handicap: no works manager welcomes the idea of a visit from a Government official. Soon their tactfulness removed any idea of Government "interference" with business, and latterly their usefulness to industry as well as to the State has become recognised. So much is this the case that when a year or so ago the question of raising the fees under the Act arose, from which fees the staff are paid, chemical industrialists agreed at once to pay 50 per cent. more than they were paying.

The Alkali Inspectors

point out that although there has been a distinct improvement in some sections of the heavy chemical trade, what may be called normal conditions have not yet been re-established. They also refer to the introduction of new methods of manufacture, on the one hand, as a hopeful sign of the future of the country, and, on the other, a call to increased vigilance on the part of the Alkali Inspectors. I rather agree with them when they express surprise that any chemical manufacturer can be so unfamiliar with the operations registrable under the Act as to lay themselves open to penalties for carrying on such operations. Yet so it is, and six works in the year under review were discovered doing so. All the way through the reports there are instances where manufacturers for their own (and the surrounding neighbourhood's) good have been gently coerced into getting rid of their noxious fumes instead of letting them loose on an unsuspecting public: "Two works have given considerable trouble, but a steady application of pressure has secured better working and greater attention to detail. . . . It is confidently anticipated that the improvement is of a permanent character." In another case: "The District Inspector had occasion to complain. . . . As a result a considerable improvement has been effected." In trying to convey the spirit of the reports I ought not to omit to mention the valuable statistics, a noteworthy feature.

SOCIETY OF CHEMICAL INDUSTRY

LIST OF MEMBERS ELECTED

June 21, 1923

Coles, Alfred B., Technical College, Workington, Principal.
Cruikshank, Samuel G., c/o Tasmanian Cement, Ltd., Railton, Tasmania, Chemist.
Dent, James H., 25, Dover Street, Crumpsall, Manchester, Chemist.
Dow, Eric, 9, Park Quadrant, Glasgow, W., Research Chemist.
Feeny, Howard R. J., 2, Mannering Road, Sefton Park, Liverpool, Technical Chemist.
Frame, Archibald W., 662, Fillmore Avenue, Buffalo, N.Y., U.S.A., Chemist.
Furusaki, Hidejiro, 3570, Agariyashiki, Mejiro, Tokyo-fu, Japan, Engineering Chemist.
Hill, R. Ashton, 4, Cloud View Cottages, Timbersbrook, Congleton, Cheshire, Chemist.
Hutchinson, Dr. Henry B., The Distillers' Co., Research Laboratory, Hammersmith Distillery, Hammersmith, London, W. 6, Technical Bacteriologist.
Jeacock, Arthur G., "Ombersley," Moughland Lane, Runcorn, Analytical Chemist.
Karavaeff, Nicolas M., 8, Campden Grove, London, W., Engineer-Chemist.
Lawrence, William J., 13, Bryant Street, Rockdale, Sydney, Australia, Chemist.
Lee, Frederick C., 5, Bower Street, Oldham, Manufacturing and Analytical Chemist.
Macarthur, Hector, 23, Langside Road, Newlands, Glasgow, Assistant Works Manager.
McEvoy, Fred, 161, North Road, St. Helens, Analytical Chemist.
Ohfuka, Mitsuzo, Bei Dr. C. Tobias, 16, Hähnel Strasse, Dresden, Germany.
Rao, K. Umanatha, c/o The Mysore Distillation and Iron Works, Bhadravati, Shimoga District, Mysore State, India, Chemist.
Rawlinson, Herbert, 21, Clarendon Road, Garston, Liverpool, Chemist.
Turner, Sydney L., 26, Aston Street, Oxford, Chemist.
Veillon, Dr. Louis, c/o The Graesser-Monsanto Chemical Works, Ltd., Ruabon, N. Wales, Director.
Wainwright, Frank, "Heathside," Heath Road, Runcorn, Analytical Chemist.
Whiston, John R. H., Artillery College, Red Barracks, Woolwich, London, S.E. 18, Lecturer in Chemistry.
Willcox, Cyril M., 4, Worple Avenue, Wimbledon, London, S.W. 19, Student.

DEATHS

Calm, Dr. Charles E. (elected 1902), California Club, Los Angeles, Cal., U.S.A., Chemical Manufacturer. On 22 May, 1923.
Clemes, J. H. (elected 1893), 111, Mount Wise, Newquay, Cornwall. On 8 May, 1923.
Esilman, Alexander (elected 1884), of 38, Norwood Avenue, Southport, Lancs., Analytical Chemist. On 13 April, 1923.
Klipstein, Ernest C. (elected 1902), of 93, Prospect Street, East Orange, N.J., U.S.A. On 29 April, 1923.
Scard, Frederic I. (elected 1917), c/o West India Committee, 14, Trinity Square, London, E.C. 3, Consulting Chemist. On 22 June, 1923.
Storie, Geo. Bright (elected 1914), of Hotel Atlantic, Beach and Rockland Roads, Sea Point, Cape Town. On 21 May, 1923. Works Manager.
Wilkinson, Herbert T. (elected 1916), 17, Grosvenor Gardens, Westminster, London, S.W. 1, Engineer. On 7 May, 1923.

THE FARADAY SOCIETY

Five papers were read at the meeting held on July 2 :—(1) " Determination of the Density of Charcoal by Displacement of Liquids," by Dr. J. B. Firth. Investigation showed that the value obtained for the density of the charcoal increases with the time of contact between the liquid and the charcoal. The final density value varies with different liquids. The rate of change in the density value and the final density will be determined by the rate of sorption and sorptive capacity respectively. Cude and Hullet concluded that sorption forces exert only a very minor influence. The author, however, found that the density of each variety of charcoal is higher in benzene than in water which, compared with chloroform and alcohol, again gives the lowest value. Capillarity is an important factor, but the author believes that an additional force of a chemical nature which is responsible for sorption phenomena also operates. A further factor that must also influence the final result is the compressibility of the liquids.

(2) " Concentration Cells in Methyl Alcohol," by J. Grant and Prof. J. R. Partington. The paper consists of a re-examination of Wilson's work on the E.M.F. of concentration cells formed from solutions of silver nitrate in methyl and ethyl alcohol, compared with the E.M.F.'s calculated from Nernst's formula. The authors' results are in satisfactory agreement with Nernst's equation and show that the discordant results of Wilson must have been due to experimental errors.

(3) " The Formation of Anomalous Liesegang Bands," by F. G. Tryhorn and S. C. Blacktin. The authors adduce two examples of the production of these bands in addition to the case of lead chromate in agar gels first noticed by Hatschek, and show that the substances formed in these three reactions crystallise from the respective gels more readily in the light than in the dark. This effect is put forward to explain the formation of anomalous bands in these instances, and a tentative suggestion of the mechanism of the process is advanced.

(4) " On the Relation between Surface Tension and Density," by Dr. A. Ferguson. The paper consists of a mathematical investigation of the exactness and physical meaning of the relation between surface tension and density, designed to determine the connexion of the constant C in Macleod's formula $\gamma = C(\rho_l - \rho_v)^4$, with other physical constants.

(5) " The Law of Definite Proportions in the Light of Modern Research," by U. R. Evans, M.A. The author points out that many solid solutions met with in alloys show a maximum melting-point (*i.e.*, a maximum thermal stability) at a composition indicated by a simple atomic formula. It is usual to describe this number of the series as an " inter-metallic compound," and to record it as the parent of the series, but where there is a maximum hardness, *i.e.*, a maximum mechanical stability, at a composition indicated by a simple atomic formula, or where there is an abrupt change of chemical behaviour, it is not customary to apply the word compound. The use of the word is clearly one of convenience, and the compound is often merely a member of a continuous series of solid solutions, but possessing greater stability than other members. The fact that the maximum stability usually occurs at a composition expressible by a simple formula, is often capable of physical explanation. Many oxides of metals which possess more than one valency have variable composition. The decomposition pressure varies greatly with the oxygen content, thus distinguishing these solid solutions from mechanical mixtures. There is a continuous series of iron oxygen crystals varying in composition between Fe_3O_4 and Fe_2O_3 and homogeneous bodies of variable oxygen content occur along with oxides of platinum, iridium, nickel, molybdenum, tungsten, and possibly silver, lead and thallium. Similar series can be traced among various chlorides, bromides and sulphides.

ACADÉMIE DES SCIENCES

At the meeting held on June 11, Monsieur Lemoine presented a paper in which he showed that on cultivating *B. subtilis* in an infusion of hay, the acid formed was intermediate between glucose and acetone.

The influence of neutral salts on silica gels was discussed by Monsieur Urbain ; Prof. C. Moureu gave a list of radioactive springs ; and Dr. Roux communicated a note by MM. Levaditi and Nicolan on the immunity of body tissues.

PERSONALIA

The following names are included in the Prime Minister's List of Honours, conferred on the occasion of the King's birthday :—*Baronet*, Sir A. J. Dorman, K.B.E., J.P. *Order of the British Empire, Commander of the Civil Division*, E. T. Neathercoat, president of the Pharmaceutical Society. *Imperial Service Order*, Mr. T. J. Cheater, B.Sc., Superintendent Chemist, Customs House Laboratory.

The following officers have been elected by the National Academy of Sciences : President, Prof. A. A. Michelson ; vice-president, Dr. J. C. Merriam ; secretary, Dr. David White ; foreign secretary, Prof. R. A. Millikan ; and treasurer, Dr. F. L. Ransome, and Professors D. L. Webster and R. C. Tolman as council members.

Dr. V. F. Hess has resigned his post as chief physicist to the U.S. Radium Corporation in order to take up the professorship of experimental physics at the University of Graz, in Austria.

CORRESPONDENCE

BIOCHEMICAL ACTION OF POLARISED LIGHT

Sir,—In tropical and sub-tropical countries there is a deep-rooted belief in the poisonous character of meat, and especially fish, that has been exposed to strong moonlight. South African fishermen, Italians and Malays mostly will not go out fishing at full moon, nor will housewives knowingly buy fish caught beneath or exposed to lunar radiation. Many of our transport-riders will not sleep where the full moon can shine on their faces. Perhaps this may seem to many readers like "lunacy" in more than one sense. Some years ago I wrote a letter to *Nature* on this subject and detailed certain experiments I had made. I received personal replies from England, Canada and Australia giving apparently well-authenticated cases of actual poisoning from eating "moon-struck" fish or flesh (the Canadian and English correspondents had served as sailors in tropical waters). So far as I know no scientific worker took up the matter.

Now that the Biochemical Society is in being, and that your *Journal* numbers the members of that society among its readers, I thought it might be of interest to bring the matter up again in the hope that someone better qualified than myself might investigate it. My own experiments were necessarily very crude and ill-fitted to deal with such problems as fermentation and putrefaction, yet they showed results of some promise.

In searching for any possible explanation of the alleged action of moonlight, I recalled the well-known fact that moonlight, like almost all reflected light, is more or less polarised. In order, then, to obtain artificial "moonlight" I took a 1000 candle-power electric lamp and reflected a portion of its rays from a pile of glass plates. Some perfectly fresh fish were taken and split lengthways so as to get two portions as nearly alike as possible. One half of each fish was placed directly under the lamp and about one foot away from it, the other was a little further off, and only the reflected light was allowed to reach it. The whole arrangement was enclosed in a cool, dark chamber for from twelve to twenty-four hours. The sole criterion of any change that I could make use of was the effect on my own nose, but it was quite sufficient. The specimen exposed to the reflected light was invariably in the condition known as "stinking," the other piece being far less affected. I also attempted experiments on the growth of seeds and of moulds, but they were inconclusive.

It seems almost impossible that the possible chemical or biochemical action of polarised light has hitherto not been investigated, but I have never been able to find any reference to the matter in the records I have been able to examine. Since ordinary light has such marked effects, it seems *a priori* reasonable to suppose that polarised light might have even stronger powers as a directional agent for certain changes. If that be so, the poisonous effects of easily decomposed matter exposed to moon-rays is explainable.

Another matter mentioned by my correspondents was "moon-blindness"; a person with apparently normal eyesight by day becoming totally blind in moonlight. I have never seen any other mention of this phenomenon.—I am, Sir, etc., E. G. Bryant

Prieska, S. Africa

THE FORMULA OF CARBON MONOXIDE

Sir,—The formula of carbon monoxide presents a good deal of interest from the point of view of the octet theory.

The formula $:\mathrm{C}\overset{\textstyle :}{\underset{\textstyle :}{:}}\mathrm{O}:$ allows us to represent both atoms as surrounded by an octet, and receives support from thermochemical data.

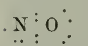
v. Weinberg (*Ber.*, 1920, 1352) has pointed out the remarkable fact that the heat of combustion of a ketone, such as $CH_3.CH_2.CO.CH_2.CH_3$ equals the heat of combustion of CO + the heat of combustion of the hydrocarbon—in this case $CH_3.CH_2.CH_2.CH_3$—which would be formed by the combination of the remaining parts of the ketone molecule.

In the example chosen we can imagine the two carbon-carbon bonds between the carbonyl group and the neighbouring carbon atoms to be overcome, thus conferring the energy of two carbon-carbon bonds on the system, and then we can imagine the two ethyl groups uniting, which would involve the loss of the energy of one carbon-carbon bond. If the carbon monoxide formed had the constitution represented by the formula $C = O$, the net result would be that we conferred the energy of a carbon-carbon bond on the system, and we should expect the heat of combustion of the two new compounds to be greater than that of the ketone by an amount equal to the value of one carbon-carbon bond.

Since the new compounds have the same heat of combustion as the ketone, we must conclude, as v. Weinberg does, that more valency is exercised on the oxygen by the carbon in carbon monoxide than in the ketone, and further that this increase in energy of combination is equal to that of a C-C bond.

This increased energy of combination of carbon and oxygen finds expression in the formula $:\mathrm{C}\overset{\textstyle :}{\underset{\textstyle :}{:}}\mathrm{O}:$ v. Weinberg shows, further, that $Q_{C=O}$ (*i.e.*, the energy of combination of carbon and oxygen in the ketones) is equal to Q_{C-O-C} (*i.e.*, the energy of combination of carbon and oxygen in the ethers) (*cf.*, Hückel, *Ber.*, 1922, 2841).

In spite of the great affinity of carbon for oxygen, carbon monoxide is stable in the air at ordinary temperatures, whereas nitric oxide is spontaneously oxidised, although nitrogen has not much affinity for oxygen. It is not possible to represent nitric oxide with a complete octet round each atom if we use the electrons of the outer shells only. We can only write



$\cdot\mathrm{N}\vdots\mathrm{O}\vdots$ This may be connected with the tendency to oxidise.—I am, Sir, etc.,

G. W. F. Holroyd
Municipal Technical College, Blackburn
June 19, 1923

NEWS AND NOTES

"Van't Hoff Fund."

The Faraday Society announces that application for grants from the above Fund must be made before November 1, 1923, by registered post to: Het Bestuur der Koninklyke Akademie van Wetenschappen; bestemd voor de Commissie van het "Van't Hoff-fonds," Trippenhuis, Kloveniers-burgwal, te Amsterdam, with a detailed account of the proposed use of the grant, and of the reasons on which the candidate grounds his claim. The grants are made to investigators in the fields of pure and applied chemistry. The amount available for 1924 is about 1400 Dutch florins.

The Arsenic Industry in Canada

The Canadian production of arsenic declined from 4,918,000 lb. ($447,848) in 1920, to 2,982,000 lb. ($269,300 in 1921). The production in 1920 included 3,662,000 lb. of white arsenic, the remainder of the output being obtained from arsenical concentrates. Important deposits of arsenic occur in the Kingston district, some containing as much as 12 per cent. of arsenic. Arsenic is also a constituent of silver-cobalt ores obtained at Cobalt, Ontario, large quantities being recovered in the silver refineries. Recently, the manufacture of insecticides was commenced at Deloro, Ontario.—(*Cham. Comm. J., June* 23, 1923.)

The Japanese Camphor and Celluloid Industries

It is reported from Yokohama that the Japanese camphor market has begun to revive in consequence of orders received from Europe and the United States. There is also a certain improvement in the celluloid industry, and camphor manufacturers in Japan and Formosa are now supplying the home trade. Since 1916, when the record production of 6,517,232 kin of crude camphor and 11,010,059 kin of camphor oil was obtained, the output has decreased gradually until in 1921 it was 2,535,047 kin and 7,224,600 kin, respectively. Exports have also decreased, falling from 6,014,200 kin in 1916, to 982,700 kin in 1921.—(*Cham. Comm. J., June* 23, 1923.)

PARLIAMENTARY NEWS

HOUSE OF COMMONS

The Alcohol Industry

Replying to Mr. Hardie, Capt. D. King said available information indicated that there were 125 distilleries producing alcohol solely for use as a beverage, 14 producing it for use as a beverage and in industry and 3 for industrial purposes only.

Sir W. Joynson-Hicks, in a written answer to Viscount Curzon, gave the following figures of consumption of spirits during the year ended March 31, 1923:—*Home-made spirits*: retained for consumption, 12,858,660 gallons; exported (excluding Irish Free State exports *via* Great Britain), 5,848,787 galls.; exported as medical preparations, 167,960 galls.; used for ships' stores, etc., 320,638 galls.; used in arts and manufactures, 597,669 galls; methylated, 6,458,695 galls.; allowed as deficiencies, 3,706,703 galls.; distilled in England, 6,564,824 galls., in Scotland 27,095,609 galls., and in Northern Ireland 2,476,985 galls. *Foreign spirits*: retained for consumption, 2,299,620 galls.—(June 26.)

Exports of Coal

Sir P. Lloyd-Greame, answering Mr. Hardie, gave the following figures of exports of coal from the United Kingdom and of imports of coal into Great Britain and the Dominions during 1922, the figures for 1913 being given in brackets:—*Exports of Coal from the United Kingdom*: Italy, 6,341,743 tons (9,647,161 t.); Spain, 1,711,021 t. (2,534,131 t.); Germany, 8,345,606 t. (8,952,328 t.); France, 13,579,417 t. (12,775,909 t.); India, 999,159 t. (179,192 t.); Denmark, 2,866,233 t. (3,034,240 t.); Sweden, 2,522,820 t. (4,563,076 t.); Algeria, 1,032,282 t. (1,281,664 t.). *Shipments of Coal from Great Britain to Ireland*: 4,062,748 t. (4,667,548 t.). *Imports of Coal into Great Britain and the Dominions*: Great Britain, 113 t. (7226 t.); British India, 1,191,966 t. (622,659 t.); Dominion of Canada, 11,622,344 t. (16,251,744 t.); Commonwealth of Australia, 15,213 t.* (4849 t.); Dominion of New Zealand, 501,478 t. (468,940 t.); Union of South Africa, 4358 t. (51,526 t.); Newfoundland, 223,300 t.† (289,451 t.).—(June 26.)

* Year ended June, 1921, later figures not being available.

† Year ended June.

Consumption of Boiler Fuel in Collieries

Replying to Lord Cavendish-Bentinck, Lieut.-Col. Lane-Fox said that 16·25 million tons of coal was consumed under colliery boilers at coal mines in Great Britain during 1922. The percentage of output thus consumed was 3·3 in Durham, 5·9 in the Eastern districts, 9·5 in Lancashire and 9·7 in Scotland. The reasons for this disparity were discussed in the final report of the Mining Sub-Committee of the Coal Conservation Committee (Cd. 9084). Allowance had to be made in any such comparison for the difference in the calorific value of the coal used for steam raising in the different districts.—(June 26.)

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for June* 28)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W.1) from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Leather	835
,,	Rubber goods, bronze and copper tubes ..	836
Australia	Steel	11541/E.D./E.P.
Belgium ..	Pharmaceutical specialities	814
British India	Steel rails (tender) ..	*
Egypt ..	Hides (tender)	**
Italy ..	Shellac, gum arabic, medicinal herbs and plants	818
Japan ..	Steel	10966/F.E./E.C./2
Norway ..	Sugar	822
Poland ..	Caustic soda, perfumery, ethereal oils ..	823
Spain ..	Chemicals, fertilisers ..	824
,, ..	Rubber sheeting, surgical and rubber goods	825
Spain and Portugal	Chemicals	826
Tripolitania	Sugar	830
United States	Fertilisers, glassware ..	19858/F.W./M.C./2.

* Director-General, The East India Railway Co., 73-76 King William Street, E.C. 4.

** Muh. 1923/64/1 Inspecting Engineer, Egyptian and Sudan Governments, Queen Anne's Chambers, S.W.1.

TARIFF CUSTOMS EXCISE

France.—Anthraquinone is now admitted duty-free.

Malta.—Amendments in the customs tariff affect petrol and refined and raw sugar.

New Zealand.—The prohibition of the exportation of silver has been revoked.

Rumania.—New export duties have been applied to caustic soda, tinplate, iron sheets, zinc dross and casein. Copper sulphate is exempted from import commission tax.

San Salvador.—A duty of 5 per cent. has been imposed on exports of sugar.

Sweden.—The sugar import monopoly has been withdrawn and all restrictions removed.

REPORTS

FORTIETH REPORT OF THE COMPTROLLER-GENERAL OF PATENTS, DESIGNS AND TRADEMARKS, 1922. *Pp.* 20. *H.M. Stationery Office,* 1923. *Price* 6*d.*

That the business transacted by the Patent Office is gradually approaching a more normal level may be judged by the slight increase (compared with previous years) in the number of applications for patents in 1922, viz., from 35,132 to 35,494; of provisional specifications from 24,674 to 25,862; complete specifications from 19,159 to 19,060, and of sealed patents from 17,697 to 17,336 (*cf. J.*, 1922, 296 R).

A small increase was shown in the number of applications for trademarks (11,620 as against 11,168), but the number registered under Part A decreased from 6787 to 6443. The number of letters and correspondence forms despatched was 275,000, and the number of parcels of publications 113,000, compared with 265,000 and 112,000, respectively, in 1921. There was a slight decrease in the sales of the various publications of the Patent Office.

Hearings upon oppositions to the grant of patents numbered 83, as compared with 35 in 1921, and there were 12 appeals to the Law Officer. Hearings fixed under Sections 7 and 8 of the Acts numbered 3384, but 1712 were either abandoned or withdrawn. In five of the 1762 cases outside appeals were made to the Law Officer. Altogether 135,785 readers used the Library (129,975 in 1921), and the number of works in the library increased to 61,106, the approximate number of volumes, excluding duplicates, being 194,697.

Receipts from patents fees were £413,378, from designs fees £10,373, and from trademarks fees £46,045, compared with £445,947, £9648 and £47,803 respectively in the previous year. Receipts fell by £32,367 to £493,133. Expenditure totalled £419,059, leaving a surplus of £74,073.

REPORT ON THE ECONOMIC AND FINANCIAL CONDITIONS IN GERMANY TO MARCH, 1923. *By* J. W. F. THELWALL, *H.M. Commercial Secretary, Berlin, and* C. J. KAVANAGH, *Commercial Secretary, Cologne. Pp.* 157. *Department of Overseas Trade. H.M. Stationery Office. Price* 4*s.*

The outstanding features of Germany's position in 1922 were, as in the immediately preceding years, inflation and reparations, and they have become more important with the lapse of time. Extreme caution has to be observed in coming to a conclusion on the actual position of the country as results of trading are almost completely disguised by inflation.

Trade in 1922 was much below pre-war level, but it must be remembered that the pre-war frontiers were wider than the present ones, and also that reparations do not figure in trade returns. Exports, 21,560,244 metric tons in

1922, amounted to 29 per cent. of the pre-war figure and imports, 45,871,043 t., to 62 per cent. In the latter part of the year exports declined and imports increased. Coal, coke, and briquettes imported in 1922 amounted to 10,914,000 t., exports to 6,115,000 t.; imports of iron ore were 9,276,000 t., exports, 117,900 t.; iron imports 774,300 t., exports 199,800 t.; cement imports, 122,500 t., exports, 350,200 t. The policy of merchants as to prices has been very erratic and though this is comprehensible when applied to inland sales, owing to fluctuations of currency, it is less so where exports are concerned, as merchants are encouraged to quote in a stable currency. Complaints from buyers have come from all over the world; these appear to be due chiefly to an excess of orders leading to neglect of contracts and scamping of work. It is considered that in any case satisfactory conditions cannot be established until control of exports is abandoned. Important commercial treaties were entered into in 1922 with Finland, Lettland, Russia, and Czechoslovakia.

The occupation of the Ruhr area last January created a new situation with regard to Germany's coal supply. Of her pre-war coalfields Germany has lost Lorraine and 75·4 per cent. of the Upper Silesian area, whilst the Ruhr and Aix-la-Chapelle fields may be drawn upon only at the discretion of the occupying Powers; the annual supply of the country is only about 18,576,000 t. compared with 190,109,000 t. in 1913, whereas in 1922 about 163,621,000 t. was required. The sinking of new shafts, a work neglected since the beginning of the war, is becoming a necessity, but the cost presents an obstacle; levies on coal and coke have been suggested as sources of revenue for the purpose. Lignite has been produced in increasing quantities and in 1922 the output was 137,207,000 t. The relatively high cost of transport prevents the use of lignite, however, except near its source. Instead of being the largest European exporter of iron and steel, Germany has now become the largest importer, with serious effects upon State finance. The industry itself is working at full pressure, but only as the result of inflation. Germany is no longer self-contained as regards the raw materials of the iron industry; home production of ore in 1922 was about 5,000,000 t., and imports about 11,000,000 t. The pig-iron output in 1922 was about 9,000,000 t.; the demand has been relieved to some extent by the extensive use of scrap iron and steel. The steel trade has been busy, with demands far in excess of supply, and the 1922 output is estimated at 9,000,000 t.

In an appendix devoted to potash it is pointed out that of the world's consumption in 1922, 1,600,000 t., Germany supplied 1,300,000 t.; thus the supposition that the loss of Alsace would break the German monopoly does not appear to have been fulfilled.

REVIEWS

Market Milk. *By* E. Kelly *and* C. E. Clement. *Pp. xvii*+445. *New York: John Wiley and Sons; London: Chapman & Hall, Ltd.*, 1923. *Price* 19*s*.

"Market Milk" is a term in general use in America to distinguish milk sold ultimately by retail in its liquid state, from the equally large volume of milk which is ultimately marketed as cheese, butter, and other manufactured goods. One of the authors is described as a "Market Milk Specialist" in the United States Department of Agriculture, and the other as in Charge of the Market Milk Investigations of that Department. Of their qualifications, therefore, to write of the production and distribution of milk in their own country, there can be no doubt. The book will be studied eagerly in Great Britain because certain sections of the milk industry are disposed to adopt certain American practices, and because there appears to be in Whitehall and elsewhere an organised attempt to accelerate this tendency. The circulation of this book may well have a contrary effect, although its authors seem well satisfied with the way that the trade in market milk is carried out and regulated in the United States. A study of this book, however, must make clear to those who did not realise the fact before that our insular problem is very different from that which confronted the great cities of the States. Distances are so much less here. As the President of the forthcoming World's Dairy Congress said to the writer, what we call "long-distance milk" would be regarded as "short-distance milk" in America, and we ought to be able largely to dispense with pasteurisation, which is becoming universal in America.

The book is not written for chemists, but no chemist who is connected with the milk industry should fail to study it. In studying its interesting statistics, one has constantly to bear in mind that the American gallon is only 0·83 of an imperial gallon. There is no aspect of the market-milk industry that is not dealt with, and dealt with at length, so one need not reproduce the Table of Contents, minutely subdivided as is the way with American books. The amount of supervision to which American traders submit, and the readiness with which they produce detailed profit and loss accounts to these statistical officers will occasion surprise to British readers, but in some respects Whitehall might take a lesson from Washington. For example, the authors say that in planning a grading system, it is desirable to have only a very few grades, and they suggest three. Now grading is of long-standing in America. Here we have just started with five official grades, exclusive of ordinary milk, which is still the staple article of the trade.

The section on the cost of milk production is particularly interesting just now to us in Great

Britain, and not less interesting because it gives costs of milk produced under conditions differing widely from our own. Very briefly the authors discuss the question: "Can production cost govern selling price?" and their conclusions can be commended to the consideration of everyone in the industry. One section may do mischief if it falls into the hands of ignorant people anxious to fasten American standards upon us. In some States of the Union it is an offence to sell milk containing less than 3·5 per cent of fat, and this is stated in the book. The application of such an ordinance in Great Britain would hold half the milk off the market from March to August inclusive. Reformers of a certain type do not think of these things.

There are very few misprints or statements of fact to which exception can be taken. In a table on page 16, 24·68 per cent. of milk sugar in condensed milk appears to be a misprint for 14·68 per cent. On page 52 one reads that the freezing point of milk is usually from 29° to 31° F. On page 130 it is correctly stated that the freezing point of milk is practically constant at -0·55° C. On page 19 it is stated that scientific opinion is generally to the effect that heated milk is uninjured in its nutritive properties. One could cite many authorities against this dictum. Finally, on page 252 the estimate for a 500 gallon plant ($4000-6000) must be too low, or that for a 1000 gallon plant ($15,000-25,000) too high.

G. Cecil Jones

Anorganische Chemie. Ein Lehrbuch zum Weiterstudium und zum Handgebranch. *By Prof.* Fritz Ephraim. *Second edition, revised. Pp. viii+742. Dresden and Leipzig: Theodor Steinkopff,* 1923. *Price, paper,* 8*s.* 6*d., bound,* 10*s.* 8½*d.*

The utility of this comprehensive text-book of inorganic chemistry may be gathered from the fact that only a few months after publication a second edition has been called for (*cf. J.*, 1922, 407 R). Opportunity has accordingly been taken to add accounts of recent work, such as that of Bohr on the rare earths, and to enlarge the subject index. By the use of concise, clear language the author manages to cover a very wide range of subjects and although omissions are inevitable in a work of this kind, nothing of real importance has been neglected. The book is primarily of interest to advanced students, but it should prove stimulating reading for everyone who has more than a slight knowledge of chemistry.

Mr. C. H. MacDowell, president of the Armour Fertiliser Works, Chicago, has been awarded the United States Service Medal for his work as Head of the Chemical Branch of the War Industries Board during the war.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acetic Acid, 40% tech...	£24 per ton. Still firm, but rather less inquiry.
Acid Hydrochloric ..	.. 3s. 9d.-5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw. ..	.. £23 per ton.
Acid Sulphuric ..	.. Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical ..	.. £6 10s. per ton.
Ammonia Alkali ..	.. £7 12s. 6d.-£8 per ton. Demand steady, export inquiry good.
Arsenic (White) ..	.. About £71 per ton.
Bleaching Powder ..	.. Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Business much below normal.
Bisulphite of Lime ..	.. £7 per ton, packages extra.
Borax, Commercial—	
Crystal ..	.. £27 per ton.
Powder ..	.. £28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride ..	.. £5 17s. 6d. per ton d/d. In slightly better demand.
Copper Sulphate ..	.. £27 per ton.
Potash Caustic ..	.. £33-£34 per ton. Little moving.
Potass. Bichromate ..	.. 5¾d.-6d. per lb. d/d.
Potass. Chlorate ..	.. 3d. per lb. Very dull.
Salammoniac ..	.. £32 per ton d/d.
Salt Cake ..	.. Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76% ..	.. £20-£21 per ton. Steady demand.
Soda Crystals ..	.. £5 5s.-£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98% ..	.. £26 per ton. Very scarce for spot delivery.
Sod. Bicarbonate ..	.. £10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62% ..	.. £19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate ..	.. 2¾d.-3d. per lb. Very dull.
Sod. Nitrate refd. 96%..	.. £13 5s.-£13 10s. per ton ex Liverpool. Steady demand.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	£15-£16 per ton carr. paid. Very quiet. Prices unstable.

Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25-£29 per ton according to quantity.
Carbon Black	1s. 1½d.-1s. 3d. per lb. Ample supplies now coming forward.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood distillation products.

Acetate of Lime—	
Brown	£11 10s.-£11 5s. per ton. Dearer. Good steady demand.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8 5s. to £10 15s. per ton, according to locality of market and type of charcoal.
Iron Liquor	1s. 5d. per gall. 32° Tw. 1s. 2d. „ „ 24° Tw.
Red Liquor	1s. 3d. „ „ 14/15° Tw.
Wood Creosote	2s. 7d. „ „ Unrefined.
Wood Naphtha—	
Miscible	6s. 8d. „ „ 60% O.P. Market quiet.
Solvent	5s. 9d.-6s. per gall. 40% O.P. Demand increasing.
Wood Tar	£5-£6 10s. per ton, according to grade.
Brown Sugar of Lead	£42-£43 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 4d.-1s. 5d. per lb.
Crude 60's	3s. 4d.-3s. 6d. per gall. Numerous inquiries.
Acid Cresylic—97/99	2s. 1d.-2s. 4½d. per gall. Steady demand.
Pale 95%	1s. 10d.-2s. 4d. per gall.
Dark	1s. 10d.-2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	8¾d.-11d. per gall. Supply short. Plenty of inquiries.
Unstrained	8¼d.-9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1¼d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.
Pure	2s. 1d.-2s. 2d. per gall.
Toluole—90%	1s. 9d.-2s. per gall. Quiet.
Pure	2s.-2s. 5d. per gall. Not much inquiry.
Xylol	2s. 6d.-3s. 3d. per gall., according to quality. Good demand.
Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil	8d.-9½d. per gall. Market steady. Good demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.-9½d. per gall.
Solvent 90/160	1s. 6½d.-1s. 7d. per gall. Business quiet.
Solvent 90/190	1s. 5d.-1s. 7½d. per gall. Market moderately active.
Naphthalene Crude—	
Drained Creosote Salts	£7-£8 per ton. Fair demand. Supply short.
Whizzed or hot pressed	£11-£13 per ton. Few inquiries.
Naphthalene—	
Crystals	£18 10s. per ton.
Flaked	£17 per ton.
Pitch, medium soft	Market quiet. Prices from 110s.-135s. per ton, according to delivery.
Pyridine—90/140	17s.-18s. per gall. Demand good.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Business in dyestuffs is moderately good. Depression in the textile trade continues, and until this improves there is not much chance of better business, at least in the home trade. Prices remain firm.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 6d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Dinitrobenzene	11d.-1s. per lb. naked at works.

Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 9d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. 6d. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market remains very dull and stocks are slowly accumulating.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s.-3s. 3d. per lb. Market steady but quiet.
Acid, Benzoic	2s. 6d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8¾d. per lb., less 5%.
Acid, Gallic	3s. per lb. Down to 2s. 11d. for large quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 3d. per lb. Orders falling off.
Acid, Tannic	3s. 6d. per lb. Firmer tendency.
Acid, Tartaric	1s. 4d. per lb. Demand improved on account of warmer weather.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 6d. per lb. Complete lack of demand.
Amidopyrin	14s. per lb. Still neglected.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. per oz. More active.
Barbitone	21s. per lb. Less inquiry.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Unchanged. Continent still offering at low prices.
Calcium Lactate	2s. 6d. per lb. for best makes. Foreign makes of inferior quality still being offered.
Chloral Hydrate	3s. 8d.-4s. per lb., duty paid.
Chloroform	2s. 2d. per lb. for cwt. lots.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	£90-£92 per ton. Very firm.
Guiacol Carbonate	8s. 6d. per lb. Neglected.
Hexamine	3s. 7d. - 3s. 10d. per lb. Tendency rather weaker.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots.
Magnesium Carbonate—	
Light Commercial	£37-£38 per ton net, according to quantity.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	1s. 9d.-2s. per lb. Good demand.
Menthol	40s. per lb. spot.
Methyl Salicylate	2s. 4d.-2s. 5d. per lb. for carboys. Somewhat weaker.
Methyl Sulphonal	15s. per lb.
Morphine	Makers have advanced all prices. Alkaloid—Cryst. 10s. 11d., Precip. 10s. 8d., Acetate 8s. 6d., Hydrochlor. 8s. 6d., Sulphate 8s. 6d. per oz.
Paraformaldehyde	3s. 9d. per lb. Lifeless.
Paraldehyde	1s. 6d. per lb. accepted for large orders. In better supply.
Phenacetin	6s. 6d. per lb. More active than other pharmaceuticals.
Phenazone	7s. 6d. per lb. More active than other pharmaceuticals.
Phenolphthalein	6s. 6d. per lb still quoted, but demand slow.
Potass. Bitartrate—99/100% (Cream of Tartar)	96s.-98s. per cwt., less 2½%.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d.-15s. 11d. per lb. In very strong demand.
Potass. Permanganate	10½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	6s. per lb. Very firm.
Salol	2s. 9d. per lb.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 6d. per lb. Slow of sale.
Sod. Citrate	2s. 2d. per lb. for U.S.P. quality.
Sod. Hyposulphite—Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.-85s. per cwt. Fairly good demand.
Sod. Salicylate	Powder 2s. 7d. per lb., and Crystal at 2s. 9d. per lb. In steady demand for small lots.
Sod. Sulphite, anhydrous	£27 10s.-£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.

Thymol	.. Better inquiry. 15s. 6d. per lb. for cwt. lots of natural recryst. The synthetic product is being offered at 14s. 6d. per lb. for cwt. lots.	

PERFUMERY CHEMICALS

Acetophenone ..	.. 10s. 6d. per lb.	
Aubepine ..	.. 14s. ,, ,,	
Amyl Acetate ..	.. 3s. ,, ,,	
Amyl Butyrate ..	.. 7s. 3d. ,, ,,	
Amyl Salicylate	.. 3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol ..	.. 3s. ,, ,,	
Benzyl Alcohol free from Chlorine ..	.. 3s. ,, ,,	
Benzaldehyde free from Chlorine ..	.. 2s. 9d. per lb.	
Benzyl Benzoate	.. 3s. 3d. ,, ,,	
Cinnamic Aldehyde	.. 17s. 6d. ,, ,,	
Coumarin ..	.. 18s. ,, ,,	
Citronellol ..	.. 19s. 6d. ,, ,,	
Citral	.. 9s. 6d. ,, ,,	
Ethyl Cinnamate	.. 15s. ,, ,,	Cheaper.
Ethyl Phthalate	.. 3s. 9d. ,, ,,	,,
Eugenol	.. 11s. ,, ,,	
Geraniol (Palmarosa)	.. 32s. 6d. ,, ,,	Advanced.
Geraniol	.. 5s. 6d.-12s. 6d. per lb.	
Heliotropine ..	.. 8s. per lb.	
Iso Eugenol ..	.. 16s. 6d. per lb.	
Linalol ex Bois de Rose ..	21s. ,, ,,	
Linalyl Acetate ..	.. 21s. ,, ,,	
Methyl Anthranilate	.. 7s. ,, ,,	
Methyl Benzoate	.. 8s. 6d. ,, ,,	
Musk Xylol ..	.. 11s. ,, ,,	Dearer.
Phenyl Ethyl Acetate ..	10s. ,, ,,	
Phenyl Ethyl Alcohol ..	17s. 6d. ,, ,,	
Rhodinol ..	.. 45s. ,, ,,	
Safrol	.. 2s. 4d. ,, ,,	
Terpineol ..	.. 3s. 1d. ,, ,,	
Vanillin	.. 23s. 6d. per lb.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	.. 14s. 6d. per lb.	
Anise Oil	.. 2s. ,, ,,	
Bergamot Oil ..	.. 12s. 6d. ,, ,,	spot.
Bourbon Geranium Oil ..	29s. ,, ,,	
Cananga Oil, Java	.. 9s. ,, ,,	
Cinnamon Oil, Leaf	.. 4¼d. per oz.	
Cassia Oil 80/85%	.. 12s. 6d. per lb.	
Citronella Oil—		
Java 85/90%	.. 4s. 2d. ,, ,,	
Ceylon ..	.. 3s. 8d. ,, ,,	
Clove Oil	.. 8s.-8s. 6d. per lb.	
Eucalyptus Oil 70/75%	1s. 10d. per lb.	
Lavender Oil, Mont Blanc 38/40%	.. 13s. ,, ,,	
Lemon Oil ..	.. 3s. 1d. ,, ,,	
Lemongrass Oil ..	.. 2¾d. per oz.	
Orange Oil, Sweet	.. 13s. 7d. per lb.	
Otto of Rose Oil—		
Anatolian ..	.. 24s. per oz.	
Bulgarian ..	.. 30s. per oz.	
Palma Rosa Oil	.. 19s. per lb.	
Peppermint Oil—		
English ..	.. 80s. ,, ,,	
Wayne County	.. 13s. ,, ,,	
Japanese ..	.. 7s. 1½d. ,, ,,	Advanced.
Petitgrain Oil ..	.. 7s. 3d. ,, ,,	

TRADE NOTES

The Japanese Fertiliser Trade

During 1922 the Japanese fertiliser trade recovered considerably from the previous year's depression, and imports increased nearly 42,000 tons in quantity and 15,000,000 yen in value (yen = 2s. 0½d.). Exports increased in value by 538,325 yen to 859,665 yen. The agricultural demand, however, is still low. The following statistics show the values and quantities of fertilisers imported during 1921 and 1922:—

	1922 tons	1922 Yen	1921 tons	1921 Yen
Ammonium sulphate..	92,284	12,742,145	78,596	11.006,010
Nitrate of soda	52,447	6,540,094	18,057	2,601,093
Sulphate of potash ..	7,431	1.003,560	1,194	224.044
Bean cake	1,093,250	89.375,154	1,196,841	85,793,475
Rape seed cake ..	70,519	5,350,549	46,190	3.169,110
Cotton-seed cake ..	34,719	2,978,912	58,024	4,387,443
Oil cake, other ..	10,704	817,718	15,180	961.235
Fish guano	22,308	3,043,951	1,256	193,879
Phosphate rock ..	282,827	8,983,554	210,586	8,884,692
Bone dust	40,429	3,789,465	29,099	2.375.700
Animal bones	20,403	1.964,500	30,618	2,302.187
All other manures ..	—	881,150	—	899.624

It is stated by the Department of Overseas Trade, which has furnished these figures, that imports of ammonium sulphate from the United States and from Great Britain stand in the proportion of roughly 8 to 1. Exports of phosphatic fertilisers continued to decrease, but exports of oil cake rose considerably. Production costs hamper the Japanese manufacturers in competing in foreign markets.

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JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

Official Organ of the Federal Council for Pure and Applied Chemistry

Vol. 42 NEW SERIES LONDON, JULY 13, 1923 No. 28

EDITORIAL

IN our issue of June 29 we suggested that the Presidential Address of this year was of such importance that a discussion of it was very desirable, that no adequate opportunity for discussing it existed at the Annual Meeting, and that it might be worth while to have a full discussion of it prior to the dinner in London, which is usually held in the autumn. For this we have been taken to task in last week's issue by " Eye-witness," who suggests that a discussion should have been arranged in the afternoon after the delivery of the address. Perhaps, but it was not arranged. Hastily written editorials are perhaps not always plain enough. *Brevis esse laboro, obscurus fio.* To avoid any further misapprehension may we repeat, in slightly different words, that we regard the meeting at Cambridge as unusually important by reason of the many matters of public interest dealt with by the President in his Address. We believe that a full discussion of these would interest not only our readers but also a far wider public whose attention should be directed to these problems through the agency of the newspapers. The Society of Chemical Industry includes leading representatives of the academic, industrial and commercial classes, and is for this reason particularly qualified to take a wide outlook on such matters and, notwithstanding the criticism of " Eye-witness," we hope that the items we alluded to may be discussed seriously and carefully and that the discussion, at any rate of such proposals as affect chemistry in its relation to the public or the State, will be such that the public will have an opportunity of realising the importance of them.

* * *

Of the many attractive fields of speculation which abound in the vast domain of applied chemistry, none presents greater interest or wider scope for the imagination than that relating to the origin of natural products. When we come to review the state of our knowledge of such products we have to admit that, in the majority of cases, we know surprisingly little having regard to the amount of theorising which has been indulged in, and of experimenting which has in some instances led up to the formulation of the respective theories. A striking case in point is the problem of the origin of petroleum. The many theories that have been put forward to explain the genesis of this, one of the world's most valuable raw materials, may be grouped broadly as " organic theories " and " inorganic theories." The protagonists of the former theories hold that petroleum has its origin in materials of organic nature, particularly plant materials or humic acids and related compounds. Recently, too, K. Kobayashi has put forward the idea that petroleum originates from fish oils and has adduced experimental evidence to support this view. Again, J. E. Hackford is of the opinion that Mexican petroleum is derived from seaweed. The adherents of the " organic theories " will, however, have to take serious account of certain facts which at present seem to lend considerable support to the views of the " inorganic theorists " ; particularly is this the case regarding the metallic content of petroleum. In a recent note in the " Transactions " Mr. W. Ramsay publishes the interesting fact that all the fuel oils which he examined contained nickel in small, but definite, amounts, ranging from 1 to 83 parts per million, whilst petroleum pitch and asphalt held 120 to 240 parts per million ; most of these oils also contained small amounts of copper. Vanadium is another metal which has been found in oils from such widely distant sources as Egypt, Persia, and America. Ramsay points out that the presence of these metals can hardly be accidental, and he puts forward the ingenious suggestion that the presence of nickel, with its well-known catalytic powers, gives material strength to the theory of Sabatier and Senderens, that petroleum results from a process similar to that which occurred when they produced a liquid strongly resembling natural petroleum by hydrogenating acetylene at high temperatures and pressures. It will be interesting to watch the progress of the arguments for and against the various theories as they develop in the light of the facts of the hypotheses that are constantly being put forward.

* * *

The Report of the British Dyestuffs Corporation, Limited, must be agreeable reading for the shareholders of that company and satisfactory to Sir William Alexander and his colleagues on the board. It is no little achievement to show a profit of over £100,000 after making due provision for depreciation. The chairman claims, and we believe rightly, that the dye-making industry has been definitely established in this country, that the quality of our production is equal to that of the best German types, and that British makers are now able to satisfy the bulk of the requirements of the colour-using industries here. The consumer now has a security of supply which was lost to him in 1914, and enables him to face with equanimity the present uncertainty of foreign supplies. The industrial supremacy and national security of this country have in the past been mainly due to our strong position in the iron, steel and heavy chemical industries. We shall all wish Sir William Alexander, his colleagues and shareholders, success in their efforts to include the dye-making industry in this category. Surely the time is not far distant when the chemical industry of this country will no longer be divided into a strong heavy one and a weak fine one. The two are now so intimately connected that the country cannot afford that either of these shall be weak. As time goes on they will be more and more closely connected, and the sooner they are regarded as one industry and so organised that there is a great deal of mutual support and common interest, the better for all. The dye-making industry may, and we trust will, be an important means of building up again the prosperity of the country, but its intimate connexion with the fine chemical industry, the heavy chemical industry and the industry of chemical engineering is obvious. A few years ago the prospects of the dye-making industry in this country seemed very gloomy; they are difficult yet, but the courage with which the difficulties are being faced gives us every ground for hope. Every reader of this Journal will join us in congratulating the Dyestuffs Corporation on its past achievement and hoping for a great measure of further favours to come.

THE THEORY OF SPECTRA AND ATOMIC CONSTITUTION

By PROF. W. L. BRAGG, F.R.S.

This English edition of three essays by Bohr* will be universally welcomed, as it constitutes a fascinating introduction to the theory which has thrown so much light on atomic constitution. The essays which Bohr has selected to represent his work were published in 1913, 1920 and 1921. They therefore give an historical summary of the way in which the theory has been developed step by step, and it is a remarkable tribute to the intuition which has guided the author from the first, that the earliest essay still describes, with hardly any modification, the main principles which have inspired the remarkable developments during the last few years.

The first essay describes Bohr's classical theory of the hydrogen spectrum, introducing the principle which marked so radical a departure from the established way of regarding the emission of radiation by the atom, and which gave an explanation for the first time of the most fundamental feature of all series spectra, the Ritz law of combination. According to this law the very complex assemblage of frequencies in the spectrum of an element can be summarised more simply by assigning to the element several series of terms, these terms having the form first proposed by Rydberg, and expressing the frequency of any line in the spectrum as the difference between a pair of these terms each chosen from one of the series. Bohr regarded the emission of radiation as due to an alteration in the structure of the atom, resulting in a diminution of its total energy. The energy is emitted as monochromatic radiation whose frequency, given by the quantum relationship $h\nu = E_1 - E_2$, can be equated to the difference in energy of the final and initial stages, divided by Planck's constant h. If it is supposed that each series term corresponds to a possible configuration of the atom, and that the lines of the spectrum are due to transitions from one of these configurations to another, the combination principle follows as an immediate consequence.

Radiation is emitted when an electron is being recaptured by an atom from which an electron has been removed. The lines in the spectrum represent successive stages by which this takes place. If their frequencies are multiplied by Planck's constant h, we obtain a measure of the potential energy lost as an electron passes from one orbit of temporary stability to the next. The simplest spectrum is that emitted by the hydrogen atom, all the lines being represented by the formula

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

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* *The Theory of Spectra and Atomic Constitution.* Three Essays. By Niels Bohr. *Pp. x + 126.* Cambridge: The University Press, 1922. *Price 7s. 6d.*

In this formula λ is the wave length of the line, R the Rydberg constant, n_1 and n_2 integers. The case of the hydrogen atom also lends itself readily to calculation, since the atom consists of a single electron describing an orbit about the nucleus. Bohr supposes that in the process of radiation the electron is more and more tightly bound by the nucleus, the major axis of the ellipse which it describes rapidly diminishing as it passes from one stage to the next. In order to explain the series formula for hydrogen by the quantum law, it must be supposed that the energy lost in arriving at the nth orbit is equal to $\frac{R\ hc}{n^2}$ c being the velocity of light, and n an integer which is the quantum number of the orbit. The process is complete and the stable hydrogen atom formed when n becomes equal to unity.

This is an entirely different view of the process of emission from that given by classical electromagnetic theory. According to classical theory, an electron rotating about the nucleus with a definite frequency, will give out electromagnetic radiation of that frequency, and of its higher harmonics. As the electron passes from one orbit to another in the process of being bound to the atom, its frequency continually increases, and we would expect the radiation to consist of a band of all frequencies between two extremes. This reasoning obviously fails somewhere, since in actual fact the spectrum of an element consists of sharp lines. Bohr's theory does not "explain" this failure; recognising its existence, it provides a satisfactory formula by which to calculate the frequency of the monochromatic radiation which we observe. In certain cases, however, classical theory is found to represent the observed facts. For instance, when electrons surge up and down a wireless antenna, the electromagnetic radiation which is emitted has the same frequency as the current in the antenna. In the Bohr atomic model, although the classical theory cannot indicate the frequency of the radiation when the electron passes from one orbit to another of very different frequency, there are cases where it may be expected to give a close approximation to the truth. This is so when the electron passes from one orbit of a high quantum number to a neighbouring one, for during the whole of this process the rate at which it circulates around the atom remains practically constant. It is here that Bohr's theory receives one of its most brilliant confirmations; the frequencies calculated by his application of the quantum theory become identical, in this limiting case, with those radiated by the electron according to classical theory. This may alternatively be expressed in another way. Assuming that the two theories must tally or "correspond" in these limiting cases, we can calculate a value for the Rydberg constant R from the charge and mass of the electron, which agrees exactly with that which is actually observed in the hydrogen and other spectra.

The "correspondence principle," thus outlined in the first essay, has been a guiding principle in suggesting formal relationships for more complex spectra. The series terms in these spectra, as in the case of the hydrogen spectra, again indicate different energies of configuration of the atomic system. The application of the correspondence principle to the determination of the formulæ for these series terms is developed in the second essay.

The theory is applied, for instance, to the radiation given out by the atom when placed in an electric or magnetic field (Stark and Zeeman effects) in order to explain the splitting-up of the lines into components in such fields. Electromagnetic theory indicates that the orbit of the electron around the hydrogen atom will go through a series of transformations in such a field, returning at definite intervals to its original conformation. Each frequency of radiation which is emitted in the unperturbed condition becomes a group of frequencies slightly differing from each other on account of these slow transformations. According to the Bohr theory, the splitting up of the lines corresponds to the existence of several configurations of the atom differing slightly in energy. Bohr finds formal expressions for the energies of the perturbed stationary states, which are such that in the limit quantum theory and classical theory give the same answer. He shows that the same formal expressions can be applied throughout the spectrum, and give results which are in the closest agreement with the observed effect for all the lines.

In considering these perturbed orbits the necessity for a second quantum number arises. In the unperturbed hydrogen atom, for instance (neglecting the relativity correction), it is only necessary to assume that the possible orbits are restricted to those with a definite major axis and energy characterised by the major quantum number "n." When the atom is in an electric field, the slightly different energies of the perturbed orbits must be sharply defined by a second quantum condition, involving an integer "k," in order that in the limit there may be correspondence between these energy differences and the harmonics of the cyclic changes through which the orbit goes.

The realisation of the significance of these two numbers "n" and "k" is essential to the understanding of Bohr's theory of atomic structure. This theory depends on the assignation of the correct quantum numbers to each electron in the atom, thus defining the energy with which that electron is bound to the atom, and ultimately the form of the orbit which it takes up. The electron orbits around the nucleus of an atom of high atomic weight are not simple ellipses, since the electron comes into the sphere of different fields of force in approaching and receding from the nucleus, owing to the variation in the screening effect of the other electrons. The orbit is perturbed and goes through a cycle of changes. It must, therefore, be characterised by two quantum numbers " n " and " k." In the case of the hydrogen atom in an electric field, the perturbations are so small that the energy is almost entirely determined by the " n " quantum number, and the integer " k " only produces slight alterations in the total energy which account for the splitting up of the lines. In an atom such as sodium, the perturbations produced by the complex atomic structure are very large, and the energy is greatly influenced by " k " as well as by " n. " Each series of terms in the spectrum of an alkaline element corresponds to orbits of the returning valency electron, for which " k " is a constant and " n " varies, so that there is a set of terms for every value of " k." A study of the spectrum leads to the determination of the quantum numbers " n " and " k " for every term. We can say, for instance, that the yellow line of sodium is given out when the electron goes from an orbit where $n = 3$, $k = 2$ to an orbit where $n = 3$, $k = 1$, and that the last orbit is the final stage of the process, in that no transference to a more tightly bound orbit with the emission of radiation takes place.

It is in this way that Bohr develops his theory of atomic structure in the third essay. In examining spectra, we are in fact witnessing the final stages in the building of an atom from its constituent parts. The whole process can be followed in the case of hydrogen with its single electron, but in the more complex atoms we can only watch the last electron, or the last but one, being incorporated into the structure, since under the conditions of excitation of the spectrum no more than one or two electrons are torn away from the atom. There are two ways, however, of arriving at a complete knowledge of the quantum numbers for all the orbits. The optical spectra tell these numbers in the case of the last few electrons to be added ; the X-ray spectra give information about the firmness of binding of the other electrons, since X-rays are emitted when an electron in one of the interior tightly bound orbits is removed from the atom.

It is this third essay which will make the greatest appeal to the chemist, since Bohr shows that the form of the periodic table can be predicted by a study of spectra alone. He considers the formation of the atoms in turn, commencing with hydrogen, and supposing them to be formed by the binding of electrons accompanied by the emission of radiation. In all cases where series spectra are available, they tell the orbits into which the last electrons finally settle down. In helium, for instance, the two electrons move in 1_1[*] orbits. In lithium the spectrum shows that the third electron does not join the former two, but ends its approach to the atom in a far more loosely bound 2_1 orbit, so becoming the valency electron. The electrons added during the second period culminate in neon with four 2_2 orbits and four 2_1 orbits. The valency electron of sodium does not join this two quantum group, but ends in a three quantum (3_1) orbit. The spark spectrum of calcium indicates that a previously formed group of three quantum orbits, completed in argon, will be still further added to in the succeeding elements. Hence, while the valency electrons describe four quantum orbits in the elements from scandium to copper, their number is not increased in passing from atom to atom ; the additional electrons go into an existing three quantum group to build up its numbers from eight to eighteen. From zinc onwards the inner group is complete, and the valencies of the elements pursue their usual course. During the transition stages the metallic ions possess an inner quantum group, which is only partially completed, and Bohr shows that this explains the colour, paramagnetism, and double valency of these ions.

A radical departure from accustomed ways of regarding radiation and atomic dynamics is inevitable, for it appears that the laws which have been deduced for large-scale phenomena must be modified when considering the atom. A new mechanics has to be framed, and this constitutes the main difficulty in the investigation of atomic constitution. Whatever may be the significance of the formal relationships which Bohr proposes, there can be no doubt of their accuracy, and of their power in correlating a vast number of phenomena.

THE REFEREEING OF SCIENTIFIC PAPERS

By T. S. PATTERSON

Most authors of scientific papers will probably agree that our methods of refereeing leave something to be desired, and I should like to raise the question here in order, if possible, to elicit from others interested in the subject, suggestions for improving the procedure. I do not take up the question with any very strong personal feeling, not having had much reason to complain[†] in regard to my own papers, but I do feel that the method adopted, at any rate by the Chemical Society, is one which, for extremely little that it produces of value,[‡] gives rise to an entirely disproportionate amount of irritation. As I am most familiar with the procedure adopted by the Chemical Society, it must be understood that, in what follows, I refer to their practice.

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[*] $n = 1$, $k = 1$.

[†] Of refereeing : literary form is another question.

[‡] I can in fact only recall one single instance in which I was really glad to adopt a suggestion made by a referee ; only one instance in which the referee succeeded in discovering what would have been an actual mistake in the paper.

The majority of papers sent to the Chemical Society, although considered by the referee to be worthy of publication, are also thought by him to require some alteration, and it is here that trouble is apt to ensue. The autocratic command to alter or omit certain passages, which reaches him through the editor from an unknown referee, seldom makes a sympathetic appeal to an author. He feels that there is something to be said on his side, and it is very difficult for him to carry on an argument, through an intermediary, with an anonimity.

It would be vastly better if, in some way, the author were put into communication with the referee in order that any debatable points might be adequately discussed. It is objected to this, and certainly with some reason, that a referee might be thus involved in a certain amount of, perhaps uncongenial, correspondence. It may be that some referees would either be so afraid of giving offence or would have so little confidence in their own judgment that they would not care even for this modified procedure, although I believe that it would tend considerably to lessen friction between the Publication Committee and the author. At least it might be tried; it would help to ensure that the refereeing of a paper, upon which, after all, much may depend, should not be done in any perfunctory manner. I should myself always be glad to hear from a referee what impression my paper had made upon him and how, if it seemed necessary, it might be made clearer. As things are now, it seems hardly worth while to put a paper into final form before sending it to the Society. If some trouble has been taken in writing the paper, so that its parts are closely knit together, it is often exceedingly difficult to cut out some portion, even a small portion, here or there, because this may easily alter the whole structure of the remainder.

But if a referee prefers to remain anonymous and the author, unable to accept his suggestions, cannot get into touch with him, then I would suggest that the author should be invited to choose a referee agreeable to the Committee, to whom the paper might be submitted for an opinion on any point in question, and with whom the author could communicate direct. Most authors would be quite willing to accept the decision of the referee whom they had themselves chosen or had a say in choosing.

A third method by means of which scientific papers might be dealt with is the simplest of all. It is that which, as far as I can judge, used to be practised by the German Chemical Society. A paper submitted to the Society was read by the editor, who, if he found it suitable, might perhaps make some slight suggestions for its modification or improvement—although in my own experience I remember none such—and if he then thought the paper suitable for publication, immediately sent it to the printers. A paper which either seemed unsuitable for publication, or else to require considerable modification, he could send to a referee.

Another method might be to allot to a paper which had been generally approved a certain number of pages, and leave the author to do the best he could with that. He might then tell his own tale exactly in his own way, which would make for greater originality in the presentation of his subject. He would probably write with a keener sense of responsibility than when he feels that there is a referee in the background, and the result in the end would be both more satisfactory and easier to achieve. In fact, if an author had attained to some standing as a contributor to a journal, he might well be trusted to write his papers without the assistance of a referee at all.

The most obvious difficulty for the referee is, of course, to have to advise the rejection, or even a very fundamental reconstruction of a paper. But this might be met by withholding always the name of the referee until his report had been submitted, and if his report were very definitely adverse, withholding his name altogether in order that a second, absolutely independent and unprejudiced, opinion might be taken. If both referees advised rejection the Committee might, with some confidence, act on their recommendation. Even then, however, I consider that the author should have a say in the selection of the second referee. As I think the matter is of greater consequence than seems sometimes to be realised by those who decide the fate of other people's papers, I trust it may be ventilated in the columns of *Chemistry and Industry.*

Organic Chemistry Department,
University of Glasgow

CHEMICAL SOCIETY'S LIBRARY

Owing to the work of redecorating the rooms of the Society, the Library will be closed during the entire month of August.

The Library will therefore close on Tuesday, July 31, at 9 p.m., and reopen on Saturday, September 1, at 10 a.m.

The Library, in accordance with the usual practice, will be closed at 5 p.m. from September 1 to 17, on and after which date it will remain open until 9 p.m. every day except Saturday, when it will close at 5 p.m.

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OBSERVATIONS BY "EYE-WITNESS"

The Editor welcomes the comments and expressions of opinion by his contributors, but it must be understood that he does not necessarily agree with them.

DYESTUFFS AND HEAVY CHEMICALS.

At the recent Brunner Mond & Co. dinner, Sir William Alexander made a very good speech, carefully prepared and excellently delivered. It dealt in an interesting manner with the history of the company whose jubilee we were celebrating, and every now and then there was a comparison of the dyestuff with the heavy chemical industry. Occasionally there was a reference to the struggle through which the dyestuff industry has just emerged and the advantages of cooperation between the two branches of the industry. All of which set me thinking. There is the heavy chemical industry well established, developing under its guidance is the production of ammonia from atmospheric nitrogen, and now the prospect opens out before us of the linking of the dyestuff industry with it. One hardly knows what to think of such a prospect, but one thing is certain, it would mean an additional menace to the German Chemical Industry.

THE CHEMICAL SECTION

of the British Empire Exhibition is, I am told, now quite full, and those who have delayed until now are finding it difficult to obtain any space for their exhibits. I was shown a letter from Dr. Ruttan, the ex-President of the Society, who is hoping that Canada will cooperate with the Mother Country in the pure chemistry part of the section. Whether this can be arranged I do not know, but I imagine that Dr. Levinstein, who is the Chairman of the Committee dealing with that portion of the exhibit, will welcome any example of distinctive work from the Colonies. The only difficulty I foresee is that each of the Colonies has its own exhibit, and may be unwilling to allow any scientific novelty to be placed anywhere, except in the very ample spaces taken by the Colonies.

THE BRITISH DYESTUFFS CORPORATION MEETING

last Tuesday was not the vigorous affair we were treated to last year. Circumstances have changed for the better, and although the Corporation is by no means out of the wood, the shareholders had evidence that the position has been consolidated. Hence there was a change in the tone of the meeting, and Sir William Alexander's speech to his shareholders was listened to with a great deal of interest. The position in the dyestuff industry at the moment is most interesting and anything may happen. Two absolutely contrary views are being put forward as to the action of the French in removing German dyestuffs from the Ruhr and its effect on the British industry. The more general opinion in the industry seems to be that the flinging of the dyes which have been taken on to the open market to fetch anything they will, must have a paralysing effect on the British industry from which it might never recover. On the other hand, I did hear that a singularly competent observer holds the view, that after a temporary depression in prices there will follow a shortage of dyestuffs all over the world which will raise prices and set the British industry on its feet once more. The industry has suffered from crisis after crisis ever since the war, and I imagine that having been "threatened" so often its leaders are becoming inured to such scares.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

this week completes its seventh year, and the Annual Meeting and dinner took place yesterday (Thursday). Circumstances have conspired to make this Association rather more truly representative of the industry than similar associations usually are. One is familiar with the association or society devoted to the furtherance of some scientific object: it usually has a small subscription and a large membership. Then you may have an association where the relative sizes of the subscription and membership are reversed; its object is, quite frankly, to make money for its members, and unless it does so it fails to retain its members. The Association of British Chemical Manufacturers falls into neither of these groups. It has a small membership, but it represents a very large amount of capital invested in the industry. The annual subscription is a large one, although graduated according to the capital of the company member. It gives no direct return for the large annual subscription it demands, yet its membership shows no diminution.

THE EXPLANATION OF THE PARADOX

is to be found in the broad basis on which the Association was built seven years ago and the wise restraint exercised by the Council in its development. Think of what our British Chemical Industry really is; it is in fact a collection of inter-related industries with scientific chemistry for their basis. If you are to group these industries under one head for purposes of representation and collective action, you must allow sufficient freedom of action for the various groups, and this the Association does by its group system. When all the groups are interested and unanimous, the Association acts in its corporate capacity in the dissemination of information and in parliamentary and transport matters for example. With this kind of organisation the individual groups in the course of their development by "trial and error" gradually work out for themselves the lines on which they can obtain the greatest possible good from combining with other groups.

SOCIETY OF CHEMICAL INDUSTRY

MEETING OF COUNCIL

The monthly meeting of Council was held on June 21, 1923 at the Arts School, Bene't Street, Cambridge, the President, Dr. E. F. Armstrong, F.R.S., in the Chair.

Prof. Harold Hibbert, of Yale University, U.S.A., representing the American Section of the Society, was present by invitation.

It was reported that the Committee of the Chemical Engineering Group had agreed, at the request of the Council, to organise both the Chemical and Physical sections of the World Power Conference, to be held in June, 1924, at the British Empire Exhibition.

It was decided to hold the Annual London Dinner of the Society in November.

The Society's annual contribution to the Federal Council for Pure and Applied Chemistry was renewed for 1922.

The reports of the Hon. Treasurer and of various Committees of the Council were discussed, and 23 new members (Home, 17 ; Australia, 2 ; India, 1 ; U.S.A., 1 ; Japan, 2) were elected.

On the proposal of Sir Wm. Pope, the following were unanimously elected honorary members of the Society :—Prof. C. F. Chandler (U.S.A.), Prince Ginori Conti (Italy), Monsieur Paul Kestner (France), Prof. Joji Sakurai (Japan), Sir Dorabji J. Tata (India).

The revised Rules of the Chemical Engineering Group were approved.

It was agreed, at the request of the Executive Committee of the National Gas Exhibition, 1923, to allow the name of the Society to appear in the list of patrons, and that the President should be a Vice-president of the Exhibition.

The President was nominated the Society's representative at the meeting of the British Association for the Advancement of Science, to be held in Liverpool on September 12 to 19.

As no meeting of Council will be held until October, the following members were appointed an Executive Committee to deal with matters of urgency arising in the meantime :—The President (Dr. E. F. Armstrong), the Hon. Treasurer (Mr. E. V. Evans), Mr. J. L. Baker, Mr. C. S. Garland, Sir Wm. Pope, Mr. Edwin Thompson, and Mr. W. J. U. Woolcock.

It was reported that Mr. C. F. Cross had represented the Society at the Centenary Meeting of the Société d'Encouragement pour l'Industrie Nationale de Paris, and that Prof. R. H. McKee, Chairman of the American Section, had similarly attended the inauguration of Prof. Stratton at the Massachusetts Institute of Technology.

The date of the next meeting was fixed for Friday, October 12, 1923, at 2.30 p.m.

CORRESPONDENCE

DR. EHRHARDT'S PAPER ON "PATENT CLAIMS FOR PRODUCTS"

Sir,—My attention has been called only within the last few days to Dr. Ehrhardt's admirable paper, entitled, "Patent Claims for Products," appearing in your issue of March 29 last. In it he discusses the case—In the Matter of Applications for Patent by W. K.-J., and W. Ltd., reported in Vol. 39 Reports of Patent Design and Trade Mark Cases at p. 263 —and its bearing on applications for Patents for new chemical substances, *e.g.*, new azo-dyes. He suggests that the Law Officer's decision in that case in so far as it interprets the word "special" in Section II of the Patents and Designs Act, 1919, renders an application for a patent for a new azo-dye, produced "in the usual way with a well known component," liable to rejection, because its method of production would not be "special."

In the case referred to the Comptroller-General raised no objection before the Law Officer to Claim 1 for the process of making the bread, giving as the reason that the claim involved chemical action during the baking stage, nor to Claim 6, which was in these words, "Bread prepared or produced by the special methods or processes of manufacture above described and claimed." The Law Officer's decision contains the following passage :—

"Lastly I have to deal with the meaning of the word, 'special.' In my judgment given upon an application by 'M.,' I have decided that the word is used not in respect of a new mixture of ingredients ; but in order to connote a method or process which has such attributes that it is the proper subject of a claim for letters patent, one that has some intrinsic characteristics which are the invention of the inventor and for which a patent may be properly and legitimately claimed and granted."

In the Law Officer's decision in the case—In the Matter of M.'s Application for a Patent (reported *loc. cit.* at p. 261)—the following passages occur :—

"In my judgment the word 'special' is introduced, in addition to the word 'described,' in order to connote that the particular method or process set out in the specification must contain the essentials of a valid patent-novelty, a manner of new manufacture—a process which produces by its own chemical reaction a new substance. It must be a method, or process, which has such attributes that it is the proper subject of a claim for letters patent, one that has some intrinsic characteristics, which are the invention of the inventor and for which a patent may be properly and legitimately claimed and granted."

"An applicant may not solely mix certain ingredients by known processes and say that he has produced a new medicine that can be the subject of a patent. That is merely to introduce a prescription to the world. But he may, by a new manner of manufacture, produce a new medicine or substance hitherto unknown, which would be the proper subject of letters patent. This might be produced, for example, by chemical reaction with properties resulting therefrom, be it by some process newly discovered, or by chemical reaction of the ingredients."

I do not think it necessary to discuss the facts, or the Law Officer's application of his interpretation of the Section to the facts of these two decisions, but it is sufficiently clear from these extracts that Dr. Ehrhardt is in error in thinking that the application for a patent for a new azo dye would be beset with difficulties by reason of the meaning given to "special" in these decisions. Such an application would be concerned not with a mere prescription, but with a process involving and dependent for its results upon chemical action and, accordingly, the process would be a "special" one within the meaning of the section as interpreted by these decisions.—I am, Sir, &c.,

Arthur Colefax

July 3, 1923

THE CASSITERIDES

Sir,—The identification of the Cassiterides is a difficult problem. There have been three main theories: the locality was off the North-West coast of Spain; it was Britain, *i.e.*, Cornwall, including the Scilly Isles; it was imaginary. The latter theory, advocated in the "Encyclopedia Britannica," need hardly be considered. The Spanish theory, although it appears to be supported by the descriptions of Diodorus Siculus and Strabo, both of whom probably drew on the same source, suffers from the defect that there are no islands off the coast of Spain which produced tin. The British theory, which is advocated by most modern writers (I may refer to Mr. T. R. Holmes' "Ancient Britain," Oxford, 1907, pp. 483 ff., to Prof. Lippmann's "Alchemie," 1919, p. 583—he gives a most exhaustive literature collection, but omits Holmes; Reinach, "L'Anthropologie," 1892, vol. 3) has a good deal in its support. These authors quote all the classical authorities in detail. The position of the Cassiterides seems to have been correctly given by Pytheas, about 360 B.C., from his own travels; the source of the Spanish theory was later, and is traced by Berger ("Geschichte der wissenschaftlichen Erdkunde der Griechen," Leipzig, 1903, p. 512) to Polybios (*c.* 200 B.C.). The charge brought against me by my editorial critic that I was guilty of propagating an old and exploded error, presumably owing to ignorance, I must vigorously repudiate.—I am, Sir, etc.

J. R. Partington

45, Kensington Gardens Square
July 7, 1923

Sir,—After reading your editorial on the subject of the Cassiterides I looked at Ptolemy's map of the world and compared it with a modern map. Although Ptolemy flourished about a century later than the ancient writers whom you mention; you ought, nevertheless, to allow him to appear as an expert witness. Bearing in mind the state of geographical knowledge in his time, I think that his evidence is conclusive that the ancient Cassiterides are the same as the Scilly Isles.

If Diodorus and Pliny were familiar with some such map as Ptolemy's, they would naturally describe the Cassiterides as "above Lusitania . . . lying off Iberia in the Ocean," and as "opposite to Celtiberia."—I am, Sir, etc.,

R. H. Atkinson

26, Maids Causeway, Cambridge
July 8, 1923

I am afraid I have put my foot into a hornet's nest, but plead not guilty to the fault which Prof. Partington attributes to me. I do not think any words of mine imply that he was ignorant of the subject. It is now obvious, and I already knew it when I wrote my article, that he was well acquainted with the literature on the subject, and I suspected him of having an acute and logical mind. My criticism was really that people are apt to go to modern books about such points when the original information is available. Now Prof. Partington refers to Holmes, Lippmann, Reinach and Berger, but I should prefer his own opinion on what the early writers said.

Herodotus says, "nor am I better acquainted with the Islands called the Cassiterides from which we are said to get our tin." (iii., 115). I have already quoted Diodorus and Pliny. Posidonius says that tin was dug up among the barbarians beyond Lusitania, and in the islands called Cassiterides and also in Britain. Pomponius Mela, after locating the Celtici in the neighbourhood of the Douro, says:—"Among the Celtici are several islands all called by the single name of Cassiterides because they abound in tin." (Mela iii., 3, 6.) Prof. Partington says "the position of the Cassiterides seems to have been correctly given by Pytheas, about 360 B.C., from his own travels." The writings of Pytheas long since disappeared except for some references to him or quotations in Strabo, Ptolemy, Geminus, Stephanus Byzantius, Plutarch, Hipparchus, the Scholiast on Appollonius Rhodius, and three or four other authors. Will Prof. Partington kindly tell us what ancient author quotes such a statement of Pytheas? I have not come across it in the references I have so far had time to turn up. I also invite him to quote any author prior to, say, 100 or 150 A.D. who states anywhere that the name Cassiterides is applied to Britain. I have furnished him with three or four references which do not. There was an old tradition that there was a tin island in the Indies, and having read most of the early passages relating to the Cassiterides I am of opinion that the old Greeks did not know very clearly where their tin came from, and that the identification of the Cassiterides (as they used the word) with Britain is without foundation.

In reply to Mr. R. H. Atkinson, the writings of Ptolemy might be of interest on such a point ; a modern reproduction of a mediæval map, supposed to have been copied from some earlier map prepared by Ptolemy is not very much good, but what particular map has he in mind ? There is a map in a well-known Latin Ptolemy of 1478 ; if Diodorus and Pliny based their views on such a may as this they would be perfectly clear that the Cassiterides were not the same as the Scilly Isles.

THE EDITORIAL CRITIC

PRESIDENTIAL ADDRESS

SIR,—On reading through the President's address to the recent Annual Meeting of the Society of Chemical Industry, I notice what is either an omission or a mistake to which I think it is worth while to draw attention.

Of the Research Association to which the President referred, the first to be formed, the Photographic, completed its first five years in May of this year. Unfortunately the financial position of the Photographic industry, comparatively a small industry, is at present at a very low ebb, and it is not yet quite certain whether it will be found possible to continue the Association. I do not know whether this should be attributed in any way to a too literal acceptance by the responsible heads of the industry of the dictum laid down by the President in another part of the address that the object of industry is definitely financial, a dictum which I am pleased to see produced a protest from Dr. Heathcote in your issue of June 29th. I think it more probable that it may be ascribed to the fact that the work of the Association has been concerned, and rightly so, with the fundamental principles underlying photographic processes, and that it has therefore made a less direct appeal to the industrial director than work which is concerned with the discovery of new processes, or the improvement of existing ones. In times of financial stress, such as the industry is now experiencing, the continuance of subscriptions to such work is one of the first things to be imperilled.

Considering the difficulties with which the Association has had to contend in its first five years, a change of directorship in the third year being one of the chief of these, it is somewhat surprising how much valuable research work has been accomplished, and how well established its reputation has become over the whole world for careful and accurate work. That the energies of the director, Dr. Slater Price, and his co-workers should be suddenly switched into other channels, and the various researches in progress should be suddenly stopped, would be a very serious loss, not only to photographic research in particular, but to scientific research in general—not only to the photographic industry in particular, but to all those industries which in one way or another make use of photographic methods or material in their own work.—I am, Sir, &c., B. V. STORR.

FORTHCOMING EVENTS

July 13 and 14.	THE FARADAY SOCIETY, Department of Physical Chemistry, Cambridge. Friday afternoon and Saturday morning. General Discussion on "The Electronic Theory of Valency."
Sept. 10–13.	THE INSTITUTE OF METALS. Annual Autumn Meeting, to be held in Manchester. "The Use of Non-Ferrous Metals in Engineering," by Lieut.-Colonel Henry Fowler. Tickets are obtainable from Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, S.W. 1.
Sept. 12–19.	The British Association for the Advancement of Science. Ninety-first Annual Meeting, Liverpool. Among the papers to be read are the following:—(1) "The Electrical Structure of Matter" (Presidential Address), by Prof. Sir E. Rutherford, F.R.S. (2) "The Origin of Spectra," by Prof. J. C. McLennan, F.R.S. (3) "The Physical Chemistry of Interfaces," by Prof. F. G. Donnan, C.B.E., F.R.S. (4) "The Position and Opportunity of the British Empire," by Dr. V. Cornish. (5) "Unemployment and Population," by Sir W. H. Beveridge, K.C.B. (6) "Transport and its Indebtedness to Science," by Sir H. Fowler, K.B.E. (7) "The Education of Demos," by Prof. T. P. Nunn. (8) "Science and the Agricultural Crisis" by Dr. C. Crowther. Membership Fees, £1 and upwards. Students' Tickets, for duly qualified persons, 10s. Full particulars can be obtained from the Secretary, British Association, Burlington House, London, W. 1, or from Local Hon. Secs., British Association, Manesty Buildings, College Lane, Liverpool.

PERSONALIA

Prof. A. C. Neish has been elected President of the Canadian Institute of Chemistry.

Monsieur Jean Perrin, professor of physical chemistry at the Sorbonne, has been elected a member of the Académie des Sciences. Prof. Perrin is the author of classic researches on the constitution of matter and is at present engaged in investigations on the changes of matter induced by light which promise to furnish an explanation of the phenomena of radioactivity.

* * *

E. F. Dyer, a well-known expert in the United States sugar industry, has died at the age of 65 years.

The death is announced, at the age ofseventy, of Prof. J. Nevinny, professor of pharmacology, in the University of Innsbruck.

The death is announced of Monsieur P. Mossot, director of the Société Métallurgique de Knutange and president of the Association des Maîtres de Forges de Lorraine.

The death is announced from Germany of Heinrich Baum, a well-known worker in the field of Azo colours, and the originator of Coccinin and many other colours. Also of Prof. B. Martiny, the founder of the modern German milk industry.

From Germany the deaths are announced of Dr. H. Liebmann, chemist to Bayer und Co., Leverkusen; W. Eckhardt, managing director of the Brüder Passer Factory; Dr. O. Spanjer, director of the Upper Silesian Portland Cement and Lime Works; of W. Hollweck, who was responsible for many improvements in firing technique in the gas industry; and of R. Schmidt, a director of the A. G. für Anilin Fabrikation.

NEWS AND NOTES

AUSTRALIA

The Sugar Industry.

According to the latest returns the output of raw sugar in Queensland in 1922 was 288,928 tons from 2,176,949 t. of cane harvested on 149,863 acres; in 1921 the figures were 282,198 t., 2,287,416 t., and 122,956 acres, respectively. The production of sugar in New South Wales in 1922 is given as 17,267 t., an increase of 483 t. over the previous crop. —(*Ind. Tr. J., June* 7, 1923.)

CANADA

Profits in the Italian Chemical Industry

It is announced in the Roman Press that during the first half of 1922, 47 out of 57 chemical companies representing a total capital of 355,000,000 lire made a profit of 28,000,000 lire, the remaining 8 companies making a loss of 6·8 million lire.—(*Chem. Ind., June* 2, 1923.)

FRANCE

Societe de Chimie Industrielle

The Third Congress of Industrial Chemistry will take place at the National Academy of Arts and Sciences, Paris, from October 21 to 26, 1923.

The Société de Chimie Industrielle has extended an invitation to members of the Society of Chemical Industry to attend this Congress as delegates. and the secretary of the Société entertains the hope that many of these delegates will be willing to present papers at the different sections of the Congress.

It is hoped in this way to strengthen the bond which already exists between the two associations.

The Turpentine and Rosin Industry

The production of turpentine and rosin in France during the last 10 years has been as follows :—

Year	Turpentine Metric tons	Rosin Metric tons
1913	25,000	85,000
1914	19,000	64.000
1915	15.000	51,000
1916	17.000	60,000
1917	17,000	60.000
1918	20.000	60.000
1919	25,000	85.000
1920	35.000	120,000
1921	31,000	105,000
1922	32,000	118,000

In normal years France is responsible for roughly one-sixth of the world output; the United States furnishes roughly four-sixths. Official statistics for 1922 are not yet available, but from private sources it appears that the export during 1922 consisted in 9105 tons of turpentine and 58,136 t. of dry rosin, figures which indicate that over 28 per cent. of the output of turpentine and slightly under 50 per cent. of the production of rosin were exported. The chief markets for rosin are Germany, Belgium, England, Italy, Holland and Poland, England and Belgium taking the largest proportion of the turpentine. Practically the whole of the French output originates in the province of Bordeaux.

Notes from Paris

The Cabinet has recently decided to allocate 5 million francs from the profits made by the "Consortium des Pétroles et Essences" to exploration for petroleum in France and the Colonies. It is understood that the scientific committee of the "Direction des Pétroles et Essences" will shortly proceed to examine a scheme of exploration extending over five or six years. It has already been decided to send a commission to study the geological and economic conditions in Madagascar with a view to exploiting the island's resources of petroleum.

The French Association for the Advancement of Science is to hold its annual meeting at Bordeaux, from July 30 to August 4.

The "Societé d'Encouragement pour l'Industrie Nationale" has recently celebrated the 122nd anniversary of its foundation. Mr. C. F. Cross, F.R.S., represented the Society of Chemical Industry and the Chemical Society at the opening meeting, and made a speech extolling French contributions to science. The proceedings included the presentation of numerous papers and visits to factories, etc.

AUSTRALIA

Mineral Output of Queensland in 1922

The value of the mineral output of Queensland in 1922 was £1,791,333 which represents an increase of £334,897 over the value of the output in the previous year. The following figures give the quantities and ore values in 1922 :—

1922	Quantity	Value
Copper	—	£321,535
Gold	80,584 fine oz.	£342,300
Coal	958,519 tons	£840,472
Coke	5,265 tons	£8,762

A general improvement is reported in tin, lead, silver, and gold-mining. The State boring for petroleum at Roma has been abandoned, but a private syndicate has carried on the work. Important discoveries of copper and cobalt ores have been made in the Kloncurry district.—(*Ind. Aust., May* 3, 1923.)

GENERAL

German Reparations Duty

In a written answer Sir W. Joynson-Hicks informed Mr. W. A. Jenkins that the amount collected under the German Reparation (Recovery) Act was £3,709,000 for the year ending March 31, 1922, £7,474,000 for the year ending March 31, 1923, and £1,397,000 for the two months ended May 31, 1923. The percentage rate of the levy was reduced from 50 to 26 per cent. after May 13, 1921.—(June 28.) .

Mineral Output of Algeria in 1922

During 1921 Algerian mining passed through a crisis which left it at the end of the year with stocks on hand exceeding 700,000 tons, principally of iron ore. During 1922, however, there was a general improvement as will be seen from the following figures showing the output of various minerals during 1921-1922 :—

	1921	1922
Phosphates	372,019	525,396
Ores :		
Iron	684.964	1,294,907
Copper	2,007	1.901
Lead	11.421	14,118
Zinc	17,537	39,405
Antimony	320	1,645
Manganese	1,893	—
Kieselguhr	1,563	3,425

The value of the export of minerals in 1922 was 110,000,000 francs compared with 69,000,000 francs in 1921.

Nickel in New Caledonia

The Institut Colonial de Marseille, reports that the Société des Hauts-Fourneaux in New Caledonia is now resuming full production as its stocks of nickel matte are partly cleared and the world market has improved. Coal obtained from the mines at Moindou has proved satisfactory and a plant is being installed to ensure regular supplies, in order to reduce the importation of Australian coal and coke The smelting works of the Société le Nickel will soon be consuming 4000 m.t. of nickel ore per month, compared with 2500 m.t. a year age. No new mines have been opened however, as the present one, combined with actual stocks, suffices to supply the works. Much difficulty is being experienced owing to the shortage of labour. The Société le Nickel is contemplating the production of chrome from an abandoned mine.

Proposed International Chemical Congress in South America

We are informed that it is proposed to hold the first chemical congress in South America in 1923. As the first National Congress held by Argentine chemists in 1919 was so successful—the transactions published in connexion with it fill four stout volumes—the Argentine Chemical Union has approached all the other chemical organisations in South America, with a view to organising an International Congress of South American chemists.

PARLIAMENTARY

HOUSE OF COMMONS

Patent Medicines

In answer to Lieut.-Colonel Fremantle's enquiry as to whether it is proposed to introduce a Bill to give effect to the recommendations of the Select Committee on Patent Medicines, Mr. Chamberlain said that in the present state of business the Government could not undertake to introduce legislation on this subject during the present Session.—(July 4.)

Coal Output and Royalties (Yorkshire)

Answering Mr. Lunn, Lieut.-Colonel Lane-Fox said the total output of saleable coal in Yorkshire during the year ended March 31, 1923, was 43,266,000 tons. He could not say what was the amount paid in royalties in Yorkshire alone ; in the eastern district, comprising Yorkshire, Nottinghamshire, Derbyshire, Leicestershire, Cannock Chase and Warwickshire, with a total output of 85,154,000 t., they amounted to £1,505,000. Royalties were not assessable to local rates in these districts.

To Mr. Lunn's further enquiry, Lieut.-Colonel Lane-Fox replied that he was not aware of any intention on the part of the Government, either to nationalise the minerals, or to introduce a Bill to make the minerals public property.—(July 4.)

Pasteurisation of Milk

In a written answer to Mr. Adams, Mr. Chamberlain stated that it was expressly provided in the Milk (Special Designations) Order, 1923, that the milk sold as "pasteurised" milk should not be heated more than once. The danger arising to public health from the sale of reheated milk, however, was not such as to justify the issue of special regulations which in present circumstances might result in restricting the supply of milk.—(July 4.)

White Lead Convention

Sir M. Barlow in a written answer to Mr. A. Greenwood said that he was aware that the International Materials' Committee, representing the Master Painters' Federation of England and Scotland, and the Association of Ireland, had declared in favour of the ratification of the White Lead Convention; also that the operatives in the painting trade had also declared themselves in favour of ratification. He added that the ratifying of the Convention by the Government was being carefully considered in the light of all the circumstances, and that the decision would be announced as soon as possible.—(July 4.)

REPORT

Report on Economic Conditions in France to March, 1923. *By* J. R. Cahill, *H.M. Commercial Counsellor, Paris. Pp.* 129. *Department of Overseas Trade. H.M. Stationery Office*, 1923. *Price* 3*s.* 6*d.*

The report opens on an optimistic note, pointing out that the present economic position of the country is strong. The industrial population is fully employed, the reconstruction of the devastated areas is almost complete, and agriculture is fast approaching pre-war conditions. In general the resources of the country are being developed and improved industrial organisation has led to consolidation of the basic industries on regional and national lines. Foreign trade is bigger than before the war. The country is still suffering, however, from war losses and the present employment of the population is no doubt due to the demands of reconstructional work, but it is hoped that France will inspire confidence and maintain her present strong position.

The trade policy of the Government is one of protection. British trade with France, however, in spite of high tariffs and the depreciated franc, has shown signs of improvement. Important commercial treaties were entered into in 1922 by France with Spain, Italy, Canada, Poland, and other countries. Restrictions on imports were largely removed in 1922 but the export of iron and steel scrap was prohibited last December. Exports in 1922 were valued at 20,642 million fr., and imports at 23,900,000 million fr., against 19,773 million fr. and 22,067 million fr. respectively in 1921. Among the items exported in 1922 were (in million fr.):—Sugar, 348 million fr.; ores, 238; iron and steel, 1003; coal, 354; chemicals, 633; perfumes and soaps, 213. Imports included:—Sugar, 657 million fr.; coal, 2392; copper, 351; mineral oils, 945; nitrate of soda, 127; iron and steel, 532; chemicals, 385.

As mentioned above French industry and production is in an improved position. Factories were erected in all parts of the country during the war occupation by Germany of the industrial areas, and the new factories erected in occupied regions are improvements upon those they replace. The coal industry has been extremely active since the beginning of 1922. Output has been checked only by the difficulties of labour and the state of the pits; in 1922 the output of coal was 31·91 million tons. In the first ten months of the year 17 million tons of iron ore was produced. During 1922 the number of blast furnaces alight increased from 73 to 116, whilst pig-iron output amounted to 5,128,600 t., and steel to 4,471,300 t.

The potash output has been much increased from that obtaining under German rule, and in 1922, 540,000 tons of potash salts were exported. In future the fields are to be worked by a single company, profit-making, but of public utility character. France is now the principle European producer of bauxite. Oil development is taking place, but the production is still relatively unimportant in France. Water-power is being developed and schemes have been formulated for the working of 1·5 million horse-power of the 8 or 9 million h.p. available.

TARIFF CUSTOMS EXCISE

British India.—A schedule is given containing a list of goods with revised rates of duties. Among the various articles are included gums, resins, lac, hides, iron, steel, oils, kerosene and motor spirit, sugar, silk and chemicals.

Finland.—A new customs tariff has been proposed, which will provide for a reduction of duty on silk goods, and an increase of the duty on sugar.

Poland.—The consumption tax has been increased on crude oil products and on coarse and refined sugar. The excise duty on sugar has been raised from 150,000 to 280,000 Polish marks per 100 kilogs.

Switzerland.—Reduction has been made in the import duties on certain kinds of iron.

REVIEWS

SYNTHETIC RESINS AND THEIR PLASTICS. *By* CARLETON ELLIS. *Pp.* 514. *New York: The Chemical Catalog Co., Inc.,* 1923. *Price,* $6·0.

Synthetic resins are beginning to play an important part in industry. In England manufacturers are touching only the fringe of this promising field, whereas America has been the pioneer in establishing a profitable business in the manufacture and use of artificial resins of all kinds. The latter country is in an exceptional position, by reason of its natural resources, to hold the market in the various resinous substitutes, which have been introduced of recent years for industrial use, and it has now again taken the lead in providing a reference book on the intricate subject of synthetic resins.

At the outset it may be said that the book under review serves to establish the impression of the growing stability of these new manufactures, and of the large and promising field for future development. Mr. Ellis merits the gratitude of the chemist and manufacturer interested in synthetic resins. The literature of the subject is exceedingly meagre, and consists mainly of isolated articles in the chemical and technical journals, and of patent specifications. The author has devoted much care to the wearisome task of collecting and arranging this widely-scattered and miscellaneous information, and he has also included results from his own researches. He has had the advantage of criticism and information from American technical chemists and engineers concerned in the manufacture and use of these resins, notably Dr. L. H. Baekeland, the originator of the most widely known synthetic resin, "Bakelite."

The varieties of resins dealt with, and their applications, are too numerous to catalogue briefly here. Those produced from aldehydes and phenolic bodies naturally occupy considerable space in the book; cumarone and indene resins are fully considered; and much data are given in regard to the newer and lesser-known substances, such as furfural resins, urea resins and the resins from polybasic acids and glycerin.

The practical nature of the book may well be judged by the four concluding chapters, dealing with the use of resins in moulding compositions. Much detail is here given by one who evidently has an intimate knowledge of the technical difficulties involved. A great deal of this information has remained until now in the private possession of the expert in the manufacture of moulded articles, the moulding foremen and skilled operators, and its publication therefore marks a distinct step in advance. Plates are included in these chapters, showing the types of machinery necessary for the successful working of moulding compositions. These illustrations are naturally—but unfortunately, from the point of view of the British user — of American machinery. American methods of testing moulded articles for use in electrical insulation are described. Here again, the chemist in this country may be preferably referred to the methods recommended by the British Electrical and Allied Industries Research Association (*Beama*, 1922, p. 374).

It is, perhaps, worth while to comment on the author's remarks relative to the nomenclature of the resins loosely termed *phenol-condensation products*. Mr. Ellis says rightly that it is better to make general use of the term *phenol-formaldehyde resins*. Moreover, it may be remarked that to obtain a still more general, and at the same time, accurately descriptive term, *formaldehyde resin*, can be used.

The general arrangement of the matter is reminiscent of Worden's *Nitro-cellulose Industry*, and Mr. Ellis has evidently endeavoured to provide the same careful presentation of detail for the synthetic resin industry, as was done for the nitro-cellulose industry. The binding, paper and print are good, typographical errors almost entirely absent, and altogether, the book is a valuable and interesting addition to the technical bookshelf, and certainly a source of inspiration for the synthetic-resin chemist.

ALAN A. DRUMMOND

THE SPECTROSCOPE. *By* T. THORNE BAKER. *Second edition. Pp. vi*+208. *London: Baillière, Tindall and Cox,* 1923. *Price* 7*s*. 6*d*.

Although the existence of the coloured spectrum of white light has been known from a very early date—certainly from the time of the Deluge—the foundations of the science of spectroscopy were laid only in 1859 as a result of the work of Kirchhoff and Bunsen at Heidelberg. Writing to Roscoe in that year, Bunsen refers to the discovery by Kirchhoff of the origin of the Fraunhofer lines in the solar spectrum, and remarks "thus the way is pointed out by which the material composition of the sun and the fixed stars can be ascertained with the same degree of certainty as we can ascertain by our reagents the presence of SO_3 and Cl. By the method, too, the composition, of terrestrial matter can be ascertained. . . ." Bunsen's modest anticipations were speedily fulfilled. By means of the spectroscope the new elements, cæsium, rubidiun, thallium, indium, germanium, gallium and scandium, were discovered in the period 1860-1879. What shall we say of modern applications and developments of the science? The electron, atomic structure, molecular configurations, isotopes and the curvature of space in the region of gravitating matter are a few among modern physical conceptions with which spectroscopy is intimately concerned. How exacting are the demands of modern spectroscopy may be illustrated by the fact that one of the crucial phenomena in Einstein's Theory of Relativity requires the measurement of a difference of wave lengths in the spectra of solar and terrestrial sources equal to 0·008 Å. U. (*i.e.*, 8×10^{-10} mm.). The spectroscopic determination of isotopes demands equally refined measurements. Modern spectroscopic methods are able to satisfy these demands.

Included in the work under review are sections devoted to: the principles and methods of spectroscopy, types of spectroscopes and of spectra, spectro-photography and photographic plates for same, spectro-photometry, spectral series and X-ray analysis. An adequate presentation of these subjects within the modest dimensions of the volume is impossible, and in our opinion were better left unattempted.

The author has "endeavoured to give as much information as space allows of the practical laboratory side of the subject . . . bibliographic notes have been supplied to enable the reader to seek further information." He will, we feel sure, agree with us that even in these broadcasting days too wide a field of reading is opened up to the reader who happens on the references, "Journ. Roentgen Soc.," or "University Press" on pp. 75 and 100 respectively. The following are noted among points in the book standing in need of revision:—The Rowland method of coincidences described on p. 15 is inaccurately given, and, moreover, it should be pointed out that wave lengths so determined need correction; resolving power is wrongly defined on p. 40 and wrongly calculated on p. 41; the angle determined by the method given on p. 47 is *twice* the prism angle; a grating is never mounted normal to the incident light by the trial and error method described on p. 50; angles are confused with their sines on p. 63; the method of use of the prism spectroscope given on this latter page leaves one wondering what one does if the third reading differs from the previous two; modern theory far from assuming "that lines in the spectrum are evidently due to wave-motions set up in the ether" (p. 65) has abolished the ether almost completely if not entirely, and contends that the lines originate in the analysing system, prism, grating, etc., just as a row of palings may convert a noise having no periodicity into a musical note; thoria is in part confused with ceria on p. 85; many substances have been dissolved in water since 1900, and one fails to recognise Hartley as a pontifical authority on the problem of solution (p. 150); the significance of Fig. 77 is far from clear; the expressions on p. 182 for the velocity of propagation of electro-magnetic disturbances are seriously in error. A number of minor inaccuracies has been noted on pp. 54, 75, 84, 181, 182. Interspersed through the book are portions dealing with photo-electricity, fluorescence and phosphorescence and the Zeeman effect. Scant justice is done to these. The reviewer would commend in the volume only Chap. VII., dealing with the manufacture of colour-sensitive plates. The author's connexion with the Research Laboratory of the Imperial Dry Plate Co., Ltd., gives an authority to this part of the book which is missing from the remainder. An authoritative work similar to Kayser's "Handbuch der Spectroscopie" is lacking in English scientific literature.

J. S. G. Thomas

Raw Materials for the Manufacture of Sulphuric Acid and the Manufacture of Sulphur Dioxide. *By* W. Wyld *Pp. xiii* + 558. *London: Guerney and Jackson*, 1923. *Price* 36*s*.

This is the first volume of the new edition of the late Prof. Lunge's classical work, "Sulphuric Acid and Alkali." Forty-four years have elapsed since the publication of the first edition in this country and in the present year of grace the chemical trade at home is celebrating the centenary of the alkali industry and the jubilee of the ammonia-soda process. Forty-four years ago the ammonia-soda process was in its infancy, the Leblanc process well established but still lacking the improvements and refinements attained in later years. The Leblanc process as a source of alkali has disappeared and the older methods of chlorine production have been replaced by electrolytic methods. In Lunge's several editions these changes and all they imply have been faithfully followed and Lunge's work has become an essential standard book of reference to a very wide circle.

The welcome to the new edition is sure to be hearty and congratulations are due to Dr. Cumming for his courage in undertaking his present task. In an appreciative editorial preface Dr. Cumming indicates the necessity for re-subdivision more in accord with modern developments; separate authors undertaking the special subject volumes. Notwithstanding the re-arrangement of the subject matter, the elimination of some that is old and the introduction of much that is new—and perhaps most of all the disappearance of the personal note—the new volume breathes the spirit of Lunge and still remains Lunge's work. Lunge's work, yes; but in improved form. Though the subject-matter index is still inadequate, the new setting out of the sub-headings makes the volume much more convenient for reference purposes and the transference of the numerous literature references to the bottom of the page renders the text much more readable. In the main the present volume covers the major part of the subjects dealt with in Volume 1

Part I, of the 1913 edition; Chapter V dealing with copper extraction, etc. is, however, based on material formerly appearing in Part III. In many cases where old subject matter remains the wording has been amended to suit the English idioms—at the same time, notwithstanding such alteration, the reviewer feels that the old wording caused him to make notes of important matter apparently omitted although such matter was subsequently found to be fully described in later pages.

Considering the contents in sequence, Chapter I deals with the history and general principles of the manufacture of sulphuric acid. Chapter II goes fully into the occurrence, properties and statistics of the various raw materials, such as sulphur, pyrites, zinc blende, etc., and concludes with the methods of supplying nitrogen oxides in the sulphuric-acid process. The literature references and statistics clearly show the large amount of new matter that has been introduced. Very striking figures indicating the growth of the sulphur industry in the United States are given on page 24, the production in 1921 amounting to 1,879,150 tons or nearly 80 times that in 1903 when the Frasch process began to receive serious general consideration. This large production, coupled with change of process, has had a marked effect on the vitriol industry and the final result of the competition between sulphur and pyrites cannot yet be foreseen.

On page 56 there is a repetition of matter appearing on page 13 under colloidal sulphur and it is not quite clear why the headings "Special Technical Forms of Sulphur" (pp. 56, 57) should be separated from those of "Commercial Descriptions" and "Uses of Sulphur" (pp. 18-19). On p. 61 under "Estimation of Arsenic" in sulphur it is stated that: "it (As_2S_3) occurs more especially in that recovered from alkali works"—this surely cannot refer to Chance sulphur, which was universally recognised as a product of remarkable purity in every respect. The statement on p. 123 under Coal-Brasses as to the non-injurious effect of carbon dioxide in vitriol manufacture should be noted and whilst the reviewer has not had experience to guide him at the same time he has never been able to understand or get any explanation as to why its presence should act prejudicially. In this connexion should not the reference on p. 143 to Chapter IX read Chapter IV? Probably the most interesting new matter in this chapter is contained in pp. 166-175 under supply of nitrogen oxides by oxidation of ammonia This subject is discussed in considerable detail, but it is difficult to understand the omission of any reference to the work of Imison and Russell published in this *Journal* (Feb. 28, 1922).

Chapter III (pp. 176-288) deals with "The Properties and Analysis of the technically employed Oxides of Sulphur." On p. 183 certain of Pellett's observations—perfectly true and probably needing emphasis in the original communication—appear superfluous to-day with our better understanding of vapour pressures The Knietsch curves for H_2SO_4—SO_3 (p. 198) deserve a more complete diagram; that given is merely qualitative, whereas to-day quantitative figures are wanted, especially of freezing (or melting) points. The specific gravity tables for sulphuric acid (pp. 203-205) have been recalculated by Dr. Cumming and are new; they occupy only half the space of the earlier tables and still contain all that is necessary for general work at home or abroad.

Under the action of sulphuric acid on metals the reviewer regrets absence of reference to his earlier work (*cf. J.*, 1903) on the action on platinum. Much new matter is given regarding the action on lead, but much still remains to be done before a satisfactory explanation of the varying life of the lead-chamber can be given The action on iron alloys (silicon iron) is discussed in two pages, and it is to be hoped that the merits and defects of these alloys will be more fully dealt with in the later volumes.

The older controversy relating to the part played by the oxides of nitrogen in vitriol manufacture has been much condensed and made more intelligible; discussion will probably continue so long as the chamber process exists.

Under Chapter IV, on the production of sulphur dioxide, the author deals with the crushing of pyrites and the burning of sulphur, pyrites, zinc blende, spent oxide, etc., and here one finds much new matter illustrated by new diagrams. The preparation of sulphur dioxide in pure or liquid state is also included, together with methods of dust removal and composition of burner gas. Several pages are devoted to electrical precipitation, but no reference is made to the results obtained in this country and published by McNab (*Ministry of Munitions Report*).

The final chapter embraces the briquetting and sintering of cinders and recovery of copper and other metals, etc. Much new matter is introduced here and the general change in methods of working is clearly indicated.

Many of the analyses quoted in this and earlier editions are old and not representative of modern conditions. In this respect an author's opportunities are limited; the average quality of a raw material or finished product is seldom advertised and published figures generally relate to odd samples or to a particular class of ore used in limited quantity in some particular works.

Printers errors are few in number; exception must, however, be taken to the word "volumetrical" and still more to "cuprous" as applied to pyrites containing copper. Cuprous to chemists has its own special meaning and hitherto home readers have only been acquainted with the word "cupreous" in the above connexion.

As in the earlier editions, patents practically stillborn are included whilst others actually operated for considerable periods are not evely quoted. All the same the volume clearly shows the trend of the industry and gives due prominence to the majority of the newer methods responsible for definite advance. More cannot be expected. J. T. Conroy

Die Polysaccharide. *By* Hans Pringsheim. *Second edition, revised. Pp. vi+234. Berlin: Julius Springer,* 1923. *Price, paper,* 7*s.* 6*d., bound* 9*s.*

So little information is available on the polysaccharides to the student of chemistry in the early stages of his work before he is in a position to consult original memoirs, that the publication of a work, now in its second edition, devoted specially to the subject, is a welcome addition to scientific literature. The explanation why no work has previously appeared on the subject is that it is of such a complex character that the workers themselves did not understand the true interpretation of the experimental data which they brought forward. They wrangled with one another, often over minor points. This state of affairs underwent a change when the "organic chemist" appeared on the scene. The subject has not, however, been divorced entirely from biochemistry, for the crisis dates from 1904, when Schardinger announced that he had obtained crystalline dextrins, by inoculating starch paste with a bacterium, *Bacillus macerans*. These dextrins were submitted to purely chemical diagnosis by the author of the present work. Pringsheim determined the molecular weights of the three crystalline dextrins obtained by Schardinger, and he showed that they were polymeric or co-ordination compounds, and that they could be reduced in molecular weight—depolymerised—by treatment with acetic anhydride and zinc chloride. Starch, cellulose and other polysaccharides appeared therefore to be polymeric or co-ordination compounds of some simple basal units. This work has been continued by Karrer, by Pictet, and by Irvine, and has thrown an entirely new light on one of the most intricate problems in chemistry.

The volume under consideration does not aim at being an exhaustive monograph. Indeed it is almost exclusively concerned with the subject from the time of Schardinger's work, although there is some mention of previous biochemical researches. The author deals with recent chemical work fairly completely, and we are glad to see that he has given credit to other workers who differ from his views in regard to the constitution of the polysaccharides. He mentions specially in his introduction the recent work of Irvine and his school, of Pictet, and of Karrer.

The author divides the fundamental units of the polysaccharides into four groups: The trehalose-, maltose- (copper reducing compounds), amylose- (ring compounds and glucosans), and anhydro-types (open chain compounds, glucans). Under the heading "Polysaccharides of the first order" are included lactose, maltose, sucrose, etc., and special attention is paid to the method of determining the constitution of these sugars by the methylation method first employed by Purdie and Irvine twenty years ago. Dealing with the synthesis of these sugars doubt is thrown on E. F. Armstrong's observation (1905) that maltose is produced by the action of emulsin on glucose, seeing that the enzyme in question does not hydrolyse maltose. It should be pointed out, however, that Armstrong was fully aware of this apparent anomaly. Pictet has claimed to have synthesised maltose by heating together the two glucosans and hydrolysing the resulting dextrin with oxalic acid.

The main portion of the work commences on page 50 and deals with what are termed polysaccharides of the second order, that is to say cellulose, starch, inulin, glycogen, pentosans, and nitrogenous bodies such as chitin.

One of the most interesting sections of the work is that devoted to the crystalline dextrins or polyamyloses with which the author's researches have been so closely connected. The bearing of this part of the subject on the constitution of starch is at present a matter of dispute between Pringsheim and Karrer. The latter holds the view that the basal unit of starch is anhydromaltose or diamylose. Pictet and Jahn have recently obtained an amorphous substance isomeric with the triamyloses, and as a result of this discovery Pringsheim is inclined to the view that the basal unit of starch is a triamylose. Irvine and his school, whose main studies are based on the methylation of polysaccharides, also put forward formulæ of the triamylose type as the basal unit of both starch and cellulose.

The author appears to have dealt with all the principal points in more recent literature on the subject, but the sequence in which these are discussed leaves much to be desired, since it is somewhat disconnected, in addition to which the diction is involved: we miss the lucid language on carbohydrate chemistry of Emil Fischer, and of Tollens. The work is remarkably free from typographical errors. It may be added in conclusion that chemists who are working on this involved branch of their subject cannot but feel grateful to the author for bringing together within a compass of a small volume an account of the extensive modern work, together with full references to the literature. Arthur R. Ling

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Business in the Chemical trade is exceedingly quiet; there is no sign of any recovery to more normal conditions. Prices are well maintained and show but little tendency to fall; naturally at times like the present there will always be a certain weakness owing to the attempts of producers to keep manufacture going.

Acetic Acid, 40% tech.	£24 per ton. Still firm, but rather less inquiry.
Acid Hydrochloric	3s. 9d.-5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw.	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Demand steady, export inquiry good.
Arsenic (White)	About £71 per ton.
Bleaching Powder	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Business much below normal.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand.
Copper Sulphate	£27 per ton.
Potash Caustic	£33-£34 per ton. Little moving.
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Potass. Chlorate	3d. per lb. Very dull.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76%	£20-£21 per ton. Steady demand.
Soda Crystals	£5 5s.-£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£26 per ton. Very scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b London, 1-cwt iron drums included.
Sod. Chlorate	2¾d.-3d. per lb. Very dull.
Sod. Nitrate refd. 96%	£13 5s.-£13 10s. per ton ex Liverpool. Steady demand.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	£15-£16 per ton carr. paid. Very quiet. Prices unstable.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25-£29 per ton according to quantity.
Carbon Black	1s. 1½d.-1s. 3d. per lb. Ample supplies now coming forward.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood distillation products.

Acetate of Lime—	
Brown	£11-£11 5s. per ton. Dearer. Good steady demand.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8 5s. to £10 15s. per ton, according to locality of market and type of charcoal.
Iron Liquor	1s. 5d. per gall. 32° Tw. 1s. 2d. „ „ 24° Tw.
Red Liquor	1s 3d. „ „ 14/15° Tw.
Wood Creosote	2s. 7d. „ „ Unrefined.
Wood Naphtha—	
Miscible	6s. 8d. „ „ 60% O.P. Market quiet.
Solvent	5s. 9d.-6s. per gall. 40% O.P. Demand increasing.
Wood Tar	£5-£6 10s. per ton, according to grade.
Brown Sugar of Lead	£42-£43 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d.-1s. 2½d. per lb. Increased demand in some directions due to lower prices now possible owing to reduction in Crude Carbolic price.
Crude 60's	3s.-3s. 3d. per gall. Fewer inquiries.
Acid Cresylic—97/99	2s.-2s. 5d. per gall. Steady demand.
Pale 95%	1s. 11d.-2s. 4d. per gall.
Dark	1s. 10d.-2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.

Anthracene Oil—	
Strained	8¾d.-11d. per gall. Supply short. Plenty of inquiries.
Unstrained	8¼d.-9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1¼d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.
Pure	2s. 1d.-2s. 2d. per gall.
Toluole—90%	1s. 9d.-2s. per gall. Weaker in sympathy with solvent naphtha.
Pure	2s.-2s. 5d. per gall. Not much inquiry.
Xylol	2s. 6d.-3s. 3d. per gall., according to quality. Good demand.
Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil	8d.-9½d. per gall. Market steady. Good demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	8¾d.-9d. per gall.
Solvent 90/160	1s. 6½d.-1s. 7d. per gall. Business quiet.
Solvent 90/190	1s. 6½d.-1s. 7½d. per gall. Market moderately active.
Naphthalene Crude—	
Drained Creosote Salts	£7-£8 per ton. Fair demand. Supply short.
Whizzed or hot pressed	£11-£14 per ton. Few inquiries.
Naphthalene—	
Crystals	£18 10s. per ton.
Flaked	£17 per ton.
Pitch, medium soft	132s. 6d.-140s. per ton. Autumn delivery. Numerous inquiries.
Pyridine—90/140	17s.-18s. per gall. Demand good.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Business in dyestuffs is moderately good. Depression in the textile trade continues, and until this improves there is not much chance of better business, at least in the home trade. Prices remain firm.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 6d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 9d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. 6d. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Markets are practically stagnant, and with foreign exchanges in violent fluctuation no improvement can be expected at present.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. 3d. per lb. for cwt. lots. This price would be shaded for large quantities.
Acid, Benzoic	2s. 6d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8¾d. per lb., less 5%. Business rather slack, but continuation of the hot weather should improve the market, as spot stocks are not large.
Acid, Gallic	3s. per lb. Down to 2s. 11d. for large quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 3d. per lb. Poor demand.
Acid, Tannic	3s. 6d. per lb.
Acid, Tartaric	1s. 4d. per lb. Demand improved on account of warmer weather.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 6d. per lb. Complete lack of demand.
Amidopyrin	12s. 6d. per lb. Now cheaper but demand still very poor.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. per oz. More active.
Barbitone	21s. per lb. Still maintained.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Unchanged. Continent still offering at low prices.
Calcium Lactate	2s. 6d. per lb. for best makes, which are not in too plentiful supply. Better demand.

Chloral Hydrate..	.. 3s. 9d. per lb., duty paid.
Chloroform ..	.. 2s. 2d. per lb. for cwt. lots. Higher prices are looked for in near future.
Creosote Carbonate	.. 8s. lb. Demand negligible.
Formaldehyde 40%	.. £90-£92 per ton. Very firm.
Guiacol Carbonate	.. 8s. 6d. per lb. Neglected.
Hexamine ..	.. 3s. 7d.-3s. 9d. per lb. Tendency rather weaker.
Homatropine Hydrobromida	.. 30s. per oz.
Iron Ammon. Citrate	.. 2s. 5d. per lb. for cwt. lots.
Magnesium Carbonate—	
Light Commercial	.. £37-£38 per ton net, according to quantity.
Magnesium Oxide—	
Light Commercial	.. £82 10s. per ton, less 2½%.
Heavy Commercial	.. £28 per ton, less 2½%.
Heavy Pure ..	.. 1s. 6d.-2s. per lb., according to quality.
Menthol	.. 40s. per lb. spot.
Methyl Salicylate	.. 2s. 4d. per lb. for carboys. Somewhat weaker.
Methyl Sulphonal	.. 15s. per lb.
Morphine ..	.. Makers have advanced all prices. Alkaloid—Cryst. 10s. 11d., Precip. 10s. 8d., Acetate 8s. 6d., Hydrochlor. 8s. 6d., Sulphate 8s. 6d. per oz.
Paraformaldehyde	.. 3s. 9d. per lb. Lifeless.
Paraldehyde ..	.. 1s. 6d. per lb. accepted for large orders. Slightly lower for forward delivery.
Phenacetin ..	.. 6s. 6d. per lb. More active than other pharmaceuticals.
Phenazone ..	.. 7s. per lb.
Phenolphthalein	.. 6s. 3d. per lb.
Potass. Bitartrate—99/100% (Cream of Tartar) ..	.. 96s.-98s. per cwt., less 2½%.
Potass. Ferricyanide	.. 3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide ..	.. 15s. 8d. per lb. Good demand. Steady market.
Potass. Permanganate	.. 10½d. per lb. for large quantities.
Quinine Sulphate	.. 2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin ..	.. 5s. 6d. per lb. Cheaper.
Salol	.. 2s. 9d. per lb.
Silver Proteinate	.. 10s. 6d. per lb.
Sod. Benzoate ..	.. 2s. 6d. per lb. Slow of sale.
Sod. Citrate ..	.. 2s. 2d. per lb. for B.P.C. 1923 quality in cwt. lots.
Sod. Hyposulphite—	
Photographic	.. £15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	.. 15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	.. 82s. 6d.-87s. 6d. per cwt. Fairly good demand. Expected to improve with continued warm weather.
Sod. Salicylate ..	.. Powder 2s. 7d. per lb., and Crystal at 2s. 9d. per lb. Less business.
Sod. Sulphite, anhydrous	£27 10s.-£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal ..	.. 14s. per lb.
Tartar Emetic ..	.. 1s. 2d.-1s. 4d. per lb.
Thymol	.. Better inquiry. 15s. 6d. per lb. for cwt. lots of natural recryst.

PERFUMERY CHEMICALS

Acetophenone ..	.. 10s. 6d. per lb.	
Aubepine ..	.. 14s. ,, ,,	
Amyl Acetate ..	.. 3s. ,, ,,	
Amyl Butyrate ..	.. 7s. 3d. ,, ,,	
Amyl Salicylate	.. 3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol ..	.. 3s. ,, ,,	
Benzyl Alcohol free from Chlorine ..	.. 3s. ,, ,,	
Benzaldehyde free from Chlorine ..	.. 2s. 9d. per lb.	
Benzyl Benzoate	.. 3s. 3d. ,, ,,	
Cinnamic Aldehyde	.. 18s. 6d. ,, ,,	Advanced.
Coumarin ..	.. 18s. 6d. ,, ,,	
Citronellol ..	.. 19s. 6d. ,, ,,	
Citral	.. 9s. 6d. ,, ,,	
Ethyl Cinnamate	.. 15s. ,, ,,	Cheaper.
Ethyl Phthalate	.. 3s. 9d. ,, ,,	,,
Eugenol	.. 11s. ,, ,,	
Geraniol (Palmarosa)	.. 32s. 6d. ,, ,,	Advanced.
Geraniol	.. 5s. 6d.-12s. 6d. per lb.	
Heliotropine ..	.. 8s. per lb.	
Iso Eugenol ..	.. 16s. 6d. per lb.	
Linalol ex Bois de Rose..	21s. ,, ,,	
Linalyl Acetate ..	.. 21s. ,, ,,	
Methyl Anthranilate	.. 7s. ,, ,,	
Methyl Benzoate	.. 8s. 6d. ,, ,,	
Musk Xylol ..	.. 11s. ,, ,,	Dearer.
Phenyl Ethyl Acetate	.. 10s. ,, ,,	
Phenyl Ethyl Alcohol	.. 17s. 6d. ,, ,,	
Rhodinol ..	.. 45s. ,, ,,	
Safrol	.. 2s. 4d. ,, ,,	
Terpineol ..	.. 3s. 1d. ,, ,,	
Vanillin	.. 24s. ,, ,,	Firm with steady demand.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A... ..	.. 14s. 6d. per lb.	
Anise Oil.. ..	.. 2s. ,, ,,	
Bergamot Oil ..	.. 12s. 6d. ,, ,,	spot.
Bourbon Geranium Oil..	29s. ,, ,,	
Cananga Oil, Java	.. 9s. ,, ,,	
Cinnamon Oil, Leaf	.. 4½d. per oz.	
Cassia Oil 80/85%	.. 12s. 6d. per lb.	
Citronella Oil—		
Java 85/90%	.. 4s. 2d. ,, ,,	
Ceylon ..	.. 3s. 8d. ,, ,,	
Clove Oil.. ..	.. 8s.-8s. 6d. per lb.	
Eucalyptus Oil 70/75%	1s. 10d. per lb.	
Lavender Oil, Mont Blanc 38/40%	.. 13s. ,, ,,	
Lemon Oil ..	.. 3s. 1d. ,, ,,	
Lemongrass Oil ..	.. 2¾d. per oz.	
Orange Oil, Sweet	.. 13s. 7d. per lb.	
Otto of Rose Oil—		
Anatolian ..	.. 24s. per oz.	
Bulgarian ..	.. 30s. per oz.	
Palma Rosa Oil	.. 19s. per lb.	
Peppermint Oil—		
English ..	.. 80s. ,, ,,	
Wayne County	.. 13s. ,, ,,	
Japanese ..	.. 7s. 1½d. ,, ,,	Advanced.
Petitgrain Oil ..	.. 7s. 3d. ,, ,,	

TRADE NOTES

London Joint City and Midland Bank, Limited

The Directors of the London Joint City and Midland Bank, Limited, announce an interim dividend for the half-year ended June 30, last at the rate of 18 per cent. per annum less income tax, payable on July 14. The dividend for the corresponding period of 1922 was at the same rate.

Reeves & Sons, Ltd.

Messrs. Reeves & Sons, Ltd., Colourmakers, Dalston, have issued a directors' report and balance-sheet at April 30, 1923, with profit and loss account from May 1, 1922, to April 30, 1923, which shows a net profit of £20,142 4s. The directors recommend a dividend of 10 per cent. upon the Ordinary shares payable on July 13 next, carrying forward the balance to next account.

The report was adopted at a meeting of the company held on July 5.

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The Universal and the Fireman's Gas Masks. *By* S. H. Katz, J. J. Bloomfield *and* A. C. Fieldner. *Technical Paper No.* 300. *Pp.* 22.

Preparation, Transportation and Combustion of Powdered Coal. *By* J. Blizard. *Bulletin No.* 217. *Pp. ix*+127. *Price* 50 *cents.*

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Bibliography of Petroleum and Allied Substances in 1919 and 1920. *By* E. H. Burroughs. *Bulletin No.* 216. *Pp.* 374. *Price* 40 *cents.*

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EDITORIAL

Our advertisement columns this week include a first preliminary list of the subscriptions to the Federal Council Fund. The list is at the moment a small one; times are not propitious for the collection of that large amount which is required for all the schemes and activities of the Federal Council. But such a time will come, and when it does the Federal Council will not hesitate to ask the large companies and the wealthy individuals for handsome gifts. However, a beginning has to be made. We understand that in the interim the Federal Council will go on begging for small sums until a capital of three or four or five thousand pounds is obtained, the income of which will more than suffice for its present needs and will enable a respectable amount to be set aside each year to be added to the capital. The Federal Council has no paid officials, no office expenses, not even two shillings per annum. No organisation carrying on important work can perform its duties more cheaply. It has already been useful to the chemical community, and we believe that it will steadily and quietly increase its influence and usefulness. When the time comes for the large schemes and the need for large sums an income of two or three hundred pounds will be very useful towards organising a thorough campaign on a large national scale. The Committee entrusted with the collection of the Fund includes representatives of all sorts and conditions in the chemical world, and consists of Sir William Pope, Dr. E. F. Armstrong, Mr. H. E. Coley, Mr. E. V. Evans, Mr. Emile Mond, Mr. W. J. U. Woolcock and Dr. S. Miall. We noticed in Dr. E. F. Armstrong's Presidential Address an appeal to chemists to support the Fund and a suggestion for a more extensive machinery for the collection of gifts in all parts of the kingdom, and we commend his eloquent words to the careful consideration of our readers.

The article, which appeared in our last week's issue, by Prof. Patterson on the "Refereeing of Scientific Papers" deals with a subject which, though it only appeals directly to a small percentage of the members of any Society, yet has a considerable indirect interest for all readers of scientific journals. The article leaves the impression that the majority of papers presented to Societies give rise to more or less serious friction between the author and Publication Committee. We hope and believe that this is only true of the small minority of papers. In the case of our own Society we can say with some authority that with only a very small portion of the papers submitted is there anything in the nature of controversy between author and Committee, and we should be sorry indeed if the opposite impression prevailed, for this would inevitably tend to check the supply of papers, especially from the younger and more sensitive authors. It should be realised that the object of the Publication Committee is to secure the dissemination of the truth, and nothing but the truth, in a form in which it can best be understood and assimilated. Authors who submit their papers to a Society for publication should feel assured that they will receive sympathetic consideration at the hands of the referee and of the Publication Committee. At the same time it is the duty of the Societies to the readers of their journals to get expert opinion on such papers. It is not, therefore, a light responsibility which is undertaken by the Publication Committees of the various Societies—to see that full justice is done to the author whilst adequate security is afforded to the reader. We might mention that Prof. Patterson's suggestion that author and referee should be put into communication with one another has in several instances been adopted by our Society, on the suggestion of the referee, and in each case the result has been eminently satisfactory.

ARTIFICIAL ABRASIVES

By M. BARRETT

The use of artificial abrasives in the engineering and allied trades is increasing very rapidly and the total amount consumed per annum now reaches an enormous total. For all practical purposes only two artificial abrasives are used industrially and these are silicon carbide, *i.e.*, Carborundum, and crystalline alumina, *i.e.*, Alundum. Unfortunately, neither of these materials is manufactured on any commercial scale in this country, and we are entirely dependent on foreign sources of supply, particularly from America. During the War this lack of a home supply occasioned, at one period, very great anxiety and necessitated the control of all existing supplies and the establishment of the Abrasives Department of the Ministry of Munitions.

Although adequate stocks are now available, at a price, it is difficult to understand why artificial abrasives are not manufactured in this country, having regard to the fact that the master patents controlling the production of both products have now expired, and ample data are available to ensure the successful technical production of both these products.

Both materials are electric-furnace products and there seems to be an impression that economic manufacture can only be carried out in countries provided with ample water power, and thus able to produce electrical energy cheaply. There is some justification for this belief in respect of silicon carbide, and it is probable that manufacture in this country would be somewhat speculative unless cheap energy was available from waste coke-oven or blast-furnace gases.

For silicon carbide the cost of electrical energy represents nearly 60 per cent. of the total cost of production, but this energy represents only eight per cent. of the total cost of producing crystalline alumina.

As raw materials we have everything required in abundance for manufacturing silicon carbide, but we have no workable deposits of suitable bauxite which is the sole raw material used in the manufacture of crystalline alumina. Very extensive deposits, however, exist in Ireland, and it is even possible that use might be made of the bauxitic clays recently discovered in Ayrshire. American bauxites, of suitable quality, it is curious to note, are scarce, and a considerable proportion of United States requirements is obtained from the Var district of France.

It is extraordinary that no attempt is made here to treat either the Irish or French bauxites and that we are willing to pay the cost involved in shipping raw material from France to America subjecting it there to a very simple process, and then shipping it back to this country. Prominent American electro-metallurgists of the writer's acquaintance have commented on this anomalous state of affiars and expressed surprise at the lack of enterprise and initiative in this country.

The aluminous type of abrasive is of much more general application and importance than the silicon carbide type ; in the United States six times as much of the former is manufactured as the latter, although the proportions were at one time reversed. This ratio difference is becoming more pronounced each year and there would appear to be little inducement, on that account alone, for the manufacture of silicon carbide to be taken up here. In case of need, however, both materials could be produced in one plant as the equipment necessary is practically the same for both products.

A conservative estimate of the total cost of producing the aluminous abrasive in this country, assuming that electrical energy would cost three times as much as it does in America, would not exceed 3d. per lb., and the current selling price is 10d. per lb. A market for the product is absolutely assured and there are even possibilities of an export trade being developed. The manufacturing process is simple in the extreme and relatively low capitalisation would be necessary. It is interesting to note that both abrasives are being manufactured in Germany, that country now being quite independent of America.

YOUR PENCIL UNMASKED

By F. COLIN SUTTON

In a recent criminal investigation much prominence was given to the matter of handwriting, and the question of forgery or of the authenticity of certain documents frequently arises. The type of communication most commonly under dispute is either typewriting or handwriting with pen and ink. In either of these instances it is a fairly simple matter to differentiate between the markings on any papers under examination.

The impressions made by different pencils, however, are not so easily distinguishable. Indeed, their comparison is reduced to a fairly exact science. Before explaining the methods employed it is necessary to give a brief historical survey of the development of the modern pencil. Prior to the discovery of graphite, which is known to chemists as an allotropic modification of carbon—another modification being the diamond—pencils were composed of metallic lead or alloys of lead which were cast into a convenient shape and wrapped in paper holders. Pencils of this type were in common use until late in the eighteenth century, and are not entirely unknown even at the present day. The metals composing the alloy were lead, tin and bismuth, and occasionally about one-sixteenth part of mercury was added to make these mixtures softer to use. About the year 1560 graphite was discovered at Borrowdale, and from that time until the latter half of the nineteenth century the "black lead" pencils used all over Europe were derived from the Cumberland mine.

The prepared blocks of graphite were 2¼in. square by 1in. in thickness and were sawn into strips 1-16in. wide. Three of these were placed in the groove of a piece of cedar-wood and the complementary half was glued into position, and with a blank end of ½ of an inch a pencil seven inches in length was produced. The different grades of pencils were made by choosing the graphite according to its degree of hardness or blackness. Sometimes the graphite was boiled in spermaceti oil before being sawn up, with the object of obtaining a substance which should be softer and give more uniform marks. The high price of this particular oil to-day inhibits its use in modern pencil manufacture. Signs of exhaustion were manifesting themselves in the Borrowdale mine about the year 1840. Various methods were tried of utilising the graphite dust. In the most successful of these methods the dust was subjected to a pressure of about 100 tons per sq. in. air being exhausted simultaneously from the press.

In 1869 the Cumberland mine ceased working and composite pencils came into common use. The modern method of pencil manufacture was originated by Conté, of Paris, in 1795. This process consisted of making a paste of finely elutriated clay and graphite and forcing it through discs in a cylinder so as to produce circular threads of pigment. These were dried, baked in a crucible, and glued into grooves in the prepared wooden holder. The hardness of the pencil depended upon the proportion of clay and the degree of baking. Various pigments, such as lampblack, sulphur and resin have been introduced, but lampblack is the pigment mainly used in the cheaper grades of pencil.

Under the microscope the difference in the character of the markings of old and modern pencils can readily be distinguished. Ordinary lead and some alloys of lead show a series of irregularly distributed patches, each lit up to the same degree, each patch being scored with regular striations. The marks made by pure graphite, if examined under the microscope with a strong side light, appear as irregular silvery strokes, entirely different in character from those of lead. The continuity of the striations affords a means of determining which of two crossing lines in pencil writing was made first. Moreover, the absence of striations in the two markings distinguishes definitely between pencil writing and a carbon copy. Differences in the character of the striations serve to distinguish different varieties or makes of pencil.

Some of the earliest pencil writings discoverable in the British Museum date back to the beginning of the sixteenth century. One such specimen consists of drawings of coats-of-arms in "Stowe's Arms of Ancient Nobilitie." Some of these drawings show the characteristics of graphite and some those of lead. The pencil writing in Hogarth's notebook is in a very rich graphite.

The avenues of escape open to the forger are still more narrowed down by the magic of the analytical chemist. The presence of mere traces of iron, titanium or chlorides are made to reveal themselves under his reagents. It is pretty to watch, say, the revelation of the presence of so rare an ingredient as titanium in the markings of a pencil by the development of a bright yellow colouration upon treatment with hydrochloric acid and hydrogen peroxide.

STABILITY OF CO-ORDINATION-COMPOUNDS

By Prof. T. MARTIN LOWRY, F.R.S.

1. Two Types of Co-ordination

The preceding articles of this series point clearly to the existence of two fundamentally distinct types of co-ordination. These may be distinguished provisionally as Centric Co-ordination and Cyclic Co-ordination.

(a) *In centric co-ordination* the fundamental factor is the grouping of a series of radicals or molecules around a metallic atom or ion, mainly with a view to completing the outer electron-shell of the metal. The co-ordinated groups therefore cover a wide range of different types, although the atoms which actually share electrons with the metal are usually of small atomic number, *e.g.*, oxygen or nitrogen. This type of co-ordination is present in the vast majority of the compounds studied by Werner.

(b) *In cyclic co-ordination* the fundamental factor is the linking up of a metallic kation with a multipolar anion, with a view to completing a conjugated ring system. The importance of ring-formation as a factor in promoting co-ordination was disclosed by Tschugæff in 1907; but most of the experimental work on this type of co-ordination has been done in recent years by Prof. Morgan and his colleagues. Morgan is also responsible for introducing the term "Chelate," derived from the great claw or "chela" of the lobster and other crustacea, to describe those "caliper-like groups which function as two associated units, and fasten on to the central metallic atom so as to produce heterocyclic rings" (*Trans. Chem. Soc.*, 1920, **117**, 1457 footnote).

2. Stability of Centric Co-ordination-Compounds

Although co-ordination complexes of this type are usually described as being held together by "subsidiary valencies," they are often more stable than chemical compounds of a more commonplace character in which only "principal valencies" come into play. This fact is illustrated in a dramatic way in the properties of purpureo-cobaltic chloride. The empirical formula, $CoCl_3,5NH_3$, of this compound is that of a tervalent chloride containing five molecules of "ammonia of crystallisation"; but the compound is remarkable in that only two-thirds of the chlorine can be precipitated by silver nitrate or displaced by cold sulphuric acid; still more remarkable is the fact that the "ammonia of crystallisation" is retained by the compound even whilst it is liberating fuming hydrochloric acid under the influence of strong sulphuric acid! Cases such as the above are so far typical that the common test for this type of co-ordination is that the co-ordinated molecules or radicals must be "*clustered round the metallic atom in such a way that their ordinary chemical reactions are wholly concealed.*" Thus the ferro- and ferri-cyanides, the cobalticyanides, cobaltinitrites and cobaltammines "show none of the simpler reactions by which ferrous and ferric salts, cobaltic salts, cyanides, nitrites and ammonia are commonly detected in solution."

These drastic conditions are fulfilled by many co-ordination-complexes in which the "nucleus" is a tervalent cobaltic atom, since in this case the conditions favourable to co-ordination appear to be developed to a maximum extent. But it is clear that there must be a descending order of stability in other metals; and experience shows that compounds, such as ferric acetate and ferric sulphocyanide, the co-ordination of which is vouched for by their colour, are ionisable in aqueous solutions. A similar statement may be made in reference to copper, which forms a wide range of deep-violet compounds with ammonia, Rochelle salt, etc. The co-ordinated character of these compounds is again vouched for by their colour; but the complexes are of such a low order of stability that the mere addition of hydrogen sulphide will bring about a complete precipitation of the metal.

3. STABILITY OF CYCLIC CO-ORDINATION-COMPOUNDS

In the case of cyclic co-ordination-compounds, two independent factors must be recognised as determining the stability of the complex, namely (*a*), the character of the chelate groups, in addition to (*b*) the character of the co-ordinating metal.

(*a*) In the footnote in which the term is first introduced, Prof. Morgan includes ethylene diamine as a chelate group; but it is doubtful whether this classification should be maintained, in view of the fact that this amine is able to form stable co-ordination-complexes only with metals of the extended transition-series, *e.g.*, from V to Ga, most of which are able to form precisely similar compounds with ammonia. In cases such as these the crab appears to be dead. The inability of the ring system to grip may be attributed to the fact that it is saturated and does not contain any double bonds. The introduction of a metallic ion between the two amino-groups does not therefore supply the missing link in a conjugated system; and the energy liberated in conjugation (to which Thiele attached so much importance, and which he even tried to calculate from thermochemical data) is not available as a factor in promoting co-ordination. For this reason, in defining "cyclic co-ordination," I should restrict the term to those cases in which the introduction of a metallic ion completes or extends a conjugated system, and therefore gives rise to an exothermic action, with a corresponding stimulus to the process of co-ordination. It is true that, even in cases such as that of ethylene diamine, where two co-ordinated radicals are joined by a saturated chain of atoms, the size of the ring is an important factor in determining the stability of the co-ordinated complex; but it is mainly a negative factor, since ring-formation does not decisively promote co-ordination, although the strain involved in forming a ring of 4 or 8, instead of 5 or 6, atoms may prevent the formation of a co-ordinated complex even when two independent univalent radicals would co-ordinate quite readily.

(*b*) Assuming, however, that the claw is by no means lifeless, the strength of its grip will depend on the character of the object which it holds and seeks to retain. Working on these lines, Morgan has established that lithium is pre-eminent amongst the alkali metals in the stability of the compounds which it forms with acetylacetone. Beryllium appears to enjoy a similar pre-eminence amongst the bivalent metals, and aluminium amongst the tervalent metals—the bivalent and tervalent metals of the transition series being excluded in each case, since their co-ordination-compounds are of the centric type and do not need a chelate group to stabilise them.* In general it appears that the lighter metals are more readily co-ordinated than their heavier homologues—just as if the claw could grasp a small object more firmly than a large one. This suggests that the more powerful chelate groups should be able to grasp a proton, giving rise to co-ordinated-compounds in which a hydrogen ion replaces the ion of a metal. This view has been discussed, and some of the more important applications are described, in a communication which I made to the Chemical Society on May 3 (this vol., p. 496), in the course of which I showed that hydrogen is not merely able to play a passive part in co-ordination, but may itself assume an active rôle, as in the case of potassium hydrofluoride,

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* The complexes formed by acetylacetone with the tervalent ions Al''', Sc''', Ir''', V''', Cr''', Mn''', Fe''', Co''', are so stable that they can be distilled. This is also true in the case of some of the bivalent metallic ions; but the compounds formed by the univalent metals of the alkalis nearly all char when heated, in spite of their much smaller molecular weight. The sodium, potassium and calcium compounds not only char when heated, but are "unstable in solution or in a moist condition." (Morgan and Moss, *T.*, 1914, **105**, 189.)

$$KHF_2 \rightleftarrows \overset{+}{K} + \overset{-}{HF_2} \text{ or } \overset{+}{K}[H\cdot 2F]^-,$$

where the hydrogen ion holds together two fluorine ions in the complex $\overset{-}{F}\overset{+}{H}\overset{-}{F}$.

4. CO-ORDINATED RINGS CONTAINING SIX ATOMS

Tschugæff suggested that the formation of co-ordinated rings is governed by the same rules that prevail in ring-systems of the ordinary type. This leads to two important conclusions:—

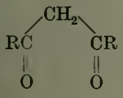
(*i*) That in saturated ring-systems a maximum of stability should be reached when the co-ordinated metal is associated with a chain of four other atoms to make a five-atom ring.

(*ii*) That in unsaturated or conjugated compounds a maximum of stability should be reached in a six-atom ring containing three pairs of conjugated atoms.

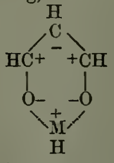
The conjugated six-atom ring-system is analogous to that of benzene, and compounds containing it may be expected to show some resemblance to aromatic compounds, not only in stability, but also in physical properties such as absorption spectra. The stability of the system is shown by the large number of cases in which the abnormal or exceptional properties of a compound may be attributed to the formation of a co-ordinated ring of this type; but the analogies in physical properties still await investigation.

Co-ordinated ring-systems are necessarily heterocyclic. Four principal types of conjugated rings can at once be recognised in the co-ordinated derivatives of β-diketones, of α-nitroketones, of α-cyanoketones acids and esters and of βγ unsaturated ketones, acids and esters respectively. These six-atom rings may be classified provisionally as follows:—

(i) *First type* (dioxonium ring)

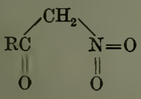


β-Diketone

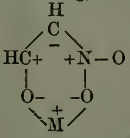


Simplest co-ordinated complex

(ii) *Second type* (nitroxonium ring)

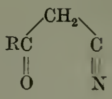


α-Nitroketone

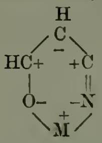


Simplest co-ordinated complex

(iii) *Third type* (cyanoxonium ring)

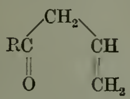


α-Cyanoketone

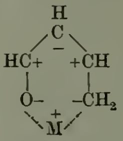


Simplest co-ordinated complex

(iv) *Fourth type* (carboxonium ring)



βγ-Unsaturated ketone

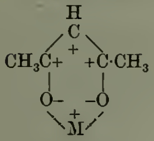


Simplest co-ordinated complex

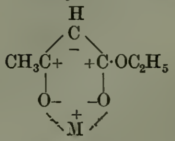
In each case the co-ordinated metallic compounds can be regarded as derived from a co-ordinated hydride or enol, isomeric with the original ketone. When, therefore, the nomenclature of co-ordinated ring-systems comes up for consideration, it will probably be convenient to name the hydrides as acids and the metallic-compounds as salts derived from them.

(i) *Examples of the first type* of conjugated six-atom ring are found in the co-ordinated derivatives of

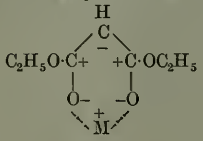
I *Acetylacetone*



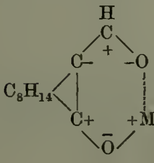
II. *Ethyl acetoacetate*



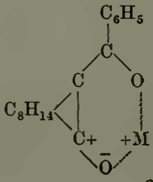
III. *Ethyl malonate*



IV *Hydroxymethylene-camphor**

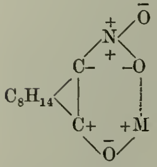


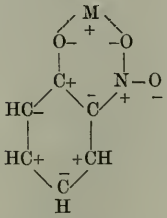
V *Benzoylcamphor**



(ii) *Examples of the second type* are found in the salts of

VI *Nitrocamphor** VII *Orthonitrophenol*

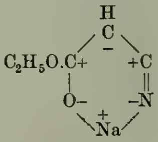




The yellow crystals of orthonitrophenol itself and the acidic dextrorotatory *pseudo*-nitrocamphor have probably the same co-ordinated structure as their metallic derivatives.

(iii) *An example of the third type* is probably found in

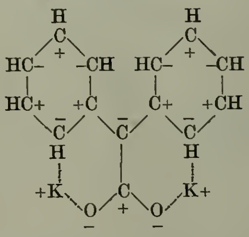
VIII *Ethyl sodio-cyanacetate*



In this case there has always been some ambiguity as to whether the sodium atom was attached to oxygen or to nitrogen; in the formula VIII it is represented as attached to both of these atoms.

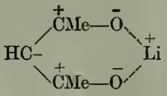
(iv) *An interesting example of the fourth type* is provided by diphenylacetic acid, a compound in which the tendency to enolisation appears to be developed more strongly than in any of the common carboxylic acids. In particular this compound is remarkable in forming a dipotassium derivative. It is suggested that this may be formulated as a doubly-co-ordinated complex IX containing two conjugated six-atom rings of the fourth type.

IX

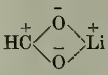


5. CO-ORDINATED RINGS WITH FOUR ATOMS

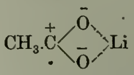
A completely-conjugated system can also be produced by the co-ordination of an ion with a chain of three other atoms, giving rise to a *four-atom* ring. The ordinary laws of ring-formation suggest, however, that such a system would be far less stable than a conjugated six-atom ring. This view is fully confirmed by experiment. Thus, although sodium derivatives are readily formed from bipolar anions, these are (apparently without exception) ionisable in solution. There is, indeed, quite a dramatic contrast between the behaviour of (i) the lithium derivatives of acetylacetone



and (ii) lithium formate or acetate,



or

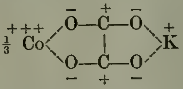


A comparison of the formulae shows that the peculiar properties of the acetylacetonate must be attributed to the replacement of $\overset{+}{\mathrm{C}}\mathrm{H}$ or $\overset{+}{\mathrm{C}}\mathrm{Me}$ by $\overset{+}{\mathrm{C}}\mathrm{Me}.\overset{-}{\mathrm{C}}\mathrm{H}.\overset{+}{\mathrm{C}}\mathrm{Me}$, *i.e.* to the change from a bipolar to a tripolar anion, whereby the ring-system is extended from 4 to 6 atoms. Whilst, therefore, we are bound to suppose that the salts of the carboxylic acids (when in the undissociated state or in a crystal) are co-ordinated, there is no difficulty in accounting for the fact that their aqueous solutions are always ionisable, except when the metallic ion is capable of developing centric co-ordination.

6. OTHER CO-ORDINATED RING-SYSTEMS

A ring containing an odd number of atoms must, if unsaturated, contain either (i) a saturated group which interrupts the conjugation, or (ii) a system involving crossed polarities. Odd-numbered rings are, however, quite common amongst co-ordinated-compounds, and under some conditions may possess definite chelate properties. Two examples of this kind may be quoted.

(a) *The oxalates.* The co-ordinated oxalates have already been formulated as containing two five-atom rings, thus



In both rings the conjugation is interrupted by two consecutive carbon atoms each carrying a positive charge. The addition of two metallic ions to the oxalate radical has, however, the effect of completing a more extensive conjugated system containing not less than *eight* alternately-polarised atoms. In these circumstances, the five-atom rings, in spite of the presence of crossed polarities in the centre of the system, appear to possess powers of co-ordination comparable with those of a four-atom conjugated system, although very much inferior to those of the conjugated system of six atoms described in section 4 above. The influence of centric co-ordination is, of course, shown in the stability of the cobaltic complex in the formula set out above, as compared with the ready ionisation of the potassium.

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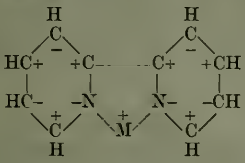
* These camphor compounds can be written most conveniently with the ion M in the position usually assigned to the nitrogen atom in *iso*-quinoline; but the co-ordinated ring is exactly the same as in the other cases.

(b) *Dipyridyl.* The dipyridyl molecule differs from that of ethylene-diamine in virtue of the two conjugated aromatic rings which it contains. Although the polarities of these rings are crossed at the point of union, a concordant system of conjugation is produced throughout the rest of the molecule when a metallic ion is co-ordinated between the two negatively-charged nitrogen atoms



The added stability produced by the conjugation of the dipyridyl group affords an explanation of the fact that Werner was able to resolve the compound $\left[\overset{++}{\mathrm{Fe.3Dip}}\right]^{--}\mathrm{Cl}_2$, where the corresponding derivative of ethylenediamine does not appear to have been sufficiently stable for this resolution to be effected.

7. Summary

(a) Two types of co-ordination are distinguished, namely (i) *centric co-ordination*, in which the principal factor is the formation of a shell of electrons round a metallic atom, and (ii) *cyclic co-ordination*, in which the principal factor is the development or completion of a conjugated ring-system by the insertion of a metallic ion. (b) The stability of centric co-ordination-complexes depends mainly on the nature of the central atom of metal and appears to reach a maximum in the tervalent cobaltic ion. (c) The stability of a cyclic co-ordination-complex depends on the nature of the conjugated ring-system as well as on the nature of the metallic ion. (d) A maximum of stability is reached in conjugated six-atom rings, the polarities of which are identical with those of aromatic compounds. (e) Conjugated four-atom rings are less stable, and the co-ordinated metal is usually ionisable in solution. (f) In the more stable cyclic systems a proton can take the place of the metallic ion and yield co-ordinated complexes.

OBSERVATIONS BY "EYE-WITNESS"

The Annual Report

of the Association of British Chemical Manufacturers was described by its Chairman at the Annual Meeting last week as a fair microcosm of the work of that Association. Considering it on that plane, it certainly gives a basis for the generally high reputation to which the work of this body has attained. To be really successful it must justify its existence to its members, to the Government and to the nation, and be useful to each in turn. The individual members probably consider its work on Alcohol, Railway Rates, Statistics and Legal Matters to be of such direct usefulness as to be obviously worth the annual subscription. The Government is possibly not unmindful of the advantage of having an Association which can be referred to for advice on any matter affecting the industry, and which has helped very judiciously in the administration of such tiresome pieces of legislation as the Dyestuffs Act and the Safeguarding of Industries Act. And if—which Heaven forbid !—we were ever landed in another war I can well imagine with what relief the Government would turn to the Association and ask for and receive the fullest possible assistance in chemical production. For whatever our pundits may say, methods of warfare have a habit of commencing in a new war just where they left off in the old one.

To the Nation

its usefulness must consist in a steady and regular representation to the world of the progress of the industry in this country. There are many ways of doing this, and but few of them are unused by the Association of British Chemical Manufacturers. It is a counterpart of our own Society ; its relation to the industry is what our relation should be to the science, and I can quite understand Sir Max Muspratt's kindly references to *Chemistry and Industry.* The policies of the Society and of the Association are identical. I have tried to think of some form of national publicity which chemical industry has not yet adopted. Newspaper articles, letters to the Press, and public dinners have become common form. Fairs and Exhibitions are a matter of routine. The art of pamphleteering has been revived. Cinematograph films illustrating the various branches of chemical work are in course of preparation. Only sky-writing has been overlooked ! But the Chairman of the Association of British Chemical Manufacturers has a complaint. It appears that the Council have made arrangements so that any new developments in a member's works—by which, I suppose, is meant any new or improved products—can be notified in even the furthest quarters of the globe, and the members will not use the machinery provided. Well, well! The chemical industrialists are only human, after all.

Alcohol

It seemed fitting that a time when we are all cutting down our consumption of alcohol on account of the heat should be chosen for the announcement of the conclusion of the negotiations between the Association and the Board of Customs and Excise. In substance I understand that what has been arranged is this :—It will be possible to use duty free spirits in the preparation of fine chemicals in which the alcohol radicle enters as part of the final product, if no alcohol, as such, remains in the final product and various other requirements are complied with. In approved cases where industrial methylated spirits are unsuitable and pure methyl alcohol involves some material disadvantage, it may be possible to use ethyl alcohol denatured with 2 per cent. of pure methyl alcohol. This should go some way in assisting British Chemical Industry to overcome the advantage which the industry in other countries has had through cheaper alcohol, but it by no means solves the problem. Each year, however, I think we get a little nearer it; every failure teaches us something.

All the Space

in the Chemical Section of the British Empire Exhibition has now been allotted, and I hear the number of complaints is very few considering that everybody cannot have a front-row position. The promptness with which anyone who was dissatisfied was offered their deposit money back indicates that a number of firms for whom room could not be found are quite prepared to take up any space which may be vacated. The pure science side is now on a satisfactory basis. I understand there is a Committee of the Royal Society, on which Mr. Woolcock has been given a seat, which will organise the scientific exhibit other than the pure chemistry part ; and that Sir Herbert Jackson, from the Royal Society Committee, will become a member of the Committee formed from the other learned bodies and the Association of British Chemical Manufacturers which is organising the pure chemistry exhibit. In this way it is hoped to prevent entirely any overlapping. The question of funds now seems to have been settled, and, while it would be an exaggeration to call them ample, there is sufficient for the Empire to make a good show. With only eight months before the Exhibition opens, and one of those a holiday month, I think we ought to know a little more about the character of the scientific exhibits. For example, did that wonderful lecture of Dr. Aston's at the Cambridge meeting of the Society give the promoters any ideas ?

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held on Thursday, July 12, 1923, when the following were elected as the officers of the Association for the ensuing year :—President : R. G. Perry, Esq. Vice-Presidents : Sir John Brunner, Bt. ; Dr. Charles Carpenter. Chairman : Sir Max Muspratt, Bt. Vice-Chairman : Sir William Pearce. Honorary Treasurer : C. A. Hill, Esq.

In connection with the new Chair of Chemical Engineering at University College, London, a sub-committee for chemical engineering has been set up, and Sir John Brunner was appointed to represent the Association on it.

The General Manager reported that a Committee had been set up by the Minister of Health to inquire into the use of preservatives and colouring matter in food, and it was agreed that the Association should prepare evidence for submission to that Committee.

Among other matters discussed by the Council were the concessions which have been granted by the Customs Authorities in connection with the use of alcohol, which should prove of advantage to chemical industry.

CORRESPONDENCE

BIOCHEMICAL ACTION OF POLARISED LIGHT

Sir,—I am exceedingly interested in your correspondent Mr. E. G. Bryant's letter in the *Journal of Chemistry and Industry* of July 6. It would seem that he has not seen my letter in *Nature* (Vol. III, p. 49, 1923), in which I described the results I had obtained on investigation of the striking action of moonlight and of plane polarised light on the germination of seeds, and of polarised light on the hydrolysis of starch grains by enzymes.

My investigations have extended over the last two years, and they leave no doubt of the reality of the phenomenon mentioned by Mr. Bryant—namely, that certain biochemical reactions are definitely stimulated more by plane polarised light than by heterogeneous light of the same intensity. I may add that I am at present carrying out further work in conjunction with Prof. Baly at this University. Although my new experiments are not sufficiently advanced to publish the results, yet the observations made seem to be of great promise. Mr. Bryant has added one more to the long list of phenomena which can be explained by the action of polarised light—namely, the putrefaction of fish—and thus he has given support to the general theory I formulated in my letter to *Nature.* I may add, in conclusion, that I hope to communicate my results to Section B at the meeting of the British Association in September next.—I am, Sir, &c., E. Sidney Semmens.

The University of Liverpool,
July 17, 1923

FORTHCOMING EVENTS

Sept. 10–13. THE INSTITUTE OF METALS. Annual Autumn Meeting, to be held in Manchester. "The Use of Non-Ferrous Metals in Engineering," by Lieut.-Colonel Henry Fowler. Tickets are obtainable from Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, S.W. 1.

Sept. 12–19. The British Association for the Advancement of Science. Ninety-first Annual Meeting, Liverpool. Among the papers to be read are the following:—(1) "The Electrical Structure of Matter" (Presidential Address), by Prof. Sir E. Rutherford, F.R.S. (2) "The Origin of Spectra," by Prof. J. C. McLennan, F.R.S. (3) "The Physical Chemistry of Interfaces," by Prof. F. G. Donnan, C.B.E., F.R.S. (4) "The Position and Opportunity of the British Empire," by Dr. V. Cornish. (5) "Unemployment and Population," by Sir W. H. Beveridge, K.C.B. (6) "Transport and its Indebtedness to Science," by Sir H. Fowler, K.B.E. (7) "The Education of Demos," by Prof. T. P. Nunn. (8) "Science and the Agricultural Crisis," by Dr. C. Crowther.

Membership Fees, £1 and upwards. Students' Tickets, for duly qualified persons, 10s. Full particulars can be obtained from the Secretary, British Association, Burlington House, London, W. 1, or from Local Hon. Secs., British Association, Manesty Buildings, College Lane, Liverpool.

PERSONALIA

Monsieur André Nicou, General Manager of the Micheville Steel Works, has been appointed Professor of Iron and Steel Technology at the National School of Mines in Paris. The same School has nominated Monsieur A. Cornu Thénard, Director of the Technical Works of the Cie. des Forges de Chatillon, to be Professor of General Metallurgy, and Monsieur J. Loiret, Engineer-in-Chief, of the Mines, to be Professor of Legislation.

FERTILISERS AND FEEDINGSTUFFS ACT

The Minister of Agriculture recently stated that he was aware that county councils were prohibited from instituting proceedings against offenders under the Fertilisers and Feedingstuffs Act, 1906, unless the Ministry gave its consent. Steps were being taken to appoint a Departmental Committee to enquire into the working of the Act and to report if and what amendments were desirable.—(June 28.)

NEWS AND NOTES

UNITED STATES

The Mangrove Industry

The Mangrove bark constitutes one of the world's most important sources of tannin because of its great abundance, wide distribution, rapid growth and comparatively low cost.

Various species of mangrove are utilised as a source of tannin, which is contained in all parts of the tree, more especially in the bark and leaves. The average content of tannin in commercial grades of bark is about 35 per cent. Care has to be taken not to expose the bark to moisture after collection, otherwise the tannin is lost. For this reason it is desirable to manufacture a tannin extract in the producing countries, although this has not yet been done to the same extent as with quebracho in South America. Although mangroves are found on most tropical coasts industrial utilisation has been developed on a large scale only in Colombia, East Africa, Madagascar, Borneo and the Straits Settlements.

The best grades of mangrove extract come from East Africa and Borneo, the tannin content ranging from 48 to 72 per cent. Used alone the extract yields a good pliant, workable leather, but of undesirable colour. To obviate this the tanners blend it with other tannin materials, such as myrobalan, valonia, sumac, and mimosa.—(*U.S. Com. Rep., May* 28, 1923).

Abrasive Materials in 1921

Natural abrasives were produced in 26 States in 1921, the chief centres of production being: Alabama, North Carolina, New Hampshire, New York, Virginia, millstones; Arkansas, Indiana, Ohio, oilstones; California, Connecticut, Maryland, Nevada, New York, Oregon, Utah, Washington, Diatomaceous (infusorial) earth; Illinois, Missouri, Oklahoma, tripoli; Indiana, rubbing stones; Kansas, California, Nebraska, pumice; Kentucky, hones; Michigan, Ohio, West Virginia, grindstones; California, Minnesota, Nevada, grinding pebbles; New Hampshire, New York, garnet; New York, Virginia, emery; Ohio, West Virginia, pulpstones; Ohio, Vermont, scythestones; Pennsylvania, rottenstone. Sales during 1920 and 1921 were valued at $4,299,812 and $2,707,366 respectively; production of all these abrasives has gradually declined. Values of sales, imports, exports, and apparent consumption in the United States in 1920 and 1921 were as follows:—

	1920.	1921.
Natural abrasives (sales)	$4,299,812	$2,707,366
Artificial „ (sales)	7,492,164	1,996,147
Imports	4,425,409	1,177,400
Total	16,217,385	5,880.913
Exports	7,025,621	3,320,590
Apparent consumption	9,191,764	2,560,323

Three different kinds of artificial abrasives are manufactured in the United States:—(1) Metallic abrasives, made by the Pittsburgh Crushed Steel Co.; and the Globe-Iron-Crush and Shot Co.; (2) Silicon carbides, manufactured by the Carborundum Co.; the Norton Co. and the Exolon Co.; (3) Aluminium oxides made by the Norton Co., the Carborundum Co., the Exolon Co., the National Abrasive Co., and the General Abrasives Co. (Inc.). In 1920 the value and production of artificial abrasives amounted to $7,492,164 (84,874,000 pounds), and in 1921 $1,996,147 (26,398,000 pounds).—(*Cf. J.*, 1922, 80 *R.*; *U.S. Geol. Surv., June* 15, 1922.)

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Reparation Dyestuffs

Sir P. Lloyd-Greame, in reply to Major Attlee, said that he was not aware that the British Dyestuffs Corporation charged 10 per cent. commission on reparation dyestuffs, and referred to an answer which he gave on this subject on December 4 last, to the effect that the Corporation received a commission of 6½ per cent. on the actual turnover, plus a further 1 per cent. for guaranteeing accounts, and a grant, which was limited in amount, towards the charges which they incurred relating to the importation of the dyestuffs. The Central Importing Agency undertook the duty of importing and distributing the dyestuffs for a commission of 3½ per cent., to be adjusted if prices fell, but this charge proved to be inadequate, and was considerably increased, with the approval of the Treasury, by various allowances made to the Central Importing Agency upon the final adjustment of their accounts.

Answering Major Attlee's further inquiries as to whether he was aware of the high prices charged for reparation dyestuffs by the British Dyestuffs Corporation, Ltd.; that the price of diamine fast yellow F.F., a dye for which there is no satisfactory British substitute, had been increased from 4s. per lb. to 7s. 6d. per lb. and to 10s. per lb., although this dye could be imported from Germany for 4s. 6d. per lb.; and of the discontent aroused by this action among colour users, Sir P. Lloyd-Greame said that no complaint as to the price of this dyestuff had been received by the Board of Trade, but arrangements were being reconsidered as to the pricing of reparation dyes, and the price of this particular dye would come under review. He also said that it was not a fact that these very high prices were put on in order to enable the Corporation to foist inferior substitutes on the colour users.—*July* 10.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for July* 5 *and* 12)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia	Chemists' and druggists' supplies	1
Belgium	Shoe leather	13
British India	Paint, oil, glass, glassware, rubber goods	5
Canada	Leather goods	7784/E.D./M.C./2
,,	Electric steel castings	*
Egypt	Ironware, building materials	22
New Zealand	Steel rails, joists	9
Norway	Leather for clothing	17
Rumania	Tubes, fittings (tender)	11017/F.E./E.C.
Sweden	Rubber mats	20
United States	Steel and iron pipe	25
Belgium	Shellac and chemical products	31
,,	Stearine, talc, carnauba wax, petroleum jelly, oils, lime carbonate, calcined magnesite	35
Canada	Copper and zinc plates	*
Czechoslovakia	Chemicals	37
Denmark	Agar agar	38
Netherlands	Perfumery, soap	45
Norway	Leather	48
,,	Tinplate	50
United States	Pyridine, ammonium carbonate, castor oil, tartaric and citric acid, naphthalene	20039/F.W./C.C.2
Uruguay	Electrical accessories (tender)	8279/F.L./C.C.2

* Canadian Government Trade Commissioner's Office, 73, Basinghall Street, London, E.C. 2.

TARIFF CUSTOMS EXCISE

Australia.—The exportation of leather is prohibited, unless it has been certified fit for export by a qualified officer.

British India.—Raw rubber is exempted from import duty.

Canada.—Revised import duties have been provided on firebrick and artificial silk.

New Zealand.—Inorganic acids, crude oils and greases are now duty free.

Poland.—The exportation of raw hides has been prohibited.

REVIEWS

Special Steels. *A concise treatise on the constitution, manufacture, working, heat treatment, and applications of alloy steels. By* T. H. Burnham, B.Sc. *Pp. xxi*+185. *London : Sir Isaac Pitman and Sons, Ltd.*, 1923. *Price* 5*s. net.*

The series of manuals of which "Special Steel," by T. H. Burnham, is one volume is stated by the publishers (Pitmans) to treat technology in a practical manner and to provide the student with a handy survey of the subject, which will be invaluable to the busy practical man who has not time for more elaborate treatises. Mr. Burnham has endeavoured to attain this result in regard to special steels by preparing a volume in which the subject-matter can be divided definitely into two parts, though in the book they are not separated. The greater part of the book is devoted to Sir Robert Hadfield's very numerous publications. The lesser part of the book contains the author's own views and the fruits of his studies in the literature.

It is noted largely on the title page and elsewhere that this book is founded on the researches published by Sir Robert Hadfield. The author's aim appears to have been to devise his chapters in such a way as to include the greatest possible number of Sir Robert Hadfield's publications. Occasionally this involves some violence to the appropriate subject-matter—as, for instance, where Sir Robert's lecture on the Metallurgical Chemist is dragged into the chapter entitled "Importance of Iron and Special Steels." The extreme prominence given to the work of one metallurgist in a book of this kind may be justified in some ways, but it is doubtful whether such a method is the best for a book which has the objects avowed for it by the publishers. The busy practical man does not want theoretical papers or repeated references to a single man's work. He wants explanations and applications, and well digested summaries of all the reliable work on the topics discussed. Unfortunately he is not very likely to find such information in this book.

The author's own contributions to the book are admirably described by himself in the opening words of Chapter II, where it is stated that, "In spite of all that has been written about iron and steel, many hazy notions regarding these still exist." Throughout his chapters the author has very little definite information to provide. His statements on the alloy steels are rather vague and on the slightest pretext he appears to turn with relief to safe ground and to quote Sir Robert Hadfield. Throughout the book the author fails to indicate those essential differences between the alloy steels and the carbon steels, which are of such great importance to the practical reader for whom the book is avowedly written. The simple example of the effect of mass during hardening, which is of such importance in this connexion, does not appear to be dealt with at all.

The book devotes a chapter each to steels containing the special elements, nickel, chromium, silicon, manganese and tungsten, and to nickel chromium steel and high speed steels. The general method of consideration is based upon the "Guillet" diagram, where available, for the particular systems. The treatment of the steels on this basis is accompanied by a general review of the mechanical properties of the steels and some still more general remarks on the method of manufacture. The balance of the chapters are provided by extracts from Sir Robert Hadfield's papers. These extracts have the merit of providing accurate information, but the author's own contributions are lacking in precision. This may be the effect of the very severe compression of the subject. Nevertheless it seems that a better treatment of the subject could have been achieved, starting from the same basis of Sir Robert's publications. The compression has led the author to give false impressions. Occasionally his statements are frankly incorrect, as, for instance, where he says, on page 54, that nickel steels have a fatigue resistance that is six time that of carbon steel.

The book is illustrated mainly by photographs of plant in Messrs. Hadfield's works and of the products of the same firm. Sir Robert Hadfield contributes an introduction to the book, and in an appendix of sixteen pages a complete list of his publications is provided.

L. Aitchisom

Absorption of Nitrous Gases. *By* H. W. Webb, M.Sc., F.I.C. *Pp. viii*+372. *London : Edward Arnold & Co.*, 1923. *Price* 25*s.*

The loss of fixed nitrogen in absorption plants has received inadequate treatment or attention in the literature mainly because practical experience was in the possession of few writers and partly because prior to the war the subject had not attained that importance with which munition and fixation plant has since invested it. Loss of nitre in sulphuric acid plants was perhaps an exception, and nitric acid plants using nitrate of soda were reasonably well served, but wherever the recovery of nitrous gases was the main object of an industrial operation, data and collaboration have been conspicuous by their absence. The author has therefore rendered a service in bringing together in logical and readable form the accumulated experience of the last decade.

The nine chapters deal with Properties of Oxides of Nitrogen; Theoretical Problems of Absorption; Construction of and Filling Material for Absorption Towers; Gas Circulation and Measurement; Handling of Acid; Concentration; Synthetic Production and Analytical Control. With regard to theoretical matter the book is comprehensive and affords a useful collection of all the more important work upon the oxides of nitrogen. In one or two places the subject might have been expanded with advantage. Fuller accounts might have been included of the paper by Donnan and Irvine Masson (not Irvine as stated), and that by Todd in the *Phil. Mag.* These two mathematical treatments of the oxidation and absorption of nitric oxide and nitrogen peroxide respectively have probably done more to remove empiricism in tower practice than any others, and deserve more than a passing reference to the original papers.

It is to be regretted that the author did not have access to the work of the Munitions Inventions Department, which settled such points as the preparation of nitrogen tetroxide by the action of nitric acid on nitrogen trioxide in the presence of a water absorber, being merely the back reaction of that reversible reaction occurring on absorption of nitrogen dioxide in towers, and that if this reaction was drawn to completion by oxidation in the liquid phase 80–90 per cent. nitric acid could be obtained. In a subsequent edition one may hope that the author and the publishers will be able to include full details of all relevant work done at University College.

Turning to the practical side, it is clear that the book will be of value not only to nitric acid technologists, but also to those dealing with absorption problems generally. The illustrations, diagrams and graphs are unusually clear and usable, and very little relevant matter has been omitted. Due prominence has been given to the importance of free space and to the other factors which bear on the relative values of the different types of filling material, but some of the figures quoted as to available scrubbing surface, etc. are inaccurate or out of date. Reference should have been made to Parrish's figures (*cf. Gas World*, Coking Section, July 6 and August 3, 1918), to intermittent flushing as against continuous circulation of liquid, and to the importance of uniform and correct distribution of gas as well as of liquid. The fallacy that gas and liquid must invariably meet on the countercurrent principle still persists. There is no reason why nitrous gases should not pass alternately up and down the towers of a series. In fact with parallel flow the time of contact is increased and the unsightly diagonal pipe lines disappear. Having regard to the very low gas velocity dictated by the time factor, "whirling" by means of spirals or the like seems a misnomer, and experience shows that a continual and considerable change of section or velocity and of direction is of primary importance. The author is misinformed in regard to Krupp's nitric acid pumps (p. 86), these being of V2A, a low-carbon nickel-chromium steel. On p. 196 the author states that a filling material with horizontal grooves will "channel" if not set accurately level. A suitable trial would surprise him and show that theory and practice do not tally on this point.

The chapter on analytical control is almost too complete and the author might be more critical to enable a choice to be made of a method most suitable for a given set of circumstances. A few selected methods fully described and criticised would have been preferable. In describing the reduction by Devarda's alloy, it is not stated when the alloy is to be added. The solubility of nitric oxide in sulphuric acid is repeated from the first chapter, and for the sake of scientific exactitude "titanous sulphate," etc. would be better than "titanium sulphate," especially as we are given the full structural formula of nitron. Considering that the author is practically breaking new ground, there is surprisingly little scope for criticism, and such details do not detract from the utility of the work, which is of a high order, and can be confidently recommended for use in industrial undertakings. C. J. Goodwin

Elements of Glass Blowing. *By* H. P. Waran. *Pp.* 113. *London: Messrs. G. Bell and Sons*, 1923. *Price* 2s. 4*d*.

Some knowledge of the methods of working glass in the blowpipe flame, and some skill in glass blowing are at last being recognised as acquisitions of great importance to science students, and general laboratory workers. To those engaged on research work, such acquisitions are of paramount importance, as the skill with which glass apparatus is made or repaired, often determines the success or failure of an experiment. It is therefore a matter for regret that glass blowing does not receive sufficient attention in the training of most of our science students, and that it has not yet found a permanent place in the curricula of our pure and applied science departments and colleges. Unfortunately, this lack of instruction in the art of glass blowing is not compensated by a good supply of reliable text books, for such books as are available in the English language are very few, and are anything but exhaustive in their treatment of the subject.

The present book is a welcome addition to this literature and compares very favourably with the best of the earlier books. It is written not for the professional glass blower but for the student, and the blowpipe, bellows and tools which are described, are such as may be found in most laboratories, but are very seldom used by up-to-date professional workers. The book is not exhaustive, and appears to have a bias towards apparatus such as is used in modern physical work, and especially towards what is termed "vacuum technology."

The subjects discussed are treated in a very practical manner, and details are given of how to perform the necessary operations; for more complex pieces of apparatus, details of the order of making and assembling the various parts are given. Throughout the book there are excellent explanatory drawings, illustrating the various exercises and showing the different stages from the original length of glass tube to the finished article. Such details and drawings will be found very useful to the student who sets out to obtain some knowledge of the subject without the aid of an instructor.

Though the treatment of each exercise is in general such as a student would require, the arrangement of these exercises is by no means so satisfactory. The drawing-down of a tube to form a tube of less diameter or to serve as a handle may well serve as a first exercise, but it is open to criticism to include in the second exercise on the bending of tubes, the making of nicely rounded U tubes, especially if light wall, wide bore tubing is to be used. The satisfactory making of such U tubes requires either a blowpipe different from the one shown on page 3, or the "gathering up" of a considerable amount of glass into the form of a thick walled elongated bulb, prior to the drawing and bending operation, and this requires skilled handling. A similar marked increase in skill is required to cope with the work of the third section of the second chapter, namely, the making of spirals. Again, after dealing with the making of joints of various types, such as T joints, internal junctions, and the making of complete circuits of tube, a chapter is devoted to the blowing of bulbs (1) at the end of a stem, and (2) in the middle of a tube. The whole of this chapter should come before the one on joints for two reasons: (1) The exercises in it are easier than most kinds of joints, and (2) the skill necessary to control and blow glass into small bulbs with uniformly thick walls is the basis on which neat junctions are made. In chapter VI the making of a thistle funnel is followed almost immediately by the making of glass stopcocks with hollow keys; the former is one of the easier things a student has to make, whilst the latter is one of the most difficult pieces of glassware to make satisfactorily. A student working from this book without the assistance of an instructor, would therefore find it difficult to select exercises of gradually increasing difficulty, so as to develop progressively his own skill in handling and blowing glass.

The last chapter of the book on "Commercial Methods for Laboratory Glassware" is evidently written from information obtained by brief visits to glass works, and unfortunately is very unreliable in many details. In this chapter it is easy to pick out a dozen errors or misstatements relative to the manufacture of glass, which to a certain extent are excusable, but one is exceedingly surprised when the author says on page 106, that the broad dark bands which are observed on examining glassware between crossed Nicols may "be coloured in the case of seriously strained pieces of glass." Surely he means the light areas may become coloured when the glass is subjected to severe stresses.

S. ENGLISH

THE ATOMIC THEORY IN 1921. *By* JAMES MOIR, D.Sc., F.R.S.S.A., F.I.C., F.C.S. *Reprinted from the "South African Journal of Science," Vol. XVIII, Nos.* 1 *and* 2, *pp.* 47–62, *December*, 1921. *Johannesburg: The S.A. Association for the Advancement of Science*, 1921.

Dr. Moir's Presidential Address to the South African Association for the Advancement of Science takes the form of a review of modern theories of atomic structure. This review is not by any means a mere recapitulation of current theories, but is impregnated with methods of interpretation that are the product of the author's own hard thinking on a difficult subject. In the main he appears to follow Kossel rather than Langmuir or Bohr, since he formulates hydrogen gas as composed of positive and negative hydrogen ions held together only by electrostatic attraction, so that the non-polar bond is practically suppressed. He also treats the hydrogen ion as identical with the hydrogen nucleus, and describes it as the cause of acidity, although it is well-known that this acidity is usually developed only in the presence of water; there is therefore very little justification for identifying the naked proton with the hydrogen ion of aqueous solutions, and still less for asserting that the size of the hydrion is somewhat smaller than that of the electron or that the nucleus of the element lithium consists of 7 hydrions held together by 4 electrons.

In order to illustrate the modern theory of atomic structure Dr. Moir develops a system of nomenclature, in which the proton is represented by the symbol $\overset{+}{\mathrm{H}}$, and the electron by the symbol θ; and these symbols are used, not only for the protons of the element hydrogen, and for the planetary electrons of various elements, but also as expressing the structure of the nucleus. This analysis of the nucleus introduces an unnecessary element of complexity, which is absent from the lucid explanations given by Lewis; it may even lead to confusion, since the distinction between the permanent nucleus and the movable electrons round it is indicated only by brackets. It is therefore by no means a substantial advance upon earlier methods of formulation when Dr. Moir writes lithium metal as $[\theta(4\mathrm{H}+4\theta\ 3\mathrm{H}+)\theta\theta]$ or the cæsium ion as $27\ \theta(78\mathrm{H}+78\theta\ 55\mathrm{H}+)27\theta$. This nomenclature has, no doubt, become a convenient medium of thought to the author, but it cannot be commended to the average student. In this respect Dr. Moir's pamphlet shows some resemblance to the recent (and not very successful) attempt made by Dr. Gray, of Aberdeen, to "unravel the chemical tangle" (*cf. Chem. and Ind.*, June 29, p. 664). Two examples of the complexity of Dr. Moir's nomenclature may be given, namely, (i) The formulation of the structure of a sodium-fluoride crystal as $[4\theta\,[\mathrm{Na}+^{9}]\,4\theta]\,[4\theta\,[\mathrm{F}+^{7}]\,4\theta]$

with a note to the effect that "The expression $Na+^{9}$ is really $Na+^{11-12}$, the atom having 2 inner electrons to make a kernel out of a nucleus." (ii) A statement that the author's theory accounts for the very low dissociation of water by the fact that the complex $\left[OH_3 \, {}^{19+}_{18\theta}\right] \left[OH \, {}^{17+}_{18\theta}\right]$ yields scarcely any free hydrion.

The author's handling of the structure of the nucleus is by no means lacking in boldness, since he carries his views far beyond the point which has been reached by Rutherford's experiments. Thus he postulates that both carbon and nitrogen have a tetrahedral nucleus, whereas Bohr and other physicists are content to assume some kind of tetrahedral symmetry in the orbits of the planetary electrons. Dr. Moir, however, goes much further than this, and suggests that the silicon nucleus is CHe_4, the zirconium nucleus is CNe_4, titanium is SiNe and niobium NNe_4. On this basis he is prepared to speculate on the possibility that isomorphous mixtures of some of these elements may be the result of transmutation rather than of vicarious replacement.

The features to which attention is directed above certainly redeem Dr. Moir's Presidential Address from any risk of being classed as commonplace; and if only on account of its unconventional character it will be read with keen interest by many who are interested in the problem of atomic structure.

LEHRBUCH DER CHEMISCHEN TECHNOLOGIE.

By Prof. H. OST. *Thirteenth edition* *Pp.* *viii*+815. *Leipzig: Max Janecke*, 1923. *Price* 19*s*.

The thirteenth edition of Ost's *Lehrbuch der Chemischen Technologie*, which appeared in December, 1922, is practically a reprint of the twelfth edition (April, 1922). The rapid succession of new editions indicates a keen demand, at least on the Continent, for a book of this type. There is, so far as the reviewer can recall, no British equivalent to it. The reason for this is probably that for the technical chemist engaged in practice it is not full enough; he will learn practically nothing new in his own particular domain; whilst the student preparing himself for a career in technical chemistry in this country does not usually cover the whole field of chemical technology, as is done in the book under review, but devotes his time mainly to chemical engineering and a detailed study of one or two technical chemical processes. The present edition of Ost's *Lehrbuch* runs to 815 pages, and is divided into short sections dealing with all the important chemical industries. The following summary gives the section headings and an idea of the contents of the sections, when these are not sufficiently indicated by the title. The space devoted to each section is also added:—Introduction, 6 pp.; production of heat (solid, liquid and gaseous fuels), 34 pp.; production of cold, 4 pp.; technology of water, 9 pp.; sulphuric acid (sulphur, carbon disulphide), 26 pp.; salt, 6 pp.; soda, sulphate and hydrochloric acid (caustic soda, sodium), 31 pp.; potassium salts (magnesium salts, bromine, borax, borium compounds), 23 pp.; the chlorine industries, 26 pp.; nitrogen compounds, 31 pp.; artificial manures, 12 pp.; aluminium compounds (sulphate, alums, ultramarine), 8 pp.; explosives (matches, phosphorus), 27 pp.; mortars and cements, 35 pp.; glass, 31 pp.; ceramics, 27 pp.; illuminating gas (other illuminants, hydrogen), 26 pp.; coke and its by-products, 19 pp.; mineral oils (coal tar, low-temperature carbonisation, wood charcoal and destructive distillation of wood), 44 pp.; fats, fatty oils and waxes (milk, butter, margarine, varnishes, resins, rubber, soap, glycerin), 49 pp.; the sugar industry, 40 pp.; starch and starch products (artificial sweetening agents), 16 pp.; cellulose and artificial silk (celluloid and other plastic materials), 14 pp.; fermentation and fermentation industries, 65 pp.; dye manufacture, 40 pp.; dyeing and calico printing (ink), 30 pp.; tanning (glue), 15 pp.; metallurgy, 103 pp.; index, 18 pp.

No one can pretend to write authoritatively on such a variety of subjects, so the volume is largely a compilation from various sources, which are given at the beginning of each section. In the modest space devoted to each industry one cannot expect exhaustive treatment. The book, gives, however, an excellent bird's-eye view of the chief chemical industries. The purely chemical side of the subject is treated comparatively briefly, the main feature being a clear summary of the manufacturing process. In most cases this is excellently done, although the few brief paragraphs in which some of the minor subjects are dismissed convey little more information than the average text-book of general chemistry. The diagrams are good and the information is usually up to date, although naturally it is mainly with German practice that the author is concerned. This, however, should be no disadvantage to British readers. The book can be thoroughly recommended to the student who wishes a short, clear and reliable account of the chief chemical industries and it should also prove useful to the consulting chemist.

Its long-continued success is a sufficient indication that it meets a popular demand. A book dealing with such a variety of subjects and substances requires a good index, and this requirement is satisfactorily met.

J. KNOX

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The market continues to be depressed with little business moving. There is no evidence yet of an early return to normal conditions. Prices, however, are well maintained and there are no important changes to report.

Acetic Acid, 40% tech.	£24 per ton. Still firm, but rather less inquiry.
Acid Hydrochloric	3s. 9d.-5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw.	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.-£8 per ton. Demand steady, export inquiry good.
Arsenic (White)	About £71 per ton.
Bleaching Powder	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Business much below normal.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand.
Copper Sulphate	£27 per ton.
Potash Caustic	£33-£34 per ton. Little moving.
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Potass. Chlorate	3d. per lb. Very dull.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76%	£20-£21 per ton. Steady demand.
Soda Crystals	£5 5s.-£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£26 per ton. Very scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b London, 1-cwt iron drums included.
Sod. Chlorate	2¾d.-3d. per lb. Very dull.
Sod. Nitrate refd. 96%	£13 5s.-£13 10s. per ton ex Liverpool. Steady demand.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	£15-£16 per ton carr. paid. Very quiet. Prices unstable.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25-£29 per ton according to quantity.
Carbon Black	1s. 1½d.-1s. 3d. per lb. Ample supplies now coming forward.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood distillation products.

Acetate of Lime—	
Brown	£11 per ton and upwards. Price very firm and demand keen.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8 5s. to £10 15s. per ton, according to locality of market and type of charcoal.
Iron Liquor	1s. 5d. per gall. 32° Tw. Some sales effected at 1s. 7d.
	1s. 2s. per gall. 24° Tw.
Red Liquor	1s 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 8d. ,, ,, 60% O.P. Firm.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5-£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d.-1s. 2½d. per lb. Market well maintained.
Crude 60's	3s.-3s. 3d. per gall. Market quiet.
Acid Cresylic—97/99	2s.-2s. 5d. per gall. Steady demand.
Pale 95%	1s. 11d.-2s. 4d. per gall.
Dark	1s. 10d.-2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.

Anthracene Oil—	
Strained	8¾d.-11d. per gall. Supply short. Plenty of inquiries.
Unstrained	8¼d.-9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1¼d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.
Pure	2s. 1d.-2s. 2d. per gall.
Toluole—90%	1s. 9d.-2s. per gall. Not many inquiries.
Pure	2s.-2s. 4d. per gall. Not much inquiry.
Xylol	3s. 3d.-3s. 10d. per gall., according to quality.
Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil Heavy Standard Specification	8½d.-9½d. per gall. Market steady. Good demand.
Napbtha—	
Crude	8¾d.-9d. per gall.
Solvent 90/160	1s. 6d.-1s. 7d. per gall. Business quiet.
Solvent 90/190	1s. 5d.-1s. 7½d. per gall. Market moderately active.
Naphthalene Crude—	
Drained Creosote Salts	£7-£8 per ton. Fair demand. Supply short.
Whizzed or hot pressed	£11-£14 per ton. Less active.
Naphthalene—	
Crystals	£18 10s. per ton.
Flaked	£17 per ton.
Pitch, medium soft	132s. 6d.-140s. per ton. Autumn delivery. Numerous inquiries.
Pyridine—90/140	18s. per gall. Demand good.
Heavy	8s.-9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Depression in the textile trade continues, but business in dyestuffs has improved slightly during the week.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 6d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	6s. 6d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Steady demand.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb.
p-Cresol 32/34° C.	2s. 1d.-2s. 3d. per lb.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 9d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. 6d. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylamine Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Markets are practically stagnant, and with foreign exchanges in violent fluctuation no improvement can be expected at present.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. 1d. per lb. for cwt. lots. Market weaker.
Acid, Benzoic	2s. 6d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8d. per lb., less 5%. Demand improved.
Acid, Gallic	3s. per lb. Down to 2s. 11d. for large quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d. per lb. Still wanted.
Acid, Tannic	3s. 6d. per lb.
Acid, Tartaric	1s. 3¼d.-1s. 3½d. per lb. less 5%. Demand improved on account of warmer weather.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 5d. per lb. now accepted for quantity.
Amidopyrin	12s. 6d. per lb. Now cheaper but demand still very poor.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz.
Barbitone	21s. per lb. No inquiry.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Position unchanged. Prices vary according to quantity and source.
Calcium Lactate	2s. 6d. per lb. for best makes.
Chloral Hydrate	3s. 9d. per lb., duty paid.
Chloroform	2s. 2d. per lb. for cwt. lots. Higher prices are looked for in near future.

Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	£90-£92 per ton. Very firm.
Guiacol Carbonate	8s. 6d. per lb. Neglected.
Hoxamine	3s. 9d. per lb. In fair supply on a quiet market.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots.
Magnesium Carbonate—	
Light Commercial	£37-£38 per ton net, according to quantity.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	70s.-80s. per cwt. Fairly steady market.
Menthol	40s. per lb. spot.
Methyl Salicylate	2s. 4d. per lb. for carboys.
Methyl Sulphonal	15s. per lb.
Morphine	Alkaloid—Cryst. 10s. 11d., Precip. 10s. 8d., Acetate 8s. 6d., Hydrochlor. 8s. 6d. Sulphate 8s. 6d. per oz.
Paraformaldehyde	3s. 9d. per lb. Lifeless.
Paraldehyde	1s. 5d. per lb. Cheaper, with poor demand.
Phenacetin	6s. 6d. per lb.
Phenazone	7s. per lb.
Phenolphthalein	6s. per lb. Lower.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	94s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d. per lb. Good demand. Steady market.
Potass. Permanganate	10½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.-2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	5s. 6d. per lb. Cheaper.
Salol	2s. 9d. per lb.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 6d. per lb. Slow of sale.
Sod. Citrate, B.P.C. 1923	2s. 2d. per lb. for cwt. lots. Firmer.
Sod. Hyposulphite—	
Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.-87s. 6d. per cwt. Fairly good demand. Expected to improve with continued warm weather.
Sod. Salicylate	Powder 2s. 7d. per lb., and Crystal at 2s. 9d. per lb. Market lifeless.
Sod. Sulphite, anhydrous	£27 10s.-£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.
Thymol	15s. 6d. per lb. for cwt. lots of natural recryst.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.	
Aubepine	14s. ,, ,,	
Amyl Acetate	3s. ,, ,,	
Amyl Butyrate	7s. 3d. ,, ,,	
Amyl Salicylate	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	2s. 9d. per lb.	
Benzyl Benzoate	3s. 3d. ,, ,,	
Cinnamic Aldehyde	18s. 6d. ,, ,,	Advanced.
Coumarin	18s. 6d. ,, ,,	
Citronellol	19s. 6d. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate	15s. ,, ,,	Cheaper.
Ethyl Phthalate	3s. 9d. ,, ,,	,,
Eugenol	11s. ,, ,,	
Geraniol (Palmarosa)	32s. 6d. ,, ,,	Advanced
Geraniol	5s. 6d.-12s. 6d. per lb.	
Heliotropine	8s. per lb.	
Iso Eugenol	16s. 6d. per lb.	
Linalol ex Bois de Rose	21s. ,, ,,	
Linalyl Acetate	21s. ,, ,,	
Methyl Anthranilate	7s. ,, ,,	
Methyl Benzoate	8s. 6d. ,, ,,	
Musk Xylol	11s. ,, ,,	Dearer.
Phenyl Ethyl Acetate	10s. ,, ,,	
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,	
Rhodinol	45s. ,, ,,	
Safrol	2s. 4d. ,, ,,	
Terpineol	3s. 1d. ,, ,,	
Vanillin	24s. ,, ,,	Firm with steady demand.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.	
Anise Oil	2s. ,, ,,	
Bergamot Oil	12s. 6d. ,, ,,	spot.
Bourbon Geranium Oil	29s. ,, ,,	
Cananga Oil, Java	9s. ,, ,,	
Cinnamon Oil, Leaf	4½d. per oz.	
Cassia Oil 80/85%	12s. 6d. per lb.	
Citronella Oil—		
Java 85/90%	4s. 2d. ,, ,,	
Ceylon	3s. 8d. ,, ,,	
Clove Oil	8s.-8s. 6d. per lb.	
Eucalyptus Oil 70/75%	1s. 10d. per lb.	
Lavender Oil, Mont Blanc 38/40%	13s. ,, ,,	
Lemon Oil	3s. 1d. ,, ,,	
Lemongrass Oil	2¾d. per oz.	
Orange Oil, Sweet	13s. 7d. per lb.	
Otto of Rose Oil—		
Anatolian	24s. per oz.	
Bulgarian	30s. per oz.	
Palma Rosa Oil	19s. per lb.	
Peppermint Oil—		
English	80s. ,, ,,	
Wayne County	13s. ,, ,,	
Japanese	7s. 1½d. ,, ,,	Advanced.
Petitgrain Oil	7s. 3d. ,, ,,	

COMPANY NEWS

THE BRITISH CYANIDES CO., LTD.

The Annual Ordinary General Meeting of the British Cyanides Co., Ltd., was held on July 18, when the Directors' Report and Statement of Accounts were submitted. The Report for the year ended April 30 last shows a profit of £17,204, which, with the amount brought forward, makes a total of £17,697. This compares with a total profit last year, including the amount brought in, of £3,342. After the payment of the dividends on the Preference Shares for the year, there remains a sum of £14,847, as compared with £492 for the year 1922, which the Directors recommend should be carried forward.

The Report states that the profits realised were almost entirely earned during the last few months of the period under review. The Tat Bank Works, which, owing to the sudden slump in trade during the previous year, had been closed down, were reopened in February last, and the operations at this factory will be further extended during the coming year with, it is hoped, very satisfactory results.

The balance-sheet shows, apart from loans to subsidiary companies, that stocks of materials, boats, tank-wagons, &c., amount to £52,267; sundry debtors, £30,421 as against creditors, £27,379; cash-in-hand and at bankers, £9,850 as against £4,880 last year; whilst the bankers' overdraft has been reduced from £47,402 to £30,001.

The main idea of the directors has been to secure a source for the supply of raw material, and with this end in view they have entered into a contract for a period for the supply of cyanogen which can be drawn cheaply from the nitrogen of the atmosphere. Large sums of money have been expended on this problem, the solution of which, the directors state, appears to be within their grasp.

PUBLICATIONS RECEIVED

Catalogue of Selected Works on Natural History. *Being recent purchases from the libraries of Prof. G. S. Boulger, F. M. Campbell, Sir F. W. Moore and Sir E. Giles Loder, Bart. Pp.* 70. *London: Wheldon and Wesley, Ltd.*, 1923.

The Wet Collodion Process. *By* Arthur Payne. *Second edition. Pp.* 122. *Newcastle-on-Tyne: Mawson and Swan, Ltd.*, 1923. *Price* 3s.

The Mineral Resources Bureau. Mineral Industry of the British Empire and Foreign Countries, 1919—1921. *Zinc. Pp. iv*+60. *H.M. Stationery Office*, 1923. *Price* 2s.

Wood Distillation. *By* L. F. Hawley. *American Chemical Society, Monograph Series. Pp.* 141. *New York: The Chemical Catalog Co., Inc.*, 1923. *Price* $3.0.

TRADE NOTE

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during June has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 512, of which 393 were from merchants and dealers. To these should be added the 21 cases outstanding on June 1. making a total for the month of 533. These were dealt with as follows :—

> Granted—372 (of which 328 were dealt with within seven days of receipt).
>
> Referred to British makers of similar products—96 (of which 78 were dealt with within seven days of receipt).
>
> Referred to Reparation supplies available —41 (all dealt with within two days of receipt).
>
> Outstanding on June 30,—24.

Of the total of 533 applications, 436, or 80 per cent. were dealt with within four days of receipt.

EMPIRE COTTON AND RESEARCH

£5,000 DONATION TO IMPERIAL COLLEGE

The Empire Cotton Growing Corporation has recently been considering the necessity for organised research at the Universities and Colleges of Great Britain and has decided to offer retaining grants to certain Universities, where highly specialised research is already going on. The Cotton Corporation has offered to the Imperial College of Science and Technology, South Kensington, the sum of £1,000 a year for a period of five years from October 1, 1923, the money to be devoted to Plant Physiology and Plant Pathology in the Department of Botany. This generous offer has, we understand, been accepted by the Governing Body and the research work will be undertaken in the new Botany Building, which was recently opened by the Duke of Devonshire and to which the Rubber Growers' Association of the City of London subscribed approximately £30,000 about two years ago. This donation is tangible evidence of the value which tropical agriculturists attach to the important research work which is being undertaken at the Imperial College, especially in connexion with plant physiology and pathology under the direction of Professor J. B. Farmer, F.R.S., and Professor V. H. Blackman, F.R.S. We have no doubt that other groups interested in research work will continue to support undertakings of this character.

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EDITORIAL

WE were, a few days ago, wandering idly in a garden, with mind somewhat out of focus, our speculations reduced "to a green thought in a green shade" when our attention was directed to some more vivid patches on the lawn caused by unequal sprinkling of sulphate of ammonia. How small a quantity of this affects the vigour of the grass! In homœopathic doses this is a wonderful stimulant, and it seemed to us that this is typical of many a chemical process, not only in those gardens where the "milder sun does through a fragrant zodiac run," but in the treatment of minerals of many kinds and precious sand from southern climates brought. We have read somewhere *De minimis non curat lex*, but if the law does not bother about trifles no such statement may be made about chemistry. There is hardly such a possibility as pure chemistry. If you take away the traces of water and other more or less accidental appendages the chemical actions diminish in vigour and in interest until hardly anything is left. In our youth two of us could play cricket, one to bat and one to bowl, but how fatiguing and unsatisfactory such a game was. At least a third player is required and half-a-dozen are still better. Is it not the same in chemistry? Variety is wanted; if an electron has only one or two opportunities of attachment it becomes dull and tedious, but give it four or five chances and how busy it gets. The slight impurities found in metallic iron, lead or copper play an extremely important part in deciding the physical and chemical properties of these metals, and how minute a proportion of these impurities, or lubricants, or whatever they are, can be detected; a few pennyweights of silver to the ton of lead may be like an odd mark given away with a pound sterling, but it has a noticeable effect and we can detect in dyestuffs, and scents quantities so small as to require a calculus of infinitesimals to measure them.

A minute quantity of copper sulphate will destroy various animal and vegetable growths; it is said that cattle will not fatten unless in the oil-cake or some other article of diet traces of prussic acid exist—how true this is we do not know—and very faint traces of unwanted substances promote the rusting of iron and many other chemical actions. Now we may read in *Nature* an account of the effect of small traces of formaldehyde in promoting photosynthesis by a living plant, an instance which would have delighted Hahnemann; minute traces promote it, larger quantities poison the plant. The effect of minute traces of moisture on the boiling points of liquids has been freely commented upon during the last few years, though we are not clear whether this does not belong to a different set of ideas. While we were pondering these thoughts in a garden we were advised of a recent paper read before the Royal Dublin Society on hydrogen ion concentration in relation to the distribution of snails. It seems that snails are as intolerant of the hydrogen ion as is Professor Armstrong. These harmless necessary ions are a red rag to the snails. A minute quantity of them to the square centimetre—the mathematical formula given in the paper does not give the limits in a very clear manner—drives them away to languish and perhaps die of undue concentration. If only someone would work out a simple method of obtaining just the right number of hydrogen ions to kill slugs without injuring the plants, what a blessing would be conferred on struggling humanity. The dead slugs would decompose in the first moonlight night and the discoverer of the process would be recommended for the Messel and all other chemical medals. We seem to have heard of a vinegar plant which produces acetic acid, though we have searched Carter's seed catalogue for it in vain, perhaps a few of these planted among the lettuces—who knows?

DEVELOPMENTS IN THE CEMENT INDUSTRY

By REX FURNESS

It is a matter for congratulation that the cement industry in the principal countries of the world has interested itself so keenly in the scientific study of the problems of the manufacture and application of cement. Even if satisfaction is somewhat qualified by the relative lack of attention paid to problems of a fundamental nature, the advances made in the control of the raw materials and in the mixing, in the study of the heat distribution throughout the length of the kiln, in the recovery of heat from the waste gases, the clinker and the kiln shell, etc., in the production of improved refractories for kiln lining, in the investigation of the effect of fineness of division of cement upon quality of concrete, in the manufacture of waterproof and acid-proof cements or concretes, and in scores of other directions, are noteworthy and represent tangible proofs of the value of scientific research in industry.

One development, however, presents so great a possibility of revolutionary change in the cement industry that it calls for special attention. It is not impossible that the near future may witness a change in the composition of cement in general use, and that high aluminous cements may supplant in large measure the ordinary Portland cement of to-day. Such a material is already being manufactured in three French works and is upon the markets under various names—ciment électrique, ciment fondu, aluminous cement, "alca" cement, fused cement, etc.—although supply is in no way equal to demand. That the price is very considerably in excess of that of ordinary cement is no indication of limited applicability, for, even if the cost of manufacture cannot be reduced (and it will appear later that the reverse is very probable), the superior qualities of the new cement will procure for it a ready sale. The development of the Portland cement industry itself, the output of which has increased a hundredfold in two decades, demonstrates clearly that a higher priced cement will displace a cheaper cement—natural cement—when the properties of the former are so markedly superior.

Let us consider briefly the nature and qualities of the new aluminous cements.

Calcium Aluminate Cements

A hydraulic material, consisting mainly of calcium aluminate, is manufactured by fusing together bauxite and lime in an electric furnace, or a water-cooled cupola type of furnace. Although the composition may vary within reasonably wide limits before its properties of slow setting and rapid hardening are impaired too greatly, an average composition may be taken as 40 per cent. alumina, 40 per cent. lime, 10 per cent ferric oxide and 10 per cent. silica.* Thus, whilst we may roughly assume that the amount of lime in all ordinary Portland cements varies between 1·7 and 2·2 times the sum of the amounts of silica, alumina and ferric oxide, the ratio in the new cements is approximately 0·66. Similarly, the silica-alumina ratio in Portland cement is invariably over 2·5, whereas in the calcium aluminate cements now upon the market, this relationship is about 0·25. It is, therefore, to be expected that aluminate cements should differ very considerably in their properties from the ordinary cements, and this is shown in no more striking instances than in their setting and hardening rates and in their compressive and tensile strengths. Cements of the composition above indicated set relatively slowly and harden rapidly. In twenty-four hours the cement mass has attained a strength equal to that of ordinary cement in twenty-eight days, and the ultimate strength is approximately three times that of Portland cement. This is well shown in the table given above, in which a random selection of available figures has been made.†

Cement	Test	One day	Two days	Three days	Seven days	Twenty-eight days	Three months
Ciment fondu—1 : 1 : 3	Compressive	—	—	7500	—	8500	9000
Ciment fondu—1 :1·5 : 3	ditto	—	5750	—	6000	7500	7750
Ciment fondu—1 : 3 mortar	ditto	5000	5500	5700	6120	6720	—
Ordinary cement	ditto	—	—	—	2750	4420	5500
Ciment fondu 1 : 3 mortar	Tensile	400	—	—	800	—	—
Ditto	ditto	412	482	500	512	540	—
Ciment électrique 1 : 3 mortar	Tensile	468	480	—	488	665	—
Ordinary cement—1 : 3 mortar	ditto	—	—	333	398	—	580

The figures are from French, American and Danish sources, and include some published by Bied and Sprackman, who may be said to have developed calcium aluminate cements, the latter having taken out the original patents. The heat evolved in the setting of the cement mixture is sufficient to allow operations to be conducted in frosty weather, for before the heat is dissipated the mass has hardened to a degree sufficient to resist deformation, etc. It is clear that a rapid hardening, specially strong cement has many advantages. Less reinforcement is required, and beams, floors, etc., can be reduced in dimensions. Work is more rapidly completed—the whole output of the French works was used during the war for the construction of artillery platforms, etc., where rapid completion of work was essential. Pile-driving experiments have shown that operations can be commenced in three days. Economy in material is, of course, possible—for equal strength, relative to Portland cement work—and in cases where forms are used, the economy in form timber is considerable, since a much smaller stock of forms is required. Concrete articles demand less storage time and, in general, the time saved by the use of a rapidly hardening cement reduces overhead charges. A further property of calcium aluminate cements is their resistance to the attack of alkaline soils, sea water and the sulphates of calcium and magnesium. Their applications in submarine work and in alkaline soils require, then, no description.

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* Reid's formula for cements like "ciment fondu" is 0·4 ($2CaO.SiO_2$) $CaO.Al_2O_3$, but the cement shows satisfactory properties with a composition of 35–45 per cent. Al_2O_3, 35–45 per cent. CaO. 5–12 per cent. of SiO_2 and 5–12 per cent. of Fe_2O_3. Indeed, the setting properties are entirely due to the calcium aluminate. *Cf.* Harms, *Concrete*, Cement Mill Section, June, 1922, p. 119, for a full discussion of the composition of fused cements.

† *Cf.* Sprackman, *Concrete*, March, 1923, p. 113, for a table of the tensile and compressive strengths of various aluminous cements. Further information as to the strength and composition of ciment fondu has recently been given in two papers read—after the writing of this paper—before the Institution of Engineering Inspection, by Davey and Knight.

The above condensed account of the properties of the calcium aluminate cements will probably serve to indicate the undoubted possibilities of these new cements. Their success is already demonstrated, for they have been continuously employed for twelve years, and today the whole of the output of the three French works is booked well ahead, at prices two to three times those ruling for ordinary cement. The general development of aluminate cements will be considerably hastened, however, if the cost of production can be lowered, and if ordinary rotary kilns can be used in their manufacture. It is pertinent, therefore, to discuss the present and possible future methods of manufacture.

Present Methods of Production

A suitable mixture of bauxite and limestone, of the composition noted above, is fused or partially fused in an electric furnace or in a water-cooled blast-furnace type of apparatus, and the resulting mass is cooled and finely ground, in the entire absence of free lime. Many problems, such as the rate of cooling, calcination, fineness of division, etc., are incompletely solved, but it is clear that the manufacturers have sufficient experience to produce a regular quality of slow-setting, rapidly hardening cement. The cost of manufacture is high compared with ordinary cement kiln practice, for in the electric furnace 2000 kw.-hrs. of electricity is required per ton of cement produced. The mass is difficultly fusible on account of its low conductivity—the resistivity of the mass has been placed at two million microhms per sq. cm.—and the electrode consumption is very high, namely, 100—200 kg. per ton of cement made. The attack of the carbon dioxide upon the electrodes at the high temperatures generated must obviously be considerable. Experiments have been conducted in the rotary kiln, but full success has not yet been realised, although Sprackman has stated that the use of the rotary kiln is not impossible.

Possible Future Methods of Production

The manufacture of the high melting calcium aluminate cements, as of a true tricalcium silicate cement, in the rotary kiln is the natural development which is to be expected. Provided certain conditions can be met, there appears no reason why the costs of manufacturing aluminate cement should be higher than those ruling today in Portland cement production. The net cost of aluminate cements should then be no higher, or only slightly higher, than that of ordinary cement to-day. The actual *amount* of heat required to " burn " a ton of aluminate cement is no higher than for Portland cement, and it becomes a matter of *intensity* of heat. The utilisation of all the available methods of heat recovery from kiln gases, clinker and kiln shell, and the high pre-heating of air for the combustion of carbonaceous matter supplied to the kiln will enable a sufficiently high temperature to be attained in the kiln. But the utilisation of temperatures of 1500 and 1600° C. in the kiln necessitates the provision of refractories that are not available to-day. Many heat economy projects for Portland cement kilns have been abandoned by reason of the impossibility of procuring refractories of sufficiently high resistance. None the less, research in this field is very progressive, and new refractories of one sort or another are almost a daily occurrence, and it is not too much to hope that the near future will see the production of a refractory of high resistance, strong and free from cracking troubles, at an economical figure. A high grade silica brick is already being used in cement kilns in order to allow greater heat retention in the waste gases—passing to waste heat boilers—without risking damage to the kiln shell.

Supply and Cost of Raw Materials

If, then, it becomes possible to manufacture a cement demanding a very high sintering or melting heat in the rotary kiln, at an economical rate, the final determining factor in cost reduction will be the supply of suitable raw materials. Now, although bauxite is by no means so widely distributed in nature as are the clays and marls employed in ordinary cement manufacture, there are deposits which will furnish a suitable raw material for aluminate cement manufacture at a technically economic price. In the first place, a " standard " bauxite is not essential, and the high-grade bauxites used in the production of aluminium or aluminium salts are not essential for making aluminate cement. Siliceous and ferrous impurities, even in relatively large amounts, do not render a bauxite unsuitable for the production of a rapidly hardening, high-strength cement. The known deposits in France, America, Canada, Germany, India, Australia, County Antrim, and other localities vary widely in composition, and there is little doubt that other sources are in existence. Even at present a high-grade French bauxite can be imported at approximately £2 per ton, a figure considerably in excess of that charged in the Portland cement industry for the necessary clay or marl, but one which would add relatively little to the final cost of a calcium aluminate cement.

It is unwise to discuss a cost figure in the abstract, but it is apparent that, broadly speaking, the raw materials—limestone and some form of bauxite—for calcium aluminate cement manufacture—should become available at prices allowing of the manufacture of such a cement at a figure not greatly in excess of that ruling now for ordinary Portland cement. The other factor—again admittedly indeterminate—is the manufacturing cost, dependent not upon the *amount* of heat required to burn the cement, but upon its *intensity*. The cheapest electrical energy is still costly in this application, and it will remain for the manufacturers of refractories to produce a high-grade kiln lining which will allow a high temperature to be attained within the kiln without rapid disintegration of the lining or damage to the kiln shell. Granted this development, the creation of the required temperature is relatively simple and cheap, and the way becomes open for the employment of the rotary kiln in the manufacture of "high temperature" cements.

Recovery of Waste Heat

Quite apart from, but pertinent to the manufacture of a highly aluminous cement, is the question of the recovery of "waste" heat. Of the heat generated by the hundred or so pounds of fuel used in the production of a barrel of cement—roughly three times the theoretical amount—a large proportion is ordinarily lost in the gases passing to the stack, whilst smaller amounts pass away by radiation from the kiln shell and from the discharged hot clinker. Within recent years a great advance has been made in the recovery and utilisation of this heat by means of waste heat boilers (in which steam is generated by the heat of the gases), by clinker coolers and shell linings which furnish preheated air for combustion of fuel in the kiln.

Waste-Heat Boilers

Since 1915, when the first attempt to recover heat from cement kiln gases was made at Louisville U.S.A., the installation of the so-called waste-heat boilers has progressed, so that in 1918 there were eight boilers in operation, whilst to-day there are over two dozen. The reports of their successful working have been vouched for by the U.S. Portland Cement Association, and there is little doubt that they will be rapidly adopted by most producers. It is calculated that the U.S. cement industry will be recovering the equivalent of two million tons of coal annually within five years by the use of waste heat boilers. A simple calculation will show that the heat carried by the escaping gases is more than is required to generate all the electrical power needed in a cement plant, including power for kiln, grinders, fans, conveyers, etc. In practice, this has been achieved more often than not, and in certain cases where this has not been realised, it is to be noted that abnormally low fuel consumption figures were being already registered. In the Louisville plant already mentioned, the average yearly fuel consumption in the boiler house fell from 91·7 to 40·2 lb. per barrel of cement produced in the kiln. Similarly, a German plant is generating 745 kg. of steam per ton of cement produced, a calculated theoretical figure of 800 kg. being almost reached, and all the power necessary for cement production is supplied indirectly from the kiln gases. The proved success of the waste heat boiler in general industry should help to induce all cement manufacturers to consider the installation of such aids to economical working. Thus, the Babcock Wilcox Co., in the United States, has erected boilers representing a total of over 150,000 rated boiler horse-power, of which 10 per cent. operate in conjunction with cement kilns. The largest application is in heat recovery from the open-hearth furnace, whilst heat is recovered from the waste gases from metal furnaces, gas benches, beehive coking-plants, glass tanks, stills, etc.

It is unnecessary to describe in detail the construction of the proved types of waste-heat boilers, and it will suffice to say that practically all the difficulties due to infiltration of air, resistance to gas flow, cleaning of boiler tubes, etc., have been successfully met. Dust is mechanically removed several times a day, and draught is well and uniformly maintained. Economy is effected by using the exhaust steam from the fan turbine to preheat the water passing to the boiler. The cost of an efficient waste-heat recovery apparatus is by no means inordinately high, and the depreciation and maintenance charges are very low. Indeed, it has been officially stated that several of the waste-heat boilers installed to recover heat from open-hearth furnace gases paid for themselves in two years. The heat recovery from cement kiln gases is no less profitable, and the comparatively high temperature of the gases from the "dry process" of cement manufacture renders highly efficient recovery relatively simple. Moreover, it is by no means impossible to recover heat at a profit from gases from "wet process" kilns, although it is admittedly easier to do so from the hotter gases from "dry process " kilns. In other words, the heat in gases at about 900° C. is more efficiently utilised than the same amount of heat in double the quantity of gases at, say, 500° C. Still, waste-heat recovery boilers are in successful and profitable operation with the entering hot gases at a temperature as low as 450° C.

Recovery of Radiated Heat

A rotary cement kiln, 200 ft. in length and 8 ft. in diameter, radiates from its surface in a year's operation an amount of heat equal to approximately 1250 tons of fuel. The recovery or retention of this wasted heat, however, is not simple. Ordinary insulation, for instance, by means of a silica brick lining between the usual firebrick lining and the outer shell may lead to a rapid disintegration of the firebrick lining, by reason of the greater heat in the kiln. The saving in fuel is lost many times over by the consequent cost of lining renewal. It has been shown possible, none the less, to insulate a portion of the kiln, and several American kilns are fitted with silica bricks between the shell and firebrick lining, for a portion of the length of the kiln, where heat intensity is not likely to be increased to a destructive level. More heat is retained in the apparatus as a whole, therefore, and provided waste heat is recovered from the gases, now hotter than ordinarily, a balance of profit can be obtained. Of a different character is the proposal to surround the kiln with an insulated housing through which cold air is drawn at a high velocity. The air becomes heated and is passed to the kiln, in which, therefore, a higher efficiency of fuel consumption is attained. Inspection windows are provided, and the interior of the housing being dark, "hot spots" in the kiln are more easily discovered.

In all such operations, however, it must be carefully considered whether the value of the heat recovered is not more than balanced by the cost of recovering it, namely, in power for air circulation, supervision, capital cost, depreciation, etc., and this is especially to be noticed when a clinker cooler is already supplying preheated air to the kiln. Nevertheless, by the installation of heat recovery devices, it is possible to increase the efficiency of fuel utilisation in cement burning to a figure easily double that now obtaining in general practice, say, about 33 per cent., and figures of coal consumption near the theoretical amount of about 30 lb. per barrel of cement burned are foreshadowed.

The question assumes another aspect, too, when the future is considered. A carborundum-like refractory, which will withstand higher temperatures than are in common use will be produced at a price allowing its use in kilns. It will then be possible to make high-melting cements in the rotary kiln and heat recovery in full measure will be necessary in order to attain the required temperature and to lower production costs of cement made from relatively dear raw materials (compared with ordinary Portland cement).

In conclusion, it must be stated that these developments, important as they are, do not by any means cover the field of progress in which the cement industry is expanding. Reference can only be made to the recovery of potash from cement kiln dust—a very profitable matter during times of potash shortage, the reduction of the amount of water in the " wet process " slurry by the addition of sodium carbonate in small amount, the control of draught, stack gases and temperature in the kiln, the investigations of the influence of the modulus of fineness or apparent specific gravity of cement, in addition to that of fine grinding, *per se*, upon the general properties of Portland cement, the investigations on integral waterproofing agents, inquiries into the optimum amounts of water, aggregate, etc., and into the best size of aggregate for concrete making, experiments upon the influence of salts, etc., upon the setting, hardening, disintegration, etc., of concrete, and to many other problems in the making, use, storage, handling and transport of cement. In connexion with researches of a nature more basic to the whole industry, we can only keep the parable of the grain of mustard seed in mind, and hope that a wise judgment will be in evidence.

RECENT PROGRESS IN THE TREATMENT OF TUBERCULOSIS

Serum and vaccine therapy have hitherto been disappointing in their results when applied to the cure or amelioration of tuberculosis and certain other diseases due to pathogenic organisms.

The trend of recent work has therefore been toward the development of antiseptics, with a powerful bactericidal action on the bacillus of tuberculosis, such as are described in the Annual Reports on the Progress of Applied Chemistry, Vol. VII.

Professor Dreyer of Oxford has, however, in the current number of the *Journal of Experimental Pathology*, reviewed the whole field of experience of vaccine and serum therapy and points out that, broadly speaking, success is obtained with bacteria which are non-acid-fast and Gram-negative, and failure with acid-fast and Gram-positive bacteria. This property of being acid-fast and Gram-positive is associated with the presence in the bacteria of fatty or lipoidal substances which prevent the particular dye, which has been used for staining, from being washed out either by 20 per cent. solutions of sulphuric or nitric acids (acid-fast) or by alcohol (Gram-positive).

In other words the failure of vaccines containing the dead bodies of acid-fast bacteria to produce an immunity response (development of antibodies) in an animal invaded by such bacteria, is probably due to the protection of the specific bacterial proteins introduced in the vaccine, by the lipoidal constituents.

Success might, therefore, be expected if vaccines could be prepared from acid-fast and Gram-positive bacteria, in which the specific bacterial proteins were liberated from their lipoidal constituents. Professor Dreyer has succeeded in accomplishing this by treatment of the acid-fast bacteria by strong formaldehyde solution followed by exhaustive extraction with acetone at 65° C. Such treatment applied to non-acid-fast and Gram-negative organisms, such as *B. typhosus*, did not destroy the well-known antigenic power (*i.e.*, the power of causing the production of antibodies when injected). When applied to the acid-fast and Gram-positive organism *B. tuberculosis* and others, it was found that the defatted bacteria were no longer acid-fast or Gram-positive and were digestible by trypsin. Most important of all they could act as antigens in the animal body, giving rise to an immunity response recognisable by various tests familiar to the bacteriologist under the terms bacteriolysins, complement-fixing substances, agglutinins and precipitins.

Experiments on rabbits and guinea-pigs suffering from tuberculosis with the defatted *B. tuberculosis* antigen brought about a definite improvement, with healing of the tuberculous lesions and restoration to more normal body weight. This justified the application of the antigen to human subjects. The results obtained at the London Hospital by Drs. Fildes and Western in the treatment of 60 cases were embodied in the statement: "Improvement has taken place in nearly all cases, and is in our opinion of an order which exceeds obviously that obtainable by any other form of treatment which is applicable to these conditions."

Time and concentrated experimental effort alone will reveal the full value of this antigen. The principles are widely applicable and Professor Dreyer records the preparation of similar antigens from *Staphylococci*, *Streptococci*, *B. diphtheriæ* and *B. anthracis*. One obvious development is the possible production of a tuberculosis antitoxin by injection of horses with the new antigen in a manner somewhat similar to the production of diphtheria antitoxin, the first great contribution of bacteriology to practical therapeutics.

Dr. O. L. Brady has been appointed Reader in Inorganic Chemistry in the University of London, University College, and the title of Emeritus Professor has been conferred on Dr. W. D. Halliburton, M.D., F.R.S., on his retirement from the Chair of Physiology at King's College, which he has held since 1890.

THE ALEMBIC CLUB

On the initiative of the late Prof. John Gibson, who was at the time chief assistant to Prof. Crum Brown in the Chemistry Department of the University of Edinburgh, the five assistants in that Department resolved, on October 29, 1889, to form a Club to which the above name was afterwards given. The objects of the Club, as detailed in the minutes of the meeting on November 19, 1889, at which a set of rules was adopted, were stated to be :—

1. To secure the better recognition of the University of Edinburgh as a School of Chemistry and a Centre of Chemical Research.
2. To encourage the study of the History and Literature of Chemistry, and to enable the members to keep abreast of the progress of the Science.
3. To promote, by individual and collective effort the professional advancement of the members.

The rules of the Club did not demand that members should possess only a single Christian name, but chance ordained that the five original members should be similarly gifted in this respect. In the order of their seniority in the University Department of Chemistry, the five were :—John Gibson, Leonard Dobbin, Hugh Marshall, James Walker, and Alexander Smith. By the unanimous vote of the members, the total membership was, on February 17, 1891, increased to six by the election of Ralph Stockman, in whose case the limitation to a single Christian name was, oddly enough, maintained.

By its rules the Club was to consist of Ordinary and of Corresponding Members—the former limited to seven, to be resident in or near Edinburgh and to become, automatically, Corresponding Members on ceasing to be so resident. The total membership was not to exceed thirteen. In actual fact it never exceeded the six already mentioned.

In an unostentatious manner the members at once set about carrying out the objects for which the Club was founded. For ten or twelve years, during session time, meetings were held once a month at the various ordinary members' houses, in rotation, at which summaries were given of important papers appearing in the current periodicals which each member had undertaken to watch and report upon ; or at which, if not present in person, communications were received from the (at first) sole Corresponding Member, Alexander Smith, who occupied successive teaching positions in the United States.

When teaching duties permitted, various lines of original investigation were taken up by members and papers from the University Laboratories were published from time to time in the Royal Society of Edinburgh, in the Chemical Society, and elsewhere.

In 1893 the Club began the publication of reprints and translations of papers of historical importance in chemistry, the first of these being, appropriately, Black's paper on *Magnesia Alba*, of which the substance had been embodied in a thesis presented by Black, in 1754, to the University of Edinburgh for the degree of M.D. Other important papers, extracts from books, and translations followed for a number of years. In this connexion a specially noteworthy point is the great interest which was taken in the English edition of Mayow's *Tractatus Quinque* by Prof. Crum Brown, who himself translated several of the shorter tracts and most laboriously revised a MS. translation of the longest one which had been prepared some time previously by a non-chemical student of Latin and required close comparison with the original and many alterations. Without this interest and the labour ungrudgingly expended in connexion with the translation, it is practically certain that an English Mayow could not have been included amongst the Club's publications. The primary object of the publication of these papers was to facilitate the work of students who desired to familiarise themselves with some of the classics of chemical discovery but for whom there was no easy access to the originals or no English version. Incidentally it was hoped that their publication would aid in encouraging students to cultivate the habit of consulting the original literature of chemistry. The gratifying measure of acceptance which the Club's " Reprints " met with at the hands of the authors of text-books as well as of teachers and students, both in Britain and in America, showed that these were appreciated in chemical circles generally and that they served to fill a place in University training in chemistry.

The activities of the Club have not been confined solely to the furtherance of the objects specified in its constitution, but have extended to certain social events. Once a year, during its earlier career, a summer afternoon run was made to some place of interest in the Edinburgh district, where a simple and quiet dinner was enjoyed ; whilst a more elaborate, but no less pleasant function, marked the promotion of a member to a Chair—occasions of which many happy memories remain.

In the course of time members got separated through obtaining appointments at various teaching centres, and the monthly meetings were no longer held ; but it was not till 1913 that the Club sustained its first loss of a member through the death of Hugh Marshall, who then occupied the Chair of Chemistry in University College, Dundee. Since that date, two other members have died—John Gibson, Professor of Chemistry in the Heriot-Watt College, Edinburgh, in 1914, and Alexander Smith, Professor of Chemistry in Columbia University, New York, in 1922 ; so that of the total membership only one-half now remains.

PERSONALIA

The Court of the Salters' Company has appointed Prof. A. Smithells to the Directorship of the Salters' Institute of Industrial Chemistry.

The following elections to Fellowships and renewals of Fellowships for the year 1923-24 are announced by the Trustees of the Ramsey Memorial Fellowship :—*British Fellowships* of £300 each to Dr. S. Coffey, A. F. Titley, B.Sc., and Dr. R. W. Lunt, M.Sc. (Renewals). *Glasgow Fellowships* of £300 to T. S. Stevens, B.Sc., and J. A. Muir. *Norwegian Fellowship* of 5400 kroner to Mr. G. Weidsmann (to work at Cambridge under Professor Gowland Hopkins). *French Scholarship* of £100, plus 14,000 francs, to Dr. H. Weiss (to work under Professor Sir W. Bragg at the Royal Institution). *Netherlands Fellowship* of £300 to Dr. J. Kalff, and a *Danish Fellowship* of £300 to Mr. K. Hjandahl (to work at Liverpool University). Appointments to the Canadian, Greek, Italian and Swedish Fellowships are to be announced shortly.

The following announcements of elections to Beit Memorial Fellowships for Medical Research are quoted from *Nature* :—Fourth-year Fellowship, Dr. K. H. Coward (Metabolism of Young Animals with special reference to Deficiency Diseases). Junior Fellowships : Dr. J. M. H. Campbell (Oxygen Consumption and Metabolism under Diseased Conditions) ; Mr. C. G. Lambie (Influence of Insulin upon Fat and Protein Metabolism) ; Mr. W. K. Slater (An Investigation of Cell-Mechanism) ; Mr. C. P. Stewart (Investigation of Thyroxin) ; Mr. H. J. Channon (The Study of Fundamental Dietary Factors in Nutrition) ; Mr. W. Smith and Mr. L. B. Winter (Investigation of the Metabolism of Carbohydrates); Mr. C. S. Hicks (The Biochemistry of Goitre).

* * *

We announce with regret the death of Mr. F. I. Scard, a well known sugar chemist. Mr. Scard was responsible for the adaption of phosphoric acid to the manufacture of Demerara sugar and the use of ammonium sulphate in the distilleries in British Guiana.

The death of Prof. E. Beckmann, on July 12, a few days after he had celebrated his 70th birthday, marks the passing of an outstanding figure among German chemists. A prolific worker, Beckmann will perhaps be remembered chiefly for his apparatus for the determination of molecular weights by the freezing-point method, employing his differential thermometer, for his sodium press and for the reaction bearing his name that has proved so valuable an aid to research in organic chemistry.

The death is reported of Prof. L. Vignon, honorary director of the School of Industrial Chemistry at Lyons, and a member of the Council of the Société de Chimie Industrielle. Prof. Vignon had carried out important investigations on cellulose esters and on silk.

ACADÉMIE DES SCIENCES

At the meeting held on July 9, Professor Vincent presented a note by Dr. Bazin, which was of great interest to chemotherapists, as the author has found that cancerous growths of animals can be transmitted to human beings and vice versa.

On July 16, Professor Urbain read two papers, one on "Nickel Complexes," and the other on "The Ionisation produced by Hydration of Sulphate of Quinine." Professor Urbain also communicated a paper by Monsieur P. Auge on β-rays, and Monsieur Haller presented an account of the meetings held at Strasburg to commemorate the two famous chemists, Charles Gerhardt and Adolphe Wurtz.

NEWS AND NOTES

UNITED STATES

The Universal Gas-mask

In Technical Paper 300, published by the United States Bureau of Mines, an account is given of a new mask of general utility for the chemical, metallurgical and related industries. Special masks have been developed for use against specific gases, but this mask is the first produced which may be used in carbon monoxide, ammonia and in many other poisonous atmospheres. The mask weighs about 8½ lb. Inspired air enters the canister at the bottom through a check valve and a wire dome supports the absorbents which, in 8 to 20 mesh sizes, are arranged as follows in order of position from the bottom upwards. *Dry, activated charcoal* (700 c.c.) to absorb organic vapours, followed by a filter of cotton wool between two light wire screens to remove suspensoids. *Caustic soda fused on granular pumice stone* (300 c.c.), to absorb acid gases and moisture, followed by another cotton wool filter, and a layer of *fused calcium chloride* (400 c.c.) to remove any further moisture. Above the calcium chloride is a wire screen followed by 500 c.c. of *hopcalite* (mixture of oxides of manganese, copper, and sometimes silver and cobalt) which catalyses the oxidation of carbon monoxide to dioxide. After another wire screen comes 700 c.c. of *silica gel* to remove ammonia and other organic vapours, and to prevent moisture reaching the hopcalite from above. A cotton wool filter holds the materials in place through pressure by a spring. Tests conducted on a large variety of gases show that the life of a mask approximates to 14 hours, but a period of 6 hours has been chosen as an arbitrary life, because of the inability of the wearer to detect the penetration of carbon monoxide. The mask, however, does not protect the wearer against methane, and cannot be used in atmospheres deficient in oxygen or those containing very high concentrations of toxic gases. In general the mask should not be used in toxic gases having a concentration of more than 1 or 2 per cent.

AUSTRALIA

Superphosphate Manufacture in Tasmania

After experiments extending for some years the Electrolytic Zinc Co. of Tasmania is about to undertake the manufacture of superphosphates in that State. Zinc concentrates carry between 25 to 35 per cent. of sulphur, which has to be eliminated by roasting before the zinc can be utilised. Until recently 40,000 to 50,000 tons of sulphur were used annually in Australia for the manufacture of sulphuric acid. The company has therefore decided to construct a sulphur works at Risdon to produce 45,000 t. per annum and to duplicate the works which has been operated successfully for some years in the north-west for the roasting of zinc concentrates for the production of sulphuric acid to be utilised in producing superphosphates and other fertilisers. The programme involves the treatment of 20,000 to 30,000 t. of zinc concentrates annually and the production of a similar quantity of sulphuric acid. It is estimated that the large plant required will cost between £200,000 to £250,000, and it is expected that within a short period over 30,000 t. per annum of superphosphates will be produced in Australia from Australian raw material.—(*Ind. Aust., May* 17, 1923.)

CANADA

New Felspar Deposit

A deposit of felspar containing a high percentage of potash has been discovered in Ontario five miles from Perth. The deposit consists of a dyke 1000 ft. long, 300 ft. wide, and 40 to 50 ft. high. It contains many thousands of tons of marketable felspar. Samples tested by a large manufacturer of insulators were reported to be satisfactory.—(*Chem. and Met. Eng., July* 9, 1923.)

GENERAL

Research on Industrial Fatigue

The third annual report of the Industrial Fatigue Research Board has recently been published by H.M. Stationery Office (price 2s.). In Part I of the Report, a general account is given of the organisation of the Board and of the investigations and researches conducted under its auspices, researches including such important subjects as productive efficiency in cotton-weaving; the construction of and ventilation of drying stoves in potters' shops; the effect of atmospheric conditions in the laundry industry, and an investigation relating to the glass industry. Part 2 of the report contains a number of personal contributions from investigators, which will be found of great interest. The report concludes with a list of 22 reports and other publications already issued under the auspices of the Medical Research Council.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for July* 19)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
British India	Steel (tender)	*
Canada	Hospital supplies	11603/E.D./C.C./2
Cuba	Paper	8355/F.L./M.C./2
Netherlands	Technical and surgical rubber goods	69
New Zealand	Steel (tender)	11690/E.D./E.C./2
Norway	Asbestos, linseed oil	70
,,	Agar-agar	73
Panama	Paper	91
Siam	Steel (tender)	10957/F.E./E.C./2
Switzerland	Chamois leather	19073/F.W./M.C./2
United States	Coal - tar products, chemicals	83
,,	Shellac, varnish gums	86
,,	Linseed and rapeseed oil	20066/F.W./C.C./2

* Director-General, India Store Department, Branch No. 10, Belvedere Road, London, S.E. 1.

TARIFF CUSTOMS EXCISE

Egypt.—Revised valuations have been made for use in assessing the duties leviable on non-ferrous metals.

Latvia.—The export duty on iron and steel scrap has been increased.

New Zealand.—Notice is given of the customs treatment of German, Austrian and Hungarian goods, including paper, iron tubes, rubber tyres, glass, perfumery and metals.

South Africa.—Additions have been made to the list of goods which are duty-free when grown, produced or manufactured in the United Kingdom, but which are otherwise dutiable at 3 per cent. *ad valorem*. Among these are oxalic acid, ammonium oxalate, leather, lead pigments, potassium and sodium metabisulphite, and other chemicals.

United Kingdom-Czechoslovakia.—A Treaty of Commerce between the United Kingdom and Czechoslovakia which was signed in London on July 14, is given in the issue of July 19. The treaty will come into force provisionally on September 1, pending the exchange of ratifications. It includes eleven articles and a list of goods is given, quantities of which will be admitted annually into Czechoslovakia. The list includes artificial silk, essential oils, rubber and leather goods, soap, perfumery, asbestos, coal-tar dyes, chemicals, paint and varnish, fertilisers, metal wares, paper, and lubricating oils.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Patents

Lieut.-Colonel Buckley, replying to Colonel Newman, said that the Government was in communication with the Irish Free State as to the course to be adopted by the latter as regards the granting of patents in future. In the meantime, as far as he was aware, the position of licensees under patents granted with validity throughout the United Kingdom has not been affected.—(July 5.)

Importation of Rubber Tyres

The Prime Minister, replying to various questions, said that he was aware of the enormous increase in the importation of motor tyres into this country and of the effect that it would have on the important British rubber industry. The questions would receive careful consideration by the Government.—(July 18, 19.)

Reparation Levy on Scientific Publications

In answer to Mr. Gray, Sir W. Joynson-Hicks said that any publication in the German language which was a periodical publication of a German learned society or other scientific or philosophical periodical publication was exempt from the provisions of the German Reparation (Recovery) Act, 1921.—(July 19.)

Sugar

Sir P. Lloyd-Greame, answering Mr. Barnes (who had asked whether he was aware that quantities of refined sugar imported into this country from the United States had had to be reshipped owing to the lack of market here), said that the quantity of refined sugar imported into England from the United States, and which had been reconsigned to that country during the first six months of the current year, was only about 100 tons.—(July 17.)

Australian Zinc Concentrates

Answering Mr. Collison, Sir P. Lloyd-Greame said he was not aware of any Australian lead contract. With regard to the Government contract for the purchase of zinc concentrates, pages 209 to 213 of House of Commons Paper, No. 92 of 1923, contained the information asked for. It was impossible to say what would be the results of the contract, which must depend upon the price of spelter.—(July 17.)

COMPANY NEWS

MOND NICKEL CO., LTD.

At the ninth annual general meeting, held on July 19 in London, Sir A. Mond, who presided, said that the demand for nickel, which had been very small, improved considerably during the last year. This improvement was being maintained, and both turnover and deliveries were satisfactory. Production had increased, but prices, owing to unrestrained competition, had been lower than at almost any other period of the industry and thus counteracted to some extent the benefits due to the larger sale and production. The extent of the recovery was shown by the fact that the credit balance in 1923 was £307,000, compared with £299,000 in 1922 and £222,000 in 1921. Before the war about half of the company's output of nickel was used for making armament steel, the remainder being used in manufacturing non-ferrous alloys and pure nickel articles. During 1922, only 12½ per cent. of the output went to steel makers, the remainder being consumed for the other purposes named. The large development of the nickel-copper, nickel-chrome and similar non-ferrous alloys and the greater use of pure nickel goods had saved the situation. Nickel was being increasingly used for coinage, and Messrs. Sankey and Co. had taken up the manufacture of nickel cooking-utensils from nickel sheets rolled by the company's subsidiary, Henry Wiggin and Co., Ltd., Birmingham. Whereas solid nickelware cost more originally, it lasted for ever, required no repairs and had great hygienic advantages. Further outlets were being found in the motor-car industry and in the resistance wires used for electric heaters. Messrs. Henry Wiggin and Co. were putting out a new nickel alloy called "Corronil," which was highly resistant to corrosion. This new alloy was being manufactured in the United States by a company at Clarefield, Pennsylvania, in which the company had a large interest. The future in the United States was very promising and a distinct development was the use by the Westinghouse Company of malleable bar nickel for turbine blades. America was the largest market for nickel in the world to-day, and the company had accordingly increased its investment in the American Nickel Corporation. The position and future of the mines and other plant were satisfactory and all operations were carried out smoothly and efficiently both in Canada and at the refining works in South Wales.

It was decided that a dividend be declared of 7 per cent. for the year ended April 30 (including the interim dividend paid on March 23, 1923) to the holders of the 500,000 cumulative preference shares and the 2,000,000 non-cumulative preference shares of £1 each, numbered 1 to 2,500,000.

REVIEWS

Textile Chemistry: An Introduction to the Chemistry of the Cotton Industry. *By* F. J. Cooper. *Pp. ix*+235. *London: Methuen and Co., Ltd.*, 1923. *Price* 10*s.* 6*d.*

The book is specially designed for students preparing for examinations, and is the result of long experience in training such students. It contains chapters on chemistry, textile fibres, machinery, sizing, dyeing, bleaching, mercerising, etc., and the only justification for treating such a variety of subjects in one volume is that the book is designed to prepare students to cover the syllabuses of examination boards. But beyond this use it can be commended to all students engaged in the cotton industry particularly if it is a means of urging those students to take up the study of chemistry more deeply.

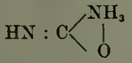
The part dealing with pure chemistry contains a large number of diagrams which are exceedingly well done, and instruction is given in the art of making sketches of apparatus. This training should be very useful to students engaged in industry.

The chapters on bleaching and mercerising are poor and should be rewritten for subsequent editions. After cotton cloth is treated with bleaching powder solution it is well washed and then immersed in acid. Acid is not used "to liberate chlorine," for the good bleacher avoids this liberation at all times. Then Mercer did not discover the lustring of cotton by caustic soda. He noticed the shrinkage of the cotton, but Lowe discovered the lustring, and on the latter discovery present day mercerising is based. The work of Gladstone on the action of caustic soda on cotton is not of sufficient interest nowadays to justify its inclusion in an elementary text-book.

S. H. Higgins

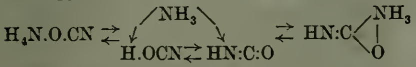
The Chemistry of Urea. *The theory of its constitution, and of the origin and mode of its formation in living organisms. By* Emil A. Werner, M.A., Sc.D., F.I.C. *Monographs on Biochemistry. Pp. xii*+212. *London: Longmans Green and Co.*, 1923. *Price* 14*s. net.*

With this book the series of Monographs on Biochemistry, which have now been edited by Professors Plimmer and Hopkins for well over a decade, reaches the very acme of specialisation. More than half of the book is devoted to disproving the generally accepted constitution of one of the simplest of carbon compounds, one of the few compounds of which every medical student can write the structural formula, or, as it now appears, wrongly imagines he can. The book also constitutes a severe indictment of successive editors of the Chemical Society's *Journal*, who have prevented chemists, at least organic chemists, from writing "urea," and insisted on the use of the term "carbamide." For lo ! urea is not at all the amide it was supposed to be, but a substance with a cyclic formula and a quinquevalent nitrogen atom :



Another unsuspected consequence of this is that the new Beilstein is wrong in dealing with urea in Vol. III. ; it should have been deferred to a much later volume !

The author begins with the discovery of urea just 150 years ago, and has tried to include every reference to theoretical and experimental work which has contributed to the chemistry of urea proper. Wöhler's synthesis, of course, figures largely, and the author is particularly concerned with the mechanism of the change. He suggested in 1913 the following scheme :



The various reactions and other syntheses of the compound are then considered in relation to this new formula. The obvious objection that only one monomethyl urea is known is countered by the suggestion that the other form is so unstable that it has not yet been isolated. Its isolation would indeed be a powerful argument for Prof. Werner's formula ; one interesting result of this formula is the light it throws on the action of urease. Some results by W. R. Fearon are quoted (since published in the *Biochemical Journal*), which include the observation that cyanic acid and biuret are formed, and seem to explain why the urease action is not reversible.

The monographs on biochemistry are presumably intended for biochemists, and after being taken through rather more organic chemistry than they are used to, including electronic formulæ with positive and negative radicles, they will turn, perhaps with some feeling of relief, to a chapter on the occurrence of urea in nature and the formation of urea in animal metabolism. In it they will find much food for thought ; but in the next chapter they will have to leave living organisms again and consider Langmuir's application of the octet theory to ammonium salts, and will find nothing further of specifically biochemical interest until they reach an appendix dealing with methods for the detection and estimation of urea, where the urease and xanthhydrol methods together occupy slightly more than two pages. Industrial chemists will find a few pages on the large-scale synthesis of urea as a fertiliser, and will have to take account of the author's theories in further work on the subject. Teachers will welcome the description of some fifteen lecture experiments, mostly in support of the author's views.

A bibliography is one of the features of the biochemical monographs. In the book under review it is of moderate dimensions and arranged chronologically. The price of the book is 14s. net. That of Dakin's *Oxidations and Reductions in the Animal Body*, of nearly the same size, recently reviewed in these columns, is 6s. net. The one was printed in Britain, the other in Germany. An impecunious student will be able to buy much more biochemical information in the cheaper book. However, the editors and publishers of the series have shown that they know their business, and doubtless *The Chemistry of Urea* will sell sufficiently in spite of its price.

In his preface the author says that he has aimed at writing for the laboratory as well as for the study ; it is, however, to a place in the latter that his book can best lay claim. The practical information seems to be subsidiary ; apart from the lecture experiments, the matter is readily accessible elsewhere. In its theoretical part the book is less of a compilation, and more concerned with the author's own work and views than most other monographs. Herein lies its chief value : as a challenge to current ideas, as a stimulus to further work. As such the reviewer welcomes it and as such he wishes it well.

GEORGE BARGER

ÜBER NATURPRODUKTE. *Chemische Abhandlungen zur Kenntniss und Verwertung Verschiedener Naturprodukte. Volume to commemorate the 70th birthday of* PROF. MAX HÖNIG. *Pp.* 180. *Dresden ; Th. Steinkopff*, 1923. *Price* $1·10.

This volume contains 24 short dissertations by well-known chemists, in most cases a summary of results of recent research work upon particular subjects, such as "Cellulose," C. F. Cross ; "Lignin, Vakuumdestillation," F. Fischer, H. Tröpsch and W. Krönig ; "Synthetische Versuche (Constitution)," P. Klason ; "Salzsäurelignin," E. Hägglund ; "Pentosangehalt," K. Kürschner ; "Huminsäure," W. Fuchs and P. Stamberger ; "Inulin," H. Pringsheim ; "Stärke" (quantitative Bestimmung), F. Tempus.

In addition to these, there are papers on technical subjects such as industrial water supply, sugar refining, sulphite by-products (lignon sulphonates) in the tanning industry, fertilisers and field experiments, and lastly a paper by C. Frenzel and E. Klarmann, "Die Röntgenstrahlen in ihre Anwendung in Chemie und Technik."

The volume is worthy of note for these special contributions, but particularly as a tribute to Max Hönig and his long life of devotion to industrial chemistry, marked by many successful applications of the results of systematic research to technical progress. The volume is prefaced with a list of more than 50 of Hönig's original papers ; these, with a photograph of the Professor, complete a worthy memento of his life's work.

C. F. CROSS

MANUFACTURE OF CHROME LEATHER. *By* M. C. LAMB, F.C.S. *Pp.* 420. *London: The Anglo-American Technical Co., Ltd,* 1923. *Price* 26*s*.

When Professor Procter published his first edition of *Principles of Leather Manufacture* in 1903, it was his intention to publish another work on methods of leather manufacture. He did not find an opportunity of so doing, but one of his students, H. G. Bennett, published a similar work which included most of the vegetable-tanning processes. Very little information was given in either of the above-mentioned works on chrome tanning, which has developed very considerably since the commencement of the present century.

There was a great scarcity of technical literature prior to 1914 on the subject, and no information of an authoritative nature. In that year J. Jettmar published his second edition of *Chromgerbung*, a German work on chrome tanning, which dealt comprehensively and thoroughly with the historical, theoretical and practical aspects of the subject. No translation of this work has been published, although several private translations are in existence. The war broke out, and chrome-tanned leathers, which had hitherto been imported almost entirely, had to be manufactured at home. The dearth of technical literature was felt most keenly, and there was a great demand for any information which could be obtained on the subject. The United Tanners' Federation and the Federation of Curriers, Light Leather Tanners and Dressers took up the question and purchased one of the translations of Jettmar's book immediately after the war. As they were advised that the book was slightly out of date, it was never published, so Mr. Lamb was requested to write a book on this most important subject and thus fill one of the widest gaps in English technical literature to-day.

The present work is the result and is an attempt to combine the theoretical principles underlying chrome tanning with the particulars of some up-to-date practical processes of manufacture. Mr. Lamb claims to be one of the earlier pioneers of the manufacture of chrome leather, having tanned leather by the chrome process so far back as 1895. Since that time he has acted as technical adviser to many of the more important manufacturers engaged in that particular branch of the trade. This work provides the first authoritative information which has been published in England. Mr. Lamb is one of the leading authorities on this subject, and his views will not only be highly respected but will carry great weight.

The information is conveyed in a very easy style, so that not only educated readers may understand it but practical workmen may also grasp its import. The result of this attempt has been very successful, but to the scientific reader there is always a loss. Practical readers will find a good deal of useful information. In turn the processes are all explained as simply and fully as possible, and there is an entire freedom from complex chemical or technical jargon. A series of special chapters is devoted to individual types of chrome leather—*e.g.*, chrome sole, upholstery leathers, box and willow calf and sides, suede calf, suede sheep, glazed kid and patent leathers. Useful appendices are provided giving tables of specific gravities of solutions of various chemicals employed in chrome-leather manufacture, and also a list of dyes particularly suitable for the dyeing of chrome leather. Mr. Lamb is to be congratulated on having made such a valuable contribution to the library of technical works and on having condensed so much valuable information into such a conveniently-sized volume. All interested in the manufacture of chrome leather will be able to glean some fresh information from this work, and it will prove to be a standard work of reference on this subject in both England and America.

D. WOODROFFE

LA TECHNICQUE INDUSTRIELLE DES PARFUMS SYNTHETIQUES. *By* RENÉ SORNET. *Pp.* *x*+135. *Paris: Gauthier-Villars et Cie*, 1923. *Price, paper,* 10 *francs.*

This brochure is one of considerable interest and value to the perfume chemist in particular, and to all interested in the technology of synthetic methods in general. For the chemist who is actually in charge of synthetic manufacturing it will scarcely contain anything new, but even to him it will be a useful *aide-memoire.*

The book is systematised according to the chemical characters of the bodies dealt with, and not in odour classes. Alcohols, Aldehydes, Ketones, Esters, and Bodies of Various Constitutions form the five chapters of the book. The principal substances in each category which are actually manufactured on a commercial scale are alone dealt with. For example, under alcohols we find benzyl alcohol, cinnamic alcohol, phenyl-ethyl alcohol, terpineol and farnesol.

One of the most interesting chapters is that on aldehydes, particularly the preparation of the higher alcohols of the fatty series. This particular group of bodies has come into considerable prominence during the past few years. They possess a most powerful odour and flavour, and unless used in minute amount they absolutely ruin any preparation in which they are used. But when used in very minute amount they impart a distinctiveness to the preparation which renders them absolutely necessary to the up-to-date perfumer and essence maker. Very full and accurate details are given of the manufacture of these aldehydes up to the twelve carbon compounds. There are, however, higher aldehydes than these which have immense value to the essence maker. Amongst the general bodies dealt with, the artificial musks are thoroughly dealt with, as well as such out-of-the-way, but useful, compounds as indol and skatol.

As a short summary of the manufacturing methods employed in the commercial preparation of a very important and interesting group of compounds, the trade in which is rapidly increasing, this little work is to be commended, and any faults are merely those of omission, which the size of the volume renders necessary.

Ernest J. Parry

Gesammelte Abhandlungen. *By* Dr. F. Kehrmann. Vol. II. Part I. Untersuchungen über Hydrochinone und Chinone. Part II. Untersuchungen über Azine und Azoniumverbingdungen. *Pp. viii*+194. *Leipzig: G. Thieme*, 1923. *Price paper*, 8*s*.

This is a companion volume to the one already reviewed in *Chemistry and Industry* (p. 133), and contains reprints of over 100 investigations, embracing a great variety of topics, by Prof. Kehrmann of the University of Lausanne and his collaborators. It is divided into two sections; the first deals with derivatives of quinols and quinones, and the second, which may be regarded as a development of the first, with azine and azonium compounds. These two groups of researches have been carried on simultaneously, during the period 1888 to 1921. It is interesting to learn from the preface that Kehrmann was attracted to the study of quinones and the closely related azine colours by the influence of his teacher, Rudolf Nietzki, who contributed so much to the elucidation of the relation between colour and constitution.

In looking through this substantial volume of researches one is struck by the amount of capable help which Kehrmann was able to command during these busy 30 years, for the number of his collaborators almost equals that of his researches. It would be interesting to know the conditions which enable so much competent assistance to be obtained; for the duties of the professor in a modern English university render such assistance imperative (if much research is to be accomplished), and often difficult to obtain for want of necessary funds. It is impossible to discuss the contents of this volume in anything like an adequate fashion and it will not be attempted. The volume covers a great variety of inquiries, the most important of which are probably those in the second section relating to the preparation and constitution of the eurhodines, indulines, rosindulines, safranines, etc. By a process of synthesis in which ortho-diamines are condensed with a variety of ketones the constitution of the products is made clear, and new methods of obtaining these colouring matters introduced. Much of the work follows the line of investigation which has been pursued with equal success by O. Fischer and Hepp.

J. B. Cohen

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The market continues to be depressed with little business moving. There is no evidence yet of an early return to normal conditions. Prices, however, are well maintained and there are no important changes to report.

Acetic Acid, 40% tech...	£24 per ton. Still firm, but rather less inquiry.
Acid Hydrochloric ..	3s. 6d. - 5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw. ..	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d. - £8 per ton. Demand steady, export inquiry good.
Arsenic (White) ..	About £71 per ton.
Bleaching Powder ..	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Business much below normal.
Bisulphite of Lime ..	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride ..	£5 17s. 6d. per ton d/d. In slightly better demand.
Copper Sulphate ..	£27 per ton.
Potash Caustic	£33 - £34 per ton. Little moving.
Potass. Bichromate ..	5¾d.-6d. per lb. d/d.
Potass. Chlorate ..	3d. per lb. Very dull.
Salammoniac	£32 per ton d/d.
Salt Cake	Home £4 10s. per ton d/d.; Export £5 5s. per ton f.o.b. Export inquiries good with small supply.
Soda Caustic 76% ..	£20 - £21 per ton. Steady demand.
Soda Crystals	£5 5s. - £5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98% ..	£26 per ton. Very scarce for spot delivery.
Sod. Bicarbonate ..	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	2¾d.-3d. per lb. Very dull.
Sod. Nitrate refd. 96%..	£13 5s.-£13 10s. per ton ex Liverpool. Steady demand.

Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	£15-£16 per ton carr. paid. Very quiet. Prices unstable.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7¾d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8¾d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25-£29 per ton according to quantity.
Carbon Black	1s. 1½d.-1s. 3d. per lb. Ample supplies now coming forward.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

There is still a ready market for wood distillation products.

Acetate of Lime—	
Brown	£11 per ton and upwards. Price very firm and demand keen.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8 5s. to £10 15s. per ton, according to locality of market and type of charcoal.
Iron Liquor	1s. 5d. per gall. 32° Tw. Some sales effected at 1s. 7d.
	1s. 2s. per gall. 24° Tw.
Red Liquor	1s. 3d. „ „ 14/15° Tw.
Wood Creosote	2s. 7d. „ „ Unrefined.
Wood Naphtha—	
Miscible	6s. 8d. „ „ 60% O.P. Firm.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5-£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d.-1s. 2½d. per lb. Fair demand.
Crude 60's	3s.-3s. 2d. per gall. Market quiet and uncertain.
Acid Cresylic—97/99	2s.-2s. 5d. per gall. Steady demand.
Pale 95%	1s. 10d.-2s. 4d. per gall.
Dark	1s. 9d.-2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	8¾d.-11d. per gall. Supply short. Plenty of inquiries.
Unstrained	8¾d.-9d. per gall.
Benzole—	
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.
Pure	2s. 1½d.-2s. 2d. per gall.
Toluole—90%	1s. 8d.-2s. per gall. Not many inquiries.
Pure	2s.-2s. 4d. per gall. Not much inquiry.
Xylol	2s. 3d. - 3s. 3d. per gall., according to quality.
Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil	8½d.-10d. per gall. Market steady. Good demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.-9d. per gall.
Solvent 90/160	1s. 5d. - 1s. 7d. per gall. Prices slightly weaker.
Solvent 90/190	1s. 4d. - 1s. 7½d. per gall. Very low prices being quoted.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Very little business passing.
Whizzed or hot pressed	£11-£13 10s. per ton. More inquiries.
Naphthalene—	
Crystals	£21 per ton.
Flaked	£17 10s. per ton
Pitch, medium soft	135s.-145s. per ton. Autumn delivery. Market steady.
Pyridine—90/140	18s. per gall. Demand good.
Heavy	8s. - 9s. per gall. Price nominal.

INTERMEDIATES AND DYES

Depression in the textile trade continues, but business in dyestuffs has improved slightly during the week.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 8d.-1s. 9d. per lb. Better demand at reduced prices.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	5s. 3d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Quiet.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb. Fair demand.
p-Cresol 32/24° C.	2s. 1d.-2s. 3d. per lb. Fair demand.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.

p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market remains exceptionally dull and orders continue to be very scarce.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. per lb. for cwt. lots. Market weak.
Acid, Benzoic	2s. 6d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8d. per lb., less 5%. Demand improved.
Acid, Gallic	3s. per lb. Down to 2s. 11d. for large quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d.-2s. 3d. per lb. Limited demand.
Acid, Tannic	3s. 3d. per lb.
Acid, Tartaric	1s. 3½d. per lb., less 5%. Demand improved.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 6d. per lb. wanted for good quality.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz.
Barbitone	21s. per lb. Supplies are short, but in absence of demand price remains unchanged.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Position unchanged. Prices vary according to quantity and source. Market for foreign rather weaker.
Calcium Lactate	2s. 6d. per lb. for best makes. Better demand.
Chloral Hydrate	3s. 9d. per lb., duty paid
Chloroform	2s. 2d. per lb. for cwt. lots. Very dull.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	£96 per ton. Quiet.
Guiacol Carbonate	8s. 6d. per lb. Neglected.
Hexamine	3s. 9d. per lb. In fair supply on a quiet market.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots.
Magnesium Carbonate—	
Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	70s.-80s. per cwt., according to quality and quantity.
Menthol	40s. per lb. spot.
Methyl Salicylate	2s. 4d. per lb. for carboys.
Methyl Sulphonal	15s. per lb.
Morphine	Alkaloid—Cryst. 10s. 11d., Precip. 10s. 8d., Acetate 8s. 6d., Hydrochlor. 8s. 6d. Sulphate 8s. 6d. per oz.
Paraformaldehyde	3s. 9d. per lb. Lifeless.
Paraldehyde	1s. 5d. per lb. Cheaper, with poor demand.
Phenacetin	6s. 6d. per lb.
Phenazone	7s. per lb.
Phenolphthalein	6s. 6d. per lb. Considerably firmer.
Potass. Bitartrate—99/100% (Cream of Tartar)	94s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d. per lb. Good demand. Steady market.
Potass. Permanganate	10½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d. - 2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	5s. 6d. per lb.
Salol	2s. 9d. per lb.
Silver Proteinate	10s. 6d. per lb.
Sod. Benzoate	2s. 6d. per lb. Slow of sale.
Sod. Citrate, B.P.C. 1923	2s. 2d. per lb. for cwt. lots.
Sod. Hyposulphite—Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.-87s. 6d. per cwt. Fairly good demand. Expected to improve with continued warm weather.
Sod. Salicylate	Powder 2s. 6d. per lb., and Crystal at 2s. 7d. per lb. Market weaker.
Sod. Sulphite, anhydrous	£27 10s.-£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.
Thymol	15s. 6d. per lb. for cwt. lots of natural recryst.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d.	per lb.	
Aubepine	14s.	,, ,,	
Amyl Acetate	3s.	,, ,,	
Amyl Butyrate	7s. 3d.	,, ,,	
Amyl Salicylate	3s. 6d.	,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d.	,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s.	,, ,,	
Benzyl Alcohol free from Chlorine	3s.	,, ,,	
Benzaldehyde free from Chlorine	2s. 9d.	per lb.	
Benzyl Benzoate	3s. 3d.	,, ,,	
Cinnamic Aldehyde	18s. 6d.	,, ,,	Advanced.
Coumarin	18s. 6d.	,, ,,	
Citronellol	19s. 6d.	,, ,,	
Citral	9s. 6d.	,, ,,	
Ethyl Cinnamate	15s.	,, ,,	Cheaper.
Ethyl Phthalate	3s. 9d.	,, ,,	,,
Eugenol	11s.	,, ,,	
Geraniol (Palmarosa)	32s. 6d.	,, ,,	Advanced
Geraniol	5s. 6d.-12s. 6d.	per lb.	
Heliotropine	8s.	per lb.	
Iso Eugenol	16s. 6d.	per lb.	
Linalol ex Bois de Rose	21s.	,, ,,	
Linalyl Acetate	21s.	,, ,,	
Methyl Anthranilate	7s.	,, ,,	
Methyl Benzoate	8s. 6d.	,, ,,	
Musk Xylol	11s.	,, ,,	Dearer.
Phenyl Ethyl Acetate	10s.	,, ,,	
Phenyl Ethyl Alcohol	17s. 6d.	,, ,,	
Rhodinol	45s.	,, ,,	
Safrol	2s. 4d.	,, ,,	
Terpineol	3s. 1d.	,, ,,	
Vanillin	22s. 6d.-23s. 6d.	per lb.	Firm with steady demand.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d.	per lb.	
Anise Oil	2s.	,, ,,	
Bergamot Oil	12s. 6d.	,, ,,	spot.
Bourbon Geranium Oil	29s.	,, ,,	
Cananga Oil, Java	9s.	,, ,,	
Cinnamon Oil, Leaf	4¼d.	per oz.	
Cassia Oil 80/85%	11s. 6d.	per lb.	
Citronella Oil—			
Java 85/90%	4s. 2d.	,, ,,	
Ceylon	3s. 8d.	,, ,,	
Clove Oil	8s.-8s. 6d.	per lb.	
Eucalyptus Oil 70/75%	1s. 10d.	per lb.	
Lavender Oil, Mont Blanc 38/40%	13s.	,, ,,	
Lemon Oil	3s. 1d.	,, ,,	
Lemongrass Oil	2¾d.	per oz.	
Orange Oil, Sweet	13s. 7d.	per lb.	
Otto of Rose Oil—			
Anatolian	24s.	per oz.	
Bulgarian	30s.	per oz.	
Palma Rosa Oil	19s.	per lb.	
Peppermint Oil—			
English	80s.	,, ,,	
Wayne County	13s.	,, ,,	
Japanese	7s. 1½d.	,, ,,	Advanced.
Petitgrain Oil	7s. 3d.	,, ,,	

TRADE NOTES

German Trade and Industry in June

H.M. Commercial Secretary at Berlin reports that the further depreciation of the mark during June induced a strong revival of business in the textile, leather, paper, indiarubber, glass and building industries, and caused exceptional advances in prices, the resulting increases in wages amounting to roughly 60 per cent. Deliveries of coke remained steady in amount, but declined in quality, and production met only the immediate requirements of foundries and gas works. Strikes in the coal districts of Upper Silesia and Waldenburg affected production and the shortage of trucks further hampered delivery. The revival in the sales of potash which occurred during May continued throughout June, the works being in general fully employed; supplies of fuel were adequate, though the quality was unsatisfactory. The strong home demand for chemicals continued, and it was not always possible to carry out orders promptly. Employment in the rubber industry was good, as the home demand was lively and there was a considerable clearance of accumulated stocks.—(*Bd. of Tr. J., July* 19, 1923.)

Trade Information

The Taylor System of Colour Harmony.—We have received a pamphlet relating to the Taylor System of Colour Harmony, which is described as a method for combining colour harmonies with accuracy, ease, speed and certainty. By means of a chart, combinations of two to seven pure different colours can be rapidly selected, as many as 20,000 distinctive combinations being available. The chart, which appears extremely simple to operate, can be obtained from the Taylor System of Colour Harmony, Bedford Row Chambers, 42, Theobald's Road, London, W.C. 1. Pamphlets are supplied which indicate the wide range of applications of the system and explain it in detail.

PUBLICATIONS RECEIVED

LIGHT AND COLOUR. *By* R. A. HOUSTOUN, M.A., D.Sc. *Pp. xi*+179. *London: Longmans, Green and Co.*, 1923. *Price* 7*s.* 6*d.*

THE MINERAL INDUSTRY OF THE BRITISH EMPIRE AND FOREIGN COUNTRIES. COAL AND COKE AND BY-PRODUCTS. *Statistics* 1919–21. *Pp. v*+135. *Imperial Mineral Resources Bureau. H.M. Stationery Office*, 1923. *Price* 4*s.* 6*d.*

AUSKUNFTSBUCH FÜR DIE CHEMISCHE INDUSTRIE *By* H. BLÜCHER. *Vol. I. A—L. Pp. xvi*+840. *Vol. II. M—Z. Pp.* 841—1672. *Berlin: W. De Gruyter and Co.*, 1923. *Price* 11*s. each,* 22*s. the two volumes.*

MANUFACTURED GAS IN THE HOME. *By* S. S. WYER. *The Mineral Industries of the United States. Smithsonian Institution. United States National Museum. Bulletin No.* 102. *Part* 8. *Pp. iv*+24. *Washington: Government Printing Office*, 1923. *Price* 10 *cents.*

BERICHTE DER DEUTSCHEN CHEMISCHEN GESELLSCHAFT. SECHSUNDFÜNFZIGSTER JAHRGANG (1923). *No.* 7. *Pp. vi*+1503—1802. *Berlin: "Verlag Chemie," G.M.B.H.*, 1923.

JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

Official Organ of the Federal Council for Pure and Applied Chemistry

Vol. 42 NEW SERIES   LONDON, AUGUST 3, 1923   No. 31

EDITORIAL

IT gives us singular satisfaction to announce an event of some interest, which is besides not without some political significance. The Chemical Society has decided to publish regularly, in *Chemistry and Industry*, abstracts of the papers read before the Chemical Society and the discussions thereon instead of, as heretofore, including these in its Proceedings. These abstracts and reports of the discussions will be supervised by the Chemical Society, and will appear with that authority which such a course confers upon them. Chemists will accordingly be able to peruse in our pages prompt and accurate summaries of these important contributions. We wish to express to the Chemical Society our gratitude for this valuable support, as well as our thanks for the honour they have conferred upon us. Discussions, especially on somewhat controversial matters, are frequently of the utmost value; they bring out new points of view and call attention to facts and ideas which are sometimes half-forgotten or imperfectly interpreted. Some of the old controversial writings are capital reading; the dissertations of Bentley on the Epistles of Phalaris, of Porson on the Three Heavenly Witnesses, and the Provincial Letters of Pascal are as amusing as anyone could wish. Of each of these it might be truly said, "nor could his ink flow faster than his wit"; and in a science growing so rapidly as chemistry there are abundant opportunities for argument. "Where there is much desire to learn, there of necessity will be much arguing, much writing, many opinions; for opinion in good men is but knowledge in the making."

* * *

Glad as we are that our weekly journal of ephemeral matter is in the future to become a means for disseminating knowledge of such importance and permanence, we are perhaps even more impressed by the fact that the Chemical Society, the oldest Chemical Society in the world, and the Society of Chemical Industry, whose activities have hitherto been distinct from those of the senior Society, are now both working together in the publication of chemical information. Perhaps an editor has as good an opportunity as any one of realising the immense number of scientific journals which include chemistry in their scope. Not only in this country, but in other parts of the British Empire and in America, are many journals, some containing original chemical news, and almost all containing epitomes or abstracts of articles appearing in sundry weekly, monthly and quarterly publications. As for the foreign journals, their very names would tire our lazy pen. The system of collecting and distributing this branch of knowledge must be very complete, but to one who has not many occasions for making use of the system, it is not perfectly clear that all the abstracts of the same article are essential. The indexing and the documentation of a rapidly growing science are no doubt necessary; possibly the ideal state of affairs would be that for every country one organisation should ensure that one abstract—and one only—should be prepared of all the papers belonging to some science. Whether the wit of man can devise such an ideal condition we do not know. Perhaps national pride may insist, even then, that the abstracts required by the South of Ireland shall not be prepared by the same individuals who prepare them for Ulster; and that Canada, the United States and South Africa shall make use of separate organisations, each writing epitomes of the same article in the same language. It is, of course, the trifles which are of supreme importance in these things; the principles are so easily adjusted.

* * *

It may be objected that "gas" is an unsuitable subject for an "editorial." Be that as it may, the word represents an investment of many millions of pounds, it lies at the heart of many a domestic problem, and it has recently achieved notoriety as a method of self-destruction. And now no less a body than the Smithsonian Institution (United States National Museum) has published a brochure on "Manufactured Gas in the Home." A glance down the table of contents revealed a fascinating series of titles, just the things one wants to know, such as the effect of a training in home economics on gas consumption, the cost of cooking food with various fuels, the proper way to use gas, and the intriguing heading, "What must happen when gas is burned," followed by its corollary, "What *may* happen when gas is burned." Armed with the information that the gas used to cook a meal for five persons represents under 3 per cent. of the total cost, that the maximum temperature required by cooking operations is always below 500° F., and that "generally much more gas is used than is needed for various cooking operations," we obtained half-hearted permission to investigate the domestic laboratory of a friend. Quoting the brochure, we said :—"The heat that does useful work must not be merely delivered into the cooking vessel, but must actually penetrate and get into the food," and then put a series of questions, of which the following are typical :—"What kind of lagging do you prefer for gas ovens ?" What is your opinion of the relative thermal conductivity and resistance to organic matter of nickel and aluminium ? Discuss the merits of Prof. Bone's Radiophragm." After a withering request to speak plain English, we were asked to go. As we left we noticed the absence of thermometers, balances, racks, and other commonplaces of the chemical laboratory. Yet delicate operations such as the pasteurisation of milk, the preparation of colloidal pastes containing carbonates, organic acids, synthetic organic chemicals such as vanillin, etc., were carried on, apparently with success. Such success, it seems, that although the industrial case-hardening of steel requires close scientific control, yet case-hardening can be applied daily to food with unfailing ease and regularity by care-free empirics. It is a very serious problem, of immense importance to national health and economy, and it is at least paradoxical that a chemist who controls a plant turning out large quantities of a product 99·98 per cent. pure from materials of known composition, will attack his evening meal without the slightest thought of fuel economy, of purity of raw materials, of corrosion, or other problems that occupy him during the day. Such a state of biochemical knowledge is serious, and we hope that a day will come when Prof. Gowland Hopkins will have students who will investigate the heat treatment of viands or isolate the succulent principle of the prawn. Owing to the national habit of mind the problem is obscured by frivolous associations, but we are intensely serious in our hope that some of our chemists will be stimulated to investigate several of those unsolved problems that few are lucky enough to ignore.

THE EXISTENCE OF AMMONIUM HYDROXIDE IN SOLUTION

By Prof. R. M. CAVEN

In reply to Prof. Moore's second article on the Existence of Ammonium Hydroxide in Solution (*Chemistry and Industry*, 1923, p. 641), I wish first to deal with specific criticisms of my previous articles (*ibid*, 1923, pp. 164 and 448), and then to summarise the evidence and arguments upon the subject as they present themselves to me.

1. Prof. Moore seems to regard the temperatures of rapid loss of water by salts of the type $CuSO_4,M_2SO_4,6H_2O$ as evidence of equal value to the vapour pressures developed by these hexahydrates in equilibrium with the corresponding dihydrates. I can only say that the vapour pressures determined by Ferguson and myself represent a true equilibrium attained both in the course of raising the temperature and of lowering it, and that we have found by experience that unless care is taken to add some of the corresponding dihydrate before the experiment is commenced erratic results even for vapour pressures are obtained. There is no doubt that the order of alkali metals established by us, agreeing as it does with that discovered by Tutton for a different class of phenomena, represents truly the power of retaining water which the alkali metals, including the ammonium radicle, confer upon the copper sulphate in the double salt ; and so the only conclusion I can draw from the fact that as regards free loss of water the ammonium double salt is out of order is that this salt does not assume a metastable state when heated as some of the others seem to do. In this respect ammonium appears to precede instead of to follow rubidium in the series of alkali metals, but I do not know what significance to attach to so obscure a phenomenon.

2. Then, as regards the temperatures of rapid dehydration of the dihydrates, Prof. Moore seeks to show from our figures that the same order of alkali metals is not maintained in the affinity of the double salts for water. As I have already stated, his argument is vitiated by the fact that a true equilibrium is not established when a hydrated salt is heated in an open space or left in a vacuum over sulphuric acid. It does not follow, however, that the same order of alkali metals is to be expected here. In the double salts $CuSO_4$, M_2SO_4, $6H_2O$, which are derivatives of the extremely unstable $CuSO_4$, $7H_2O$, the function of the alkali metal indicated by vapour pressure is that of enabling the copper sulphate to retain a larger proportion of water than it could alone, as in the salt $CuSO_4$, $5H_2O$. This is not the case with the dihydrates $CuSO_4$, M_2SO_4, $2H_2O$, which are derivatives of stable $CuSO_4$, $3H_2O$. It may be, therefore, that different conditions obtain here ; but we must wait and see. In any case, I do not admit the propriety of drawing

general conclusions in anticipation of the facts.

3. When Prof. Moore cites phenomena of solubility to show that ammonium is out of order, he ventures on to treacherous ground; for anyone who tries to generalise from these phenomena will meet with what appear, from our limited knowledge, to be baffling inconsistencies. To show this, ammonium may be left out of account, and the salts of the alkali metals potassium, rubidium, and cæsium be considered. As regards the chlorides, the order of increasing solubility is K, Rb, Cs, whilst with the platinichlorides the reverse order Cs, Rb, K obtains; with the sulphates the order is again K, Rb, Cs, and with the alums the reverse order Cs, Rb, K. It seems, therefore, as if a generalisation might be made here as regards the reciprocal relations of single and complex or double salts; but on further examination this generalisation is upset, for the order of solubility of the nitrates is Cs, K, Rb, whilst the solubilities of the salts at present under consideration, viz. $CuSO_4$, M_2SO_4, $6H_2O$, determined by Locke (*Amer. Chem. J.* 1902, 27, 459) are as follows: I litre of water at 25° dissolves of the anhydrous salts:—

	K	Rb	Cs
Grams ..	116·9	102·8	460·0
Moles. ..	0·350	0·241	0·883

If, therefore, such inconsistencies are found with regard to the solubilities of salts of the alkali metals concerning whose electropositiveness there is no dispute, of what use are these phenomena in deciding the position of ammonium, or controverting conclusions drawn from other phenomena?

4. Now, with regard to the quotation from Holleman, I must confess that my critics, Mr. F. B. Finter and Dr. A. E. Clarence Smith, as well as Prof. Moore, are right; for Holleman errs in attributing strict neutrality to a solution of ammonium chloride. It is interesting and satisfactory to recognise, as Prof. Moore points out, that the degree of so-called hydrolysis of ammonium chloride is what might be expected from the low hydroxidion concentration of dilute ammonia solution. If, however, Prof. Moore will refer again to my first article in *Chemistry and Industry* (1923, p. 165, lower part of second column), he will find that the validity of my argument is not affected by the fact that ammonium salts develop acidity in solution; for the latter, as well as the basic weakness of ammonia solution, is attributable to the instability of NH_4, which breaks down in solution into neutral NH_3 and $H^{\cdot}$. I may, however, repeat that "this reaction is not really hydrolysis, since water does not act chemically on the salt," and also that the powerful electropositiveness of ammonium is not incompatible with its instability.

5. I now offer the following summary of the subject:—Suppose the salts of an unknown basic radicle are being examined. It is found that these salts closely resemble those of potassium, and particularly it is observed that the solid hydrogen-sulphate and hydrogen-carbonate of this radicle exist. Since it is only the strongest metals which form the latter salts it is concluded that the radicle forming them must, by reason of its basigenic strength, be placed among the alkali metals. Then it is observed that, according to the accumulated results of Tutton's measurements upon double hydrated salts in which this radicle occurs, supported by the measurements of vapour pressures by Caven and Ferguson, the unknown radicle takes a place in the series of the alkali metals near to rubidium.

If that were all the evidence the basigenic strength of the radicle would not be called in question. When, however, salts of the radicle are heated with aqueous alkali, ammonia gas is evolved, and the solution of this ammonia in water behaves as a feeble base. Moreover, not only is the hydroxidion concentration of dilute ammonia solution very small, but there is found to be present in the liquid, according to the experiments of Moore and Winmill, a large proportion of a compound having the empirical composition NH_5O, which is reasonably believed to be ionisable ammonium hydroxide. Thus, there seems good reason to account for the basic weakness of dilute ammonium solution; viz., ammonium hydroxide is a weak base which is very imperfectly ionised in aqueous solution.

It must be pointed out, however, that the physical measurements employed are necessarily static; *i.e.*, they reveal the state of the ammonia solution and not the potentiality of the compound NH_5O. Whether this compound is ionisable or not, whether it is NH_4OH or $NH_3.H_2O$ is not revealed. This fact is now admitted by Prof. Moore. Therefore, we are open to consider an alternative explanation of the alkalinity of ammonia solution; which is the explanation of Lowry that NH_3 and not NH_4OH is the base; that the course of reaction of NH_3 with water is:—

$$NH_3+H^{\cdot}+OH' \rightleftarrows NH_4^{\cdot}+OH'$$

and not $NH_3+H_2O \rightleftarrows NH_4OH \rightleftarrows NH_4^{\cdot}+OH'$;

to which, however, must be added the reaction established by Prof. Moore:

$$NH_3+H_2O \rightleftarrows NH_5O.$$

The reason why I prefer the view of Prof. Lowry to that of Prof. Moore is that, whilst it seems to account equally well for the properties of solutions of ammonia and of ammonium salts, it also accounts for the properties of solid salts containing ammonium, because it makes credible the belief that the radicle ammonium is strongly basigenic though somewhat unstable.

Finally, I submit that the view I have adopted, following Prof. Lowry, is simpler than that which assumes the formation and subsequent ionisation of ammonium hydroxide; and I suggest that if we began to theorise afresh upon this subject, free from the preconception of an alkali hydroxide as a compound whose atoms are united by chemical bonds of the old-fashioned kind, which somehow break asunder when the compound is dissolved in water, we should not create the fiction of an imperfectly ionised ammonium hydroxide to explain the properties of ammonia solution and ammonium salts; and this partly because the theory is inadequate, leaving the properties of solid ammonium salts unaccounted for, and partly because it is superfluous.

It is unscientific to harbour a theory which is superfluous as well as inadequate; and therefore this discussion leaves me convinced that the views set forth in my first article are substantially correct.

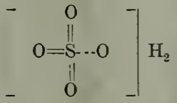
Royal Technical College,
Glasgow

OLD AND NEW THEORIES OF CO-ORDINATION

By Prof. T. MARTIN LOWRY, F.R.S.

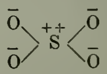
1. The appearance of an English translation of a post-war book on co-ordination* provides an opportunity of comparing the position of the theory as Werner bequeathed it to us, with the newer aspects which have been developed by Langmuir, Sidgwick and others on the basis of the electronic theory of valency. As regards the original theory of Werner, it is impossible to estimate too highly the value of his conceptions in clarifying a vast range of obscure phenomena. The successive step by which he established the octahedral configuration of the six co-ordinated groups, first by demonstrations of stereoisomerism, and then by the unshakeable evidence of optical activity, will always rank amongst the classics of chemical science. This impression of the masterly character of Werner's work is maintained on going through the theory as expounded by Professor Schwarz; but certain aspects of the theory are felt to be unsatisfactory in the light of the clearer views which are now available as to the nature of valency. Some of these are referred to in the following paragraphs.

2. The conception of auxiliary valency, which lies at the base of the whole theory of co-ordination, is too vague to bear strict criticism. In the earlier chapters of the book, the impression is obtained that these auxiliary valencies differ in character from the principal valencies, and one is led to anticipate that they will be definitely weaker. Thus, the author represents the combination of sulphur trioxide and water to form sulphuric acid by means of the formula



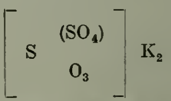
$$\left[\begin{array}{c} O \\ \| \\ O{=}S{\cdots}O \\ \| \\ O \end{array}\right]H_2$$

in which the first three oxygens are held to the sulphur by pairs of principal valencies, whilst the fourth is held only by a single auxiliary valency, represented by a series of dots. This discrimination between the four atoms of the sulphate ion is, however, entirely unjustified; and, indeed, in a later paragraph it is admitted that "no real difference between principal valencies and auxiliary valencies is found to exist in complex nuclei." The electronic formula for the sulphate ion which can be represented by the conventional formula



is free from this ambiguity.

3. A similar difficulty arises in reference to the acids, such as $H_2S_2O_7$, $H_2Cr_2O_7$, etc., which Professor Schwarz calls "isopolyacids." The idea of representing potassium pyrosulphate by the unsymmetrical formula



$$\left[\begin{array}{cc} & (SO_4) \\ S & \\ & O_3 \end{array}\right]K_2$$

is obviously without justification. The conventional formula $KO\cdot SO_2\cdot O\cdot SO_2\cdot OK$, which can readily be expressed in terms of electrons, is much more in accord with the origin and behaviour of the compound. Since each sulphur is still surrounded by four oxygen atoms, the conditions for co-ordination are satisfied, although one oxygen atom must belong to both co-ordination spheres, thus

$$\overbrace{K[O\cdot SO_2\cdot[O]}\underbrace{SO_2\cdot O]K}.$$

The polychromates and polysilicates can also be represented better by the traditional formulae than in terms of the co-ordination-theory, which contributes little or nothing to their elucidation. On the other hand, the 42 oxygen atoms which are characteristic of the phosphomolybdates and allied compounds, whether they contain 7, 8 or 9 ionisable hydrogen-atoms, find for the first time a clear interpretation in the theory of co-ordination.

4. Another point of ambiguity in the theory of co-ordination is in reference to the localisation of the electric charges on the complex ion. Prof. Schwarz writes the constitutional formula of potassium platinichloride as

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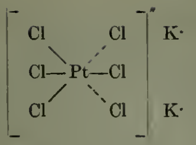
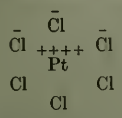
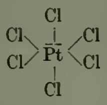
* *The Chemistry of the Inorganic Complex Compounds.* An Introduction to Werner's Co-ordination Theory. By Robert Schwarz. Authorised Translation by Lawrence W. Bass, Ph.D. Pp. x.+82. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1923. Price 8s. 6d. net.

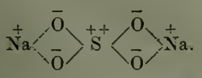


He assumes that four of the chlorine atoms are attached to platinum by principal valencies, and two by subsidiary valencies; and that since the principal valencies of the last two chlorine atoms are unsaturated, the two potassium atoms may attach themselves at these points. Here again the discrimination between principal and auxiliary valencies cannot be maintained; and a much clearer picture results from the view that the quadrivalent platinic ion begins by attracting to itself six chlorine ions as in I (compare this vol., p. 316), and then draws into its outer shell a pair of electrons from each chlorine ion giving rise to a covalent structure as in II (this vol., p. 412):

I


II


In this case, since the platinum (recalling the familiar definition of an island) is "entirely surrounded by chlorine" the orientation of the two potassium ions in the undissociated salt is probably determined by crystallographic considerations based upon the close-packing of ions. In the case of the sulphates, however, the metallic kations may well be associated definitely with the negatively-charged oxygens of the quadripolar ion, thus



5. Water of crystallisation is always a source of difficulty to the advocate of co-ordination, since the formation of hexahydrates is by no means universal. The suggestions (i) that the heptahydrates contain one unco-ordinated molecule of water, and (ii) that the alums contain co-ordinated double-molecules, H_4O_2, in a complex ion $[Al{\cdot}6H_4O_2]$, are too artificial to be accepted without further independent evidence in favour of these assumptions; but it is curious that no attempt is made to show some of the surplus molecules of water as associated with the sulphate ion, since the sulphates are practically unique in forming this particular series of hydrates. A clear distinction between crystalline hydrates and hydrated ions of sufficient stability to persist even in solution would be of value; but this will be much more difficult to realise than in the case of the ammines, since the experiments ought obviously to be made in some non-aqueous solvent, such as anhydrous liquid ammonia.

6. The distinction, made by Werner, between ionisable and non-ionisable valencies is unsatisfactory. In cases such as KCl, $BaCl_2$, etc., it is clear that "principal valencies" are ionisable; but it is equally clear that in CCl_4 they are not. The idea that "ionisable chlorine" means chlorine held by principal valencies is therefore incorrect; and the converse idea, that chlorine united directly to the metal is not ionisable, is scarcely tenable in the case of a salt such as KCl, which is an excellent electrolyte when merely melted. Sidgwick's view that non-ionisable complexes are held together by covalencies is much more satisfying, especially when combined with the further suggestion that the rupture of a weak covalency may at any moment convert it into an electrovalency. The idea that the ions of aqueous electrolytes are pushed apart and finally detached from one another by the intrusion of co-ordinated molecules of water may, however, be put forward as an interesting variant on the hydrate theory of ionisation (*Trans. Faraday Soc.*, 1905, 1, 197; 1907, 3, 132).

7. The translation has been done so well that the book bears no traces of its alien origin. It is issued in a very attractive form, and can be strongly recommended to students who wish to become acquainted with this most fascinating branch of chemistry.

THE NEW "KENNEDY" OIL METER

(From a Correspondent)

There has just been placed on the market by Messrs. Glenfield and Kennedy, Ltd., Kilmarnock, a new pressure meter for the measurement of oil, especially in connexion with oil tankers and oil storage plant generally. As is well known, Messrs. Glenfield and Kennedy for over fifty years past have supplied meters of every description for many kinds of liquid.

The new meter for measuring oil of almost any viscosity, is an adaptation of the "Kennedy" hot-water pressure meter, and is of the displacement type. It consists essentially of a vertical cast-iron measuring cylinder fitted with a metallic piston and cast-iron cover. Each complete stroke of the piston, actuated by the pressure of the oil from the pump used in causing oil to travel, corresponds to the displacement of a definite and measured volume of oil. The mechanism of the meter is double acting and automatically reversing, and each stroke of the piston is recorded in terms of gallons of oil by means of a train of wheels or a series of graduated dials.

The piston is of cast iron, with two special gunmetal piston rings, and the cylinder is machined out internally so as to give a smooth bore and form a perfectly tight joint. To the end of the piston rod, passing through a stuffing box in the cover, is attached a rack which engages in a pinion, and operates both the recording mechanism and also the reversing arrangement, which automatically ensures that the meter is double acting and the flow of oil is alternately under and over the piston, as required, at the end of the stroke. It should be noted that the measuring mechanism is continuous in action, that is to say, it does not measure merely the number of separate strokes of the piston, but the continuous travel, a much more accurate arrangement.

The meter is made in standard sizes of 3 in. to 8 in. bore. A 6 in. meter is a useful unit for oil tanker work, and handles normally 16,000 gallons of oil per hour, with an overload capacity of 25,000 gallons, and the net weight is 2966 lb. or 3080 lb. with packing, the latter being a case 60 in.+39 in.+$37\frac{1}{2}$ in. The meter is tested to 500 lb. pressure, and if provided with a gunmetal cylinder liner can also be used for hot water under pressure, or for liquids like petrol, benzol, and alcohol. The loss of pressure on the pump circuit is very small, and depends, of course, on the viscosity of the oil. When using water at 60° F. the loss caused by a 6 in. meter or the normal duty of 16,000 gallons per hour is only $2\frac{1}{2}$ lb. per square inch, and with an ordinary crude petroleum fuel oil at 60° F. the figure is about 8 lb. per square inch. Very thick viscous oils, almost like greases, can also be measured with perfect accuracy, provided the necessary extra power in the pump is available, equivalent to, say, 50-100 lb. per sq. in.

THE ARTIFICIAL SILK INDUSTRY

Reports from Lyons state that the brisk demand for artificial silk keeps the factories fully occupied, so that many cannot accept new orders until a certain period has elapsed. Statistics are appended showing the world production in 1922, according to an estimate prepared by the American Viscose Co., revised figures calculated by the *Bulletin des Soies et des Soieries*, of Lyons, on the basis of the daily output being given in parentheses :—

	Kg.	
United States ..	10,645,500	
England	6,949,020	(2,038,500)
Germany	5,700,552	(4,756,500)
Belgium	2,850,276	(3,397,500)
France	2,850,276	(4,077,000)
Italy	2,850,276	(2,718,000)
Holland	1,140,110	(543,600)
Switzerland	855,052	(2,718,000)
Hungary	855,082	
Austria	712,569	
Poland	427,541	(271,800)
Czechoslovakia ..	285,027	
	36,121,284	

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS

The Society of Chemical Industry has in each of the past two years held a dinner in London in the month of October, but for the present year arrangements have been made for an Informal Dinner and a Social Gathering of Chemists under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, which members of these, and of any other of the Chemical Societies, with their friends (including ladies) may attend.

This dinner will be held in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on the evening of Wednesday, October 31, at 7 for 7.30. The price of tickets for ladies or gentlemen will be 12s. 6d. each, not including wine.

Further particulars will be issued later, and the Councils hope that Members of the Societies mentioned, who intend to be present, will make early application for tickets, which must be limited to 300. These will be issued in the order in which applications accompanied by payment are received.

Applications should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2.

ADVANCE PROOFS OF PAPERS

Authors of papers which are to be read before local sections or groups, may in some cases desire to have a few advance proofs for distribution among those likely to make useful contributions to the discussion. Any author who requires such advance proofs is requested to hand the manuscript of his paper to the Local Secretary so that it may reach the Editor at least *one month* before the date of the meeting at which it is to be read, in order to allow sufficient time for it to be considered by the Publications Committee and, if approved, set up in type.

ANNUAL REPORTS

Vol. VII. is now ready and can be obtained by members at the price of 7s. 6d., post free, from the offices of the Society.

DEATH

Kuttroff, Fred (elected 1900), of 128, Duane Street. New York City, U.S.A., Merchant. On October 22, 1922.

SOCIETY OF GLASS TECHNOLOGY

During the visit of over 30 British members of the Society of Glass Technology and their friends to France during the first week of July, two meetings with French glass manufacturers were held on July 2. In the morning, the party was received by the Chambre Syndicale des Maîtres Verreries, and was welcomed by its president, Monsieur L. Houdaille, who said that French glass manufacturers were all united in one body—the Chambre Syndicale—which was divided into six sections representing various branches of the industry. These sections were organised in such a way as to prevent ruinous competition between members, whilst encouraging individual research and development. Monsieur L. Delloye spoke of the need for co-operation among manufacturers of different countries, and Prof. W. E. S. Turner, Col. S. C. Halse and Mr. E. A. Hailwood replied for the Society of Glass Technology.

In the afternoon (after a lunch at which visiting members were the guests of the Chambre Syndicale des Maîtres Verreries), a joint meeting was held with the Société des Ingénieurs Civils. In the absence of Monsieur Guillet, President of the Société des Ingénieurs Civils, Monsieur L. Delloye welcomed the visitors. The following papers were communicated :—(I) Prof. H. Le Chatelier : " La Méthode Scientifique dans L'Industrie." (II) Dr. A. Granger : " Les Verres Opaques et Colorées, et les Glaçures Céramiques de Même Espèce." (III) Mons. Lafon : " La Dilatation des Verres et Cristaux." (IV) Prof. W. E. S. Turner : " Specifications for Glass Products." (V) Mr. T. Teisen : " Improvements in the Design of Recuperative Glass Pot Furnaces." (VI) Mr. S. English and Prof. W. E. S. Turner : " The Physical Properties of Boric Oxide Glasses."

During the week visits were paid to the following glass works :—Etablissements Legras at St. Denis, Verreries de Reims (Messrs. Charbonneaux & Cie.), the plate-glass works at Chantereine, and the Glaceries de St. Gobain, Chauny and Cirey. Members took the opportunity when at Reims of visiting the battlefields in that district. A visit was also paid to the sand quarries at Nemours and to Fontainebleau. Amongst other social activities, a complimentary dinner was given by the visiting party to Monsieur L. Delloye, who had made all the arrangements in France. At Noyon the party was entertained to lunch by the directors of Les Glaceries de St. Gobain, Chauny and Cirey. A reception was also given to the visitors by Monsieur G. Despret (Administrateur des Verreries de Boussois), Paris, when an interesting exhibition of artistic glass was on view. It will be recalled that a party of members of the Society visited America in 1920, and owing to the success of both these visits it is proposed to arrange other tours as opportunity arises.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

The meeting held on June 27 by the Fuel Group was devoted to the presentation of a paper by Monsieur E. Audibert (director of the experimental station of the Central Committee of the French Coal Mines) on " Coal and the Liquid Fuel Problem."

After briefly sketching the history of the subject, the author showed that the consumption of petroleum followed a steep ascending curve. In 1922, out of a production of 120,000,000 metric tons of petroleum, the United States produced 68 per cent., Mexico 27 per cent., and Europe 7 per cent., but the United States, although the largest producer, was also the largest importer and consumer, its consumption having increased from 18,000,000 barrels in 1913 to 125,000,000 barrels in 1921. M. Audibert estimated the world's reserves of petroleum at roughly 10 milliard tons and suggested that all the petroleum would be exhausted in the year 2000, whereas the reserves of coal would probably last for 70 centuries. France possessed practically no petroleum and so had to import large quantities (725,000 m.t. in 1921). Consequently, close attention had been devoted to the synthesis of petroleum, starting from coal or other products, and to the use of alcohol as a national fuel.

In discussing the direct transformation of solid fuels into petroleum, the speaker recalled the process introduced 50 years ago by Berthelot, for hydrogenating many hydrocarbons and even coal, which gave yields of as much as 60 per cent. of petroleum. Recently, Bergius had re-examined the question, using hydrogen at 400° C. under a pressure of 40 to 200 atmospheres, and obtained a good yield from coal, provided that it contained less than 80 per cent. of carbon. Bergius was now working on a continuous process, in which coal dust was suspended in oil, and yields of 80 per cent. had been obtained from coal at the Kaiser Wilhelm Institute, using nascent hydrogen derived from the decomposition of sodium formate. The tars produced by the low-temperature distillation of coal could also be hydrogenated catalytically ; naphthalene could be transformed by the Sabatier process into tetralin or decalin ; and phenols could be converted into liquid fuels, such as cyclohexanol, etc. Tars produced by the high-temperature distillations of coal could also be hydrogenated, and methane from coke-oven gas could also serve as a source of alcohol or hydrocarbons.

Recent deaths in the United States include those of A. T. Beach, president of the Abbé Engineering Co., and of J. van Vorst Booraem, consulting engineer and sugar manufacturer.

CORRESPONDENCE

THE COMBUSTION OF NITROGEN UNDER HIGH PRESSURES

Sir,—Prof. Bone's contribution to the Royal Society in regard to his experiments on the "Influence of Nitrogen on Combustion of Carbon Monoxide" prompts me to refer to previous experiments which satisfactorily confirm Prof. Bone's conclusions in regard to the differences in the influence of hydrogen and carbon monoxide upon the combustion of nitrogen. I have already referred to these phenomena in 1912 (*Mitteilungen über Forschungsarbeiten*, 1913, *Heft* 133 *u. Zeitschrift des Ver. Deut. Ing.*, 1912, p. 1157) and subsequently in abstract form (this *J.*, 1922, 253 R). The tests showed, for example, that with mixtures of carbon monoxide and air the formation of nitrogen oxides was between 25 and nearly 100 per cent. greater than in the case of mixtures of coal gas and air, and this in spite of the fact that the relevant conditions, viz., explosion pressure, explosion temperature and nitrogen content were practically identical, and that the difference in the oxygen content was insufficient to explain the considerable difference in the formation of nitrogen oxides which resulted. The coal gas used contained approximately 48 per cent. of hydrogen. At that time (1912), I sought to find an explanation for this result in photochemical reactions occurring in the exploding gas mixture. Thus a striking relationship is observed between the duration of the maximum temperature and the quantity of nitrogen oxides formed, and this may be exemplified by the following figures, in which the nitric-oxide concentration for purposes of comparison has been recalculated in accordance with the law of mass action to the same oxygen content in the explosion mixture :—

Nitric oxide concentration in exploded gas mixture in vol. per cent.	0·41	0·65	0·80
Duration of maximum temperature of explosion in seconds ..	0·002	0·010	0·025

This relationship can be represented by a parabolic equation. A very similar relationship was found by Coehn (*Zeitschrift für Elektrochemie*, 1907, p. 545) in respect of the formation of sulphur trioxide from sulphur dioxide and oxygen under the influence of ultra-violet light. The relationship between the time of exposure to the light and the concentration of the trioxide can in that case also be represented by curves which are of a parabolic nature.

Prof. Bone's results, which incidentally may also prove to be of technical importance in regard to the formation of nitric oxide by means of gaseous explosions, therefore indicate the possibility of nitric oxide formation by rays of short wave length, which according to the results of Warburg (*Zeitschrift für Elektrochemie*, 1906, p. 538) and others, lead to the formation of appreciable quantities of nitric oxide at ordinary temperatures. Prof. Bone's view that the cause of the different rates of increase in pressure, which he considers to be due to the absorption of energy and to the formation of "activated" nitrogen, may thus be correct. As regards an explanation of the increased formation of nitric oxide, I am, however, of opinion that the assumption of nitrogen activation can be dispensed with and replaced by the known action of ultra-violet rays, which undoubtedly occur when gaseous mixtures are exploded.—I am, Sir, etc.,

Fr. Häusser

Dortmund-Eving, July 12, 1923

THE EFFECT OF INSECTICIDES ON BEES

Sir,—I have read in *Chemistry and Industry* the letter of Mr. W. F. Reid, and another by Mr. W. S. Gilles, commenting upon it and questioning the accuracy of Mr. Reid's impression that bees are killed by spray poison. He dismisses the whole question as merely an extraordinary superstition or prejudice prevalent among bee-keepers. It is, however, such a real fact and constitutes so serious a problem in some sections that much harm would be done should the idea become prevalent that the damage done to bees by spray poisons is only in the imagination of the bee-keeper.

Bee-keeping, of course, is a relatively unimportant industry. Yet it is estimated that the damage suffered by this industry from spray poisoning in the State of Washington last year amounted to $200,000.

In this country a repellant going under the trade name of Milkol has been considered satisfactory by some persons who have tried it, whilst others report unfavourably on it. Milkol is derived from coal tar, but just exactly what it is the writer does not know.

The State College of Washington has carried out a series of experiments on spray poisoning and repellants to be added to sprays to cause bees to avoid them. No doubt interested persons could obtain considerable information by inquiring from that Institution.—I am, Sir, &c.,

D. M. Jackman

Kenvil, New Jersey, July 16, 1923

PHOSPHORUS PENTACHLORIDE AND IODINE TRICHLORIDE AS ELECTROLYTES

Sir,—The letters of Mr. G. W. F. Holroyd in your issue of April 6 (No. 14) and of Prof. T. S. Moore in that of April 27 (No. 17) contain formulæ which indicate that phosphorus pentachloride and iodine trichloride would be electrolytes. Mr. G. W. F. Holroyd hopes to support this opinion by finding a suitable solvent, and Prof. T. S. Moore quotes the works of Oddo and of Walden. In view of the attention which is now given to the electronic theory of valency, I think the following information may be of interest.

Twenty years ago I found the suitable solvent for phosphorus pentabromide, which doubtless would have a formula analogous to phosphorus pentachloride. [*Journ. Russ. Phys. Chem. Soc.*, 35 (1903), 794; *Zeits. Phys. Chem.*, 48 (1907), 220.] Electrolysis of saturated solutions of phosphorus pentabromide in bromine shows that by the electrolysis phosphorus is produced at the cathode, and combines with the solvent, yielding phosphorus pentabromide. (*Journ. Russ. Phys. Chem, Soc.*, 49 (1917), 76.)

Likewise iodine trichloride gives with bromine good conducting solutions (*Ibid.*, 47, 723, 1915). By electrolysis of this solution with the silver anode, silver chloride is obtained at the anode. On electrolysis of a solution of iodine trichloride in dichloracetic acid iodine is liberated at the cathode, giving a violet colour to the solution near the cathode (*loc. cit.*, p. 730).

The results of my investigations fully and clearly show the electrolytic nature of phosphorus pentabromide and of iodine trichloride, in accordance with the formulation used by Messrs. G. W. F. Holroyd and T. S. Moore.—I am, Sir, etc., W. A. Plotnikow

Polytechnicum, Kieff, Russia
July 15, 1923

THE VINEGAR PLANT

Sir,—It was with extreme surprise that I read, at the end of your editorial disquisition on the effect of hydrogen-ion concentration on molluscs, of the proposal to sow "vinegar plants" among lettuces. I fear that the proposal, if carried out, cannot but lead to disappointment, as the cultivation of the vinegar plant requires the environment to be adjusted with a nicety that can hardly be attained under the conditions suggested, for the plant is not a Spermaphyte, but a Cryptogam included in the Bacteriaceæ. As typical species I may mention the *Bacterium aceti*, *B. pasteurianum*, *B. kützengianum* and *B. xylinum*, which have been investigated so exhaustively by Adrian Brown, Hausen and other workers. The common name, vinegar plant, is derived from its ability to oxidise alcohol (by a series of reactions, which, despite the antiquity of the process, are not yet clear) to acetic acid *viâ* aldehyde.

It may be, however, that allusion is made to some plant which is unknown to me. Acetic acid is, of course, a common product in nature, occurring in the juices of many plants, sometimes free, sometimes in combination; for instance, in the seeds of fruit of various species of hogweed, particularly *Heracleum sphondylium* and *H. giganteum*, it is combined with n-hexyl and n-octyl alcohols. Some years ago I detected traces of the free acid in a common weed, but the conditions of the experiment were such as to render a definite conclusion untrustworthy. If there is a new plant which possesses this property to a remarkable degree, I should be glad to receive further information about it.—I am, Sir, etc., "Biochemist"

London
July 28, 1923

PERSONALIA

The honorary degree of LL.D. has been conferred upon Dr. F. W. Aston by the University of Birmingham.

Mr. J. A. Gunton has been appointed professor of chemistry in the Western University, London, Ontario.

Dr. C. A. Browne, chemist-in-charge of the New York Sugar Trade Laboratory, has been appointed Director of the United States Bureau of Chemistry.

Mr. F. W. Horner has been elected chairman and Mr. C. F. Bardorf hon. secretary of the Montreal Section of the Society of Chemical Industry.

The following have been awarded the degree of Ph.D., of the University of London:—L. Hall, H. Phillips, A. Brammall, H. Schofield, and H. F. G. Letson.

It is announced from France that Monsieur Lesage, director of agriculture, Col. Grard of the aeronautical technical service, and Monsieur A. Cagnot have been appointed members of the Permanent Commission of Standardisation.

The following appointments are announced from Germany:—Dr. A. Penrath, to the chair of chemistry in the Technical *Hochschule* in Aachen; Dr. K. Fajans to the professorship of physical chemistry in the University of Munich.

The Gas Light and Coke Co.'s Research Fellowship has been awarded to F. R. Weston, A.R.C.S., for "The Spectroscopic Investigation of the Flames of Carbon Monoxide and Hydrogen, and Matters Cognate thereto," and a Beit Research Fellowship to H. W. Buston, B.Sc., to continue his work on "Nitrogeneous Metabolism in Plants." The research fellowships are tenable at the Imperial College of Science and Technology.

* * *

With regret we announce the death of Dr. P. C. McIlhiney, New York. Dr. McIlhiney, who was a well-known consulting analytical chemist, was for many years honorary secretary of the American Section of the Society of Chemical Industry.

Dr. F. C. Cook, who died in Texas recently, had been connected with the U.S. Bureau of Chemistry since 1904, and was the author of numerous papers on food metabolism, enzymes, insecticides, fungicides and related subjects.

The death is announced of William Brady, chief chemist and chemical engineer to the Illinois Steel Company, Chicago. Mr. Brady had given valuable assistance to the Bureau of Standards in producing standard samples of steel, and was an authority on the exploration and valuation of limestone, fluorspar and other raw materials used in the manufacture of iron and steel.

NEWS AND NOTES

UNITED STATES

Barytes and Barium Products in 1921

The quantity of crude barytes mined and sold in the United States in 1921 fell to about 66,000 short tons as compared with 100,000 t. in the previous year. This decrease is regarded as being only temporary and in large part caused by the post-war depression. The average price per ton obtained in 1921 was nearly 15 per cent. lower than that in 1920, but considerably higher than the prices that prevailed prior to 1919. The value of sales in 1921 was about one-fourth the value of the sales in 1920. The output of crude barytes during 1921 with corresponding values is as follows :—

California ..	Short tons	942	Total value	$5,084
Georgia ..	,,	24,614.	,,	191,442.
Kentucky ..	,,	—	,,	—
Missouri ..	,,	25,200.	,,	217,913.
Tennessee ..	,,	8,180.	,,	61,148.
Other States	,,	7,433.	,,	56,371.

Missouri and Georgia together marketed about 75 per cent. of the total domestic output in 1921. Missouri's production declined about 75 per cent. from that in 1920, but Georgia's output declined only 71 per cent., so that Missouri exceeded Georgia by less than 600 t. Tennessee had the next largest output, which showed a decline of about 72 per cent. In California, which is the only Western State that produced barytes, the production in 1921 decreased 58 per cent. Estimates furnished by the producers of the ore indicate that the total stock held at the end of 1921 amounted to 23,785 short tons. Imports of crude barytes for consumption amounted in 1921 to 11,054 t., and those of crude domestic barytes used in the manufacture of barium products amounted in all to 100,607 t. No barytes was exported, and the amount consumed in the United States in 1921 totalled 77,423 t. The following are statistics of the barium products made from domestic and imported crude ores and marketed in the United States, 1920-1921 :—

	1920 Short tons		1921 Short tons
Ground barytes..	65,748	..	27,661
Lithopone ..	89,373	..	55,016
Barium chemicals	20,760	..	5,487

This makes a total of 175,881 t. for 1920 as against 88,164 t. in 1921, a decline partly due to the large influx of foreign products. Imports of barium products into the United States greatly increased in 1921. They were as follows :—Ground barytes, 1002 t. ; lithopone, 10,493,938 lb. ; barium binoxide, 1,337,972 lb. ; blanc fixe (precipitated barium sulphate), 1,538,383 lb. ; artificial barium carbonate (chemically precipitated), 4,475,225 lb. ; natural barium carbonate (ground witherite), 1,336,712 lb. ; and barium chloride, 12,780 t. (*Cf. J.*, 1922, 131 R.—(*U.S. Geol. Surv., Sept.* 11, 1922.)

Talc and Soapstone in 1921

The total amount of talc and soapstone mined and sold in the United States in 1921 was 126,434 short tons, valued at $1,821,451, which compares with 210,635 t. valued at $3,035,449 in 1920. Vermont was the largest producer ; New York followed in quantity sold, but for the first time took second place in value ; and Virginia ranked next to New York in quantity, but for the first time led in value. There were in all States 30 producers, as compared with 29 in 1920. No soapstone was imported, but the imports of talc, 11,621 short t. valued at $241,748, were reduced, as compared with 1920, to about one-half in both quantity and value. The imports from Canada decreased most, being only 46 per cent. of the quantity imported in 1920 ; the imports from France were less affected, for the French product is of a higher grade. The U.S. Geological Survey estimates the world's production of talc and soapstone in 1920 at approximately 295,000 metric t. The figure for 1921 is not yet available.—(*Cf. J.*, 1922, 482 R.)

FRANCE

The Pasteur Centenary

On July 12, the Syndicat de la Presse and La Bienvenue Française met at the Académie des Sciences to hand over the sum of 8 million francs, collected during "Laboratory Week" to assist scientific laboratories.

The Pascal Centenary

The tri-centenary of Pascal was celebrated in France on July 8, when the President, accompanied by representatives of the "Institut," of the Universities and of foreign scientific societies, visited the summit of the Puy de Dôme, the spot where in 1647 Pascal carried out his famous experiment to demonstrate the pressure of the air. Various speakers, including Messieurs D'Ocagne, Pickard, Painlevé, etc., discussed the scientific work of Pascal and pointed out the practical results of his genial discoveries.

The Nitrogen Industry

The annual report of the Société Central des Industries de l'Air Liquide et de l'Azote, states that the profit during 1922 amounted to 583,000 francs, which has been allocated to depreciation account. It is stated that the preparatory work on the utilisation of the hydrogen of coke-oven gas for the production of synthetic ammonia by means of the Claude process is now completed and negotiations with various firms are in progress to extend this application. A factory is being erected in Spain at Flix (Tarragona), to produce 1000 kg. of ammonia daily, and negotiations are in progress for the erection of other factories in Belgium, Switzerland and Italy, the hydrogen to be produced electrolytically in the two last-named countries, and from coke-oven gas in Belgium.

CANADA

Low Temperature Carbonisation

It is reported that the Ford Motor Company of Canada is erecting a factory for the low-temperature distillation of coal by a process which is expected to produce 10 galls. of motor fuel per ton of coal. The factory, which is situated at Walkerville, Ontario, will cost roughly $500,000, and will distil about 400 tons of coal a day. Should the experimental plant prove successful other factories will be constructed by the company.—(*Chem. and Met. Eng., July* 9, 1923.)

JAPAN

The Alcohol Industry in Formosa

H.M. Consul at Tamsuy reports that the production of alcohol in Formosa during 1922 was 16,353,180 litres compared with 13,072,860 l. in 1921. The production for 1923 is estimated at 19,800,000 l., but it is considered that this output may not be realised. In order to maintain prices the Formosan producers agreed to limit the shipments of alcohol to Japan to 8,000,000 l., but as no restriction is placed on exports to other countries the producers are attempting to increase their exports abroad. Prices for export average 9·50 yen per case of 36 l., the price paid in Japan being 13 yen per case. A tax is applied to alcohol for domestic consumption, but not to alcohol that is exported.—(*Bd. of Trade J., July* 26, 1923.)

GERMANY

Urea as Nutrient Protein

The amides present in plants are not only decomposition products of protein matter, but also intermediate compounds in their synthesis. They are as it were intermediary between inorganic nitrogenous substances and proteins, and, according to C. Lehmann and W. Völtz, may be made under certain circumstances to yield quantitatively true digestible proteins. This is of importance in that such an amide, namely, urea, is at present obtainable from atmospheric nitrogen. Feeding trials conducted with a sheep and three lambs show that urea is a suitable substance for use as nutrient protein.

Wages in the German Chemical Industry, 1923

In the fifteen principal areas of the German chemical industry the average hourly wages of operatives in January, 1923, amounted to 575·95 marks, of process workers to 536·20 m., and of unskilled workers 530·93 m., or, respectively, 1010, 1166, and 1264 times the pre-war figures. The weekly working hours are now six to twelve less than before the war, and the total weekly wages in January amounted to 27,646 m., 25,738 m., 25,435 m. for the three classes of workers, the increases over pre-war rates being 838, 962 and 1047-fold respectively. From the middle of December, 1922, to the middle of January, 1923, the wages of married men increased by 59 per cent., and of single men by 58 per cent. The highest wages are obtained in Cologne, Dusseldorf and Essen.

GENERAL

Copper Ores

A monograph bearing the above title has been prepared by Mr. R. Allen, M.A., under the direction of the Mineral Resources Committee of the Imperial Institute (Pp. 221, price 7s. 6d.). The volume discusses sources of supply within the Empire and in other countries as well as the character, uses, properties and consumption of copper ores. No attempt can be made to give an account of such a detailed production, but it should be indispensable to all those who are interested in the subject.

Discovery of Oil in Spain

El Economista reports that the investigations of a Spanish engineer in the valley of Burunda at Alsásua (Navarre) have confirmed the existence of a hitherto unknown petroleum zone. The geological formation of the zone suggests that the deposit may prove of great importance. The land belongs to the Compañía Franco-Española de Petróleos of San Sebastian, which proposes to undertake boring operations at once.—(*Ch. Comm. J., July* 6, 1923.)

European Coal Production in 1922

Prior to the war the production of coal in Europe totalled 610 million metric tons, of which pre-war Germany produced 31·17 per cent., France 6·56 per cent., and the United Kingdom 47·87 per cent. The present state of production in Europe will be seen from the following table, in which output is given in millions of metric tons :—

	1913 m.t.	Per cent.	1920 m.t.	1921 m.t.	1922 m.t.
Germany (without the Saar)	140·9	23·10	108·4	113·9	119·1
Saar region ..	13·2	2·16	9·8	9·5	11·2
France and Lorraine ..	43·8	7·18	24·3	28·2	31·2
Belgium ..	22·8	3·74	22·4	21·8	21·3
Poland (with E. Upper Silesia)	40·5	6·64	29·4	29·9	36·4
Czechoslovakia.	12·7	2·08	11·1	11·6	—
Great Britain & Ireland ..	292·0	47·87	233·2	166·3	255·9
Rest of Europe	44·1	7·23	—	—	—

Nitrogen Fixation in Denmark

Owing to the shortage of nitrogenous fertilisers in Denmark towards the end of the war, a research committee was appointed to investigate the possibility of establishing the nitrogen-fixation industry in the country. The experimental results obtained were so favourable that it was proposed to establish an experimental factory to produce 260 metric tons of ammonia annually, an amount equivalent to half the annual production of the Danish gas industry. A factory with this capacity would, on the basis of prices ruling in 1920, cost 1 million kroner, and a factory to produce 8000 t. of nitrogen would cost about 10 million kr. The economic feasibility of establishing a nitrogen-fixation works in Denmark is not considered promising at present, especially as German, Chilean and Norwegian competition would have to be met, but the question is being examined by the Ministry of Agriculture.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for July* 26)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received by the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Belgium ..	Tanning extracts ..	103
British India	Cast iron (tender) ..	*
Canada ..	Alum, resin, rubber belting, chemicals, colours	97
Chile ..	Building materials ..	124
Dominican Republic	Steel	673/25 F.G./E.C./2
,,	Cement	8190/F.L./M.C./2
Far East ..	Chemicals, drugs ..	119
Fiume ..	Iron, steel, tinplate ..	105
Hong Kong..	Ammonium sulphate..	11121/F.E./C.C.
Italy.. ..	Hides and skins ..	108
Poland ..	Antimony, copper, tin	112
South Africa	Aluminium paint (tender)	11706/E.D./C.C./2

*Director-General, India Store Department, Branch No. 10, Belvedere Road, S.E. 1.

TARIFF CUSTOMS EXCISE

Dominica.—The export duty on copra has been reduced from 35s. to 20s. per ton.

Federated Malay States.—The exportation of rubber is prohibited except upon licence or coupon authorising such export.

France.—The "coefficient of increase" of 2·5 formerly applied to import duties on crude iodine has now been removed, the duty being fixed at 1600 and 400 francs per 100 kg., under the "general" and "minimum" tariffs, respectively.

Yugoslavia.—The duty-free importation of lead-piping is no longer permitted.

Zanzibar.—Groundnuts and salt may now be imported free of customs duty.

PARLIAMENTARY NEWS

HOUSE OF LORDS

Therapeutics Regulation Bill

A Bill has been introduced by Lord Onslow to regulate the manufacture, sale and importation of therapeutic substances, *i.e.*, vaccines, sera, toxins, antitoxins, antigens, salvarsan and analogous substances, and insulin. The Bill provides that only licensed persons shall manufacture these substances, and licences are required for importation. A Joint Committee consisting of the Minister of Health, the Secretary for Scotland, and the Minister of Home Affairs for Northern Ireland is to be established to frame regulations and to secure uniform standards, and an Advisory Committee is to be appointed, including three Government representatives, and a representative each of the Medical Research Council, the General Medical Council and the Council of the Pharmaceutical Society.

Smoke Abatement Bill

On July 19, Lord Onslow introduced the Smoke Abatement Bill designed to amend the law relating to smoke nuisances. The Bill received the first reading.

HOUSE OF COMMONS

Government Oil Boring

Lieut.-Col. Lane-Fox, replying to Mr. Hannon, said that the amount realised during the year ended March 31, 1923, by the disposal of buildings and plant utilised in the Government oil-boring experiments, was £25,000. The total loss on the undertaking at that date, including interest on Exchequer advances and administrative charges was approximately £678,000.—(July 24.)

Reparation Duty

Answering Mr. F. Gray, Sir W. Joynson-Hicks said that the total amount collected under the German Reparation Recovery Act up to June 30 was £13,264,282. -(July 25.)

Export Price of Indigo

In a written answer to Mr. Collison, Viscount Wolmer said that he was informed that the British Dyestuffs Corporation had not offered to sell any reparation indigo or indigo of their own production for export at prices less than those ruling in this country.—(July 26.)

The Dyestuffs Industry

During the debate on the Board of Trade estimates, Lieut.-Commander Kenworthy raised the question of the Government policy regarding the dyestuffs industry. Dr. G. C. Clayton said that we had all the raw materials of the dye industry, and great progress had been made. He felt sure that with the help of the Board of Trade a dye industry could be established in this country which would hold its own against foreign competition. After showing the necessity for having a sound dye industry in this country, Dr. Clayton pointed out the value of the industry as a school for chemists. Mr. J. H. Simpson observed that the dye merchant played an important part in the organisation of the dyeing industry, and gave instances showing that the merchant objected to be compelled to reveal his customers' names. In reply Sir P. Lloyd Greame said it was necessary that merchants should give these particulars, otherwise the Licensing Committee, which included a majority of users, would not work efficiently. The value of the dye industry to the textile industry in this country was greater now than it had ever been before, as was shown by the present Continental situation. Another important point was that foreign production of textiles was continually increasing and it was unwise to leave our home industry at the mercy of a possible combination of foreign dye-makers and mill-owners. Only when we made dyes in this country did the German prices come down; if the Germans again controlled the market their prices would go up, and there would be no guarantee that they would supply dyes or sell them at reasonable prices.

During further debate on the Board of Trade estimates Mr. H. H. Spencer again raised the question of the administration of the Dyestuffs Act, and complained that the high cost of colours in this country was ruining the important textile industry, the source of roughly 44 per cent. of the manufactured exports of the country. One result was that the small dyers were being crushed out of existence and the cost of dyeing could not be reduced because the dyers were working only at 60 to 70 per cent. of capacity. Sir T. Robinson, speaking as chairman of the Licensing Committee, reviewed the circumstances which led to the passing of the Dyestuffs Act, and claimed that it was not true that the Committee favoured a syndicate or was disadvantageous to the small consumer. The trouble was that France, Belgium and Italy were taking larger quantities of reparation colours than they could consume, and selling the surplus to dealers. Some British consumers were dissatisfied because they could not purchase dyes at prices as low as those quoted in France, Belgium and Italy. The dyestuffs industry had made marvellous progress, but full development would require time. Lieut.-Col. Astbury refuted the statement that the cost of dyes was ruining the dyeing industry, as the cost of dyes represented only 3 per cent. of the whole cost of producing cloth. Cloth that was exported to other countries to be dyed was sent abroad because we could not do the same work in this country, nor could we do it before the war. At present the Germans were charging 8s. 6d. per lb. for colours that we could not manufacture here, but those we could manufacture they were dumping here at any price. —(July 26.)

REVIEWS

Industrial Organic Chemistry. *By* S. P. Sadtler, *Ph.D., LL.D., and* L. J. Matos, *Ph.D. Fifth edition. Pp. xvi*+691. *Philadelphia and London: J. B. Lippincot Co.,* 1923. *Price* 35*s.*

Many technical books are now published. Some are encyclopædic in character; others are small handbooks devoted to individual industries; whilst others attempt to deal compendiously in a single volume with applied chemistry as affecting a variety of industries. Although opinions will differ as to the relative merits and demerits of such books, each of these types doubtless serves a specific purpose. *Industrial Organic Chemistry,* which has now reached its fifth edition, comes under the third category, and any review would be inapposite which failed to appreciate the angle from which the subject had been approached. This work surveys a very wide field of industries, and deals in a systematic way with each industry from the points of view of (*a*) raw materials; (*b*) processes of treatment and/or manufacture, which are outlined and elucidated; (*c*) intermediate and final products, the composition and character of which are furnished; (*d*) analytical and control tests, and (*e*) bibliography and statistics. In the preface to the new edition it is revealed that Dr. Matos is entirely responsible for chapters 9, 10, 13, 14, 15 and 16, covering several industries in which he has had many years' experience, and that Dr. Sadtler is responsible for the rest of the book, which has been thoroughly revised.

Chapter 1 deals, in 45 pages, with the important industry of mineral oil and allied bitumens, and within the space available, the subject has, on the whole, been satisfactorily treated. The account of the processes for treating petroleum, ozokerite, natural paraffin, natural bitumens and asphalts, and bituminous shales impresses one with the scope afforded for the possible improvement in methods of distillation, and the heat economy to be effected in the operation of continuous stills and "topping" plant. No mention is made of the relative advantages of natural and artificial asphalts—a subject of importance in these days.

Chapter 2 is devoted to the industry of fats and fatty oils, both of vegetable and animal origin. Information is given on the extraction of the raw materials and their purification. Both expression and solvent extraction methods are outlined, and brief reference is made to the Cogan, Everard and Wagnet processes of chemical purification of oils used when subsidence and filtration through suitable media have failed to give the necessary purity. In the bibliography at the end of this chapter, no reference is made to the recent work of Prof. J. W. McBain on soap solutions and gels.

Chapter 3 (30 pp.), devoted to the industry of essential oils and resins, surveys briefly the manufacture of perfumes, oils, inks, varnishes, linoleum, and oilcloth, as also rubber and gutta-percha and their products.

Forty-four pages are devoted to the cane sugar industry, which constitutes Chapter 4, and a fairly comprehensive review of the manufacture of sugar from sugar cane and sugar beet is given. The use of multiple-effect evaporators in this manufacture appears to be inadequately treated. No reference is made to the application of artificial refrigeration as a means of facilitating the crystallisation of sugar from its solutions. This is a current development to which attention is being given in this country. Nothing is said concerning the use of new chemical agents for defecation purposes—a phase which has received attention recently.

Chapter 5 deals with starch and its derivative products. In describing suitable converter apparatus for glucose, reference is made to "Maubré," whereas "Manbré" is obviously intended. The fermentation industries are covered by Chapter 6, embodying 80 pages, sectionised as follows :—(*a*) Nature and varieties of fermentation ; (*b*) malt liquors and the industries connected therewith ; (*c*) the manufacture of wine ; (*d*) the manufacture of distilled liquors or ardent spirits, and (*e*) bread-making. In view of the increasing importance of industrial alcohol, one would have imagined that special reference would have been made to this subject, but allusion to this aspect is peculiarly brief, and nothing of an original character is contributed.

Chapter 7 deals with the milk industries (condensed milk, butter, margarine, cheese, etc.) in an interesting way, and Chapters 8, 9, and 10, comprising 96 pages, are assigned to the cellulose industries. Paper-making receives a brief reference in twenty pages, in which the properties and characteristics of various papers are indicated, and the general methods of preparing pulp are given. The cellulose esters and the nitrocellulose plastics are reviewed, and a section is appropriated to the manufacture of artificial silk. In the chapters on vegetable and animal fibres, considerable information appears to have been judiciously compressed. Animal hides and skins, tanning, and glue manufacture are dealt with in Chapter 11, and Chapter 12 deals with the destructive distillation of wood, special reference being made to the fermentation processes in vogue for the manufacture of acetone, which were developed during the war.

Chapter 13 covers the coal-products industries, embracing the manufacture of coal gas and metallurgical coke, and the treatment of the resulting by-products. No allusion is made to generator, regenerative or recuperative methods of heating gas-retort settings, and reference to continuous carbonisation in vertical retorts is very meagre. The information conveyed in this chapter is certainly not up to date, and, indeed, in one or two instances, is inaccurate. For example, on p. 459, in dealing with the distillation of ammoniacal liquor, it is stated that "A pipe leads the ammonia vapours to a lead-lined apparatus termed a saturator, in which is a solution of sulphuric acid, standing at 140° Tw." In point of fact, in working an ammonium-sulphate plant, the specific gravity of the bath is usually about 60° Tw., at 100-110° C. Under tar distillation no reference is made to continuous distillation, either pressure or vacuum, and several of the methods indicated for the production of pure naphthalene and pure anthracene have been found to be ineffective on a practical scale.

Chapters 14, 15 and 16 deal respectively with coal-tar dyes, natural colouring matters, and bleaching, dyeing and textile printing.

Obviously, in attempting to survey 16 important industries in less than 700 pages, it is difficult to decide what to include. There is certainly a demand on the sense of proportion of the authors, and it is inevitable that there should be defects incidental to a necessary compression. Explanations of a chemical and physical character are singularly rare, and hence the book is not calculated to appeal so much to the chemist as to the industrialist, who will appreciate the broad divisions under which the various industries are treated, and will be particularly impressed with the extensive character of the bibliography.

P. PARRISH

DIE FABRIKATION DES ZELLSTOFFES AUS HOLZ SULFITZELLSTOFF. *By* RICHARD DIECKMANN. (*Vol. II. of Technik und Praxis der Papier Fabrikation-*, HEUSER.) *Pp. viii*+360. *Berlin : Otto Elsner*, 1923. *Price* 20*s*.

This exhaustive account of the practice of an important industry makes little appeal to technologists of the United Kingdom, for the simple reason that our production of "sulphite" wood pulp is of fractional dimensions. With our forest area of 4 per cent. as against the 50-60 per cent. of Sweden-Finland, and the 20 per cent. average for Europe, there is moreover no prospect of production from indigenous wood. The North American Continent, on the other hand, has developed a flourishing industry which requires the services of engineer-chemists on a proportionate scale, and this new volume must be commended to them on its obvious merits.

In the historical survey of the industry we notice that the first graph of growth of annual production represents the figures 0–1400 tons in the period 1873-1882. We are therefore in the jubilee year of the industry. This pioneer production is ascribed mainly to C. D. Ekman and his English associates, Geo. Fry, and Thompson, Bonar and Company, a recognition which should be finally adopted.

Following the opening, which tells the story of development to the year 1920, are seven chapters dealing with the subject matter in sections in the order of the succession of operations of the factory routine. This method of treatment results necessarily in a compilation of technical documents, of particular value only to the specialist, whereas the critical didactic method is required for a contribution to technology, which may be or should be a work of general interest. The author is aware of this defect of his contribution and modestly admits its sectional and essentially "practical" purport. Acknowledging the limitation of plan, the author implicitly recognises that the matter has no further cohesion than that which results from consecutive treatment, in order of time, and of successive description of the routine processes and of the machinery and appliances which constitute their factory equipment. These descriptions are exhaustive; the stages of development to present day practice are discussed with critical discrimination, and the work concludes with the design and layout of a modern factory to produce 25 tons a day with prospective increase to 50 tons a day.

These brief notes are intended to call the attention of all specialists engaged in this important industry, especially chemists and engineers, to a work which they will study with deep interest and find indispensable.

In regard to the technology of the subject, it presents another case of an industry very highly developed and very methodically controlled *qua* factory procedure, upon a slender foundation of science: the work faithfully reflects this empirical-technical perfection of the industry. The student who is equipped with a grasp of first principles—of science *and* industry—and, in addition, the critical selective faculty, would find the work attractive for its implicit suggestion of fields of research and enterprise, to be explored before the industry can rank with the ideals of economic realisation. For notwithstanding its ideal basis, a quantitative synthetic reaction of the lignone (non-cellulose) of the wood substance with inorganic compounds of lowest value (costs of production), the resulting by-product represents a waste of material at the present date, and for the fifty years of the industry, of stupendous magnitude.

The history of research, invention and partial realisation of industrial value of this by-product is well set forth in Chapter 7 of the work; and the chemist will read this with the mixed emotions awakened by the story of Palissy and the sacrifice of the household furniture to feed the furnace up to the critical temperature. As for the economic botanist, the spectacle of the wood-pulp industry must raise emotions still more emphatically mixed: on the one aspect the realisation of cellulose qualities in human industry, on the other the wholesale destruction of Nature's values, beyond anything expressed by the mere statistics of tonnage.

The chemical conscience has inspired eloquent lamentations over the world-wastes of glycerin and coal tar: but it has not reached articulate expression in the matter of our complacent sacrifice of wood substance. What is more important, however, is the call for the constructive remedy and for the chemist to undertake it; and the author's work, with the circumstances of its appearance, may be commended to the study of all chemists, and especially to those who have the additional qualifications implied in membership of our Society.

C. F. Cross

Wave Length Tables for Spectrum Analysis. *Compiled by* F. Twyman, *F.Inst.P. Pp. viii*+106. *London: Adam Hilger, Ltd.*, 1923. *Price* 7*s*. 6*d*.

In the preface we are told that "the book consists almost entirely of verbatim transcriptions. For this reason inverted commas have been omitted, all matter other than literal transcriptions or translations being distinguished by italics. The reference to the source from which each extract has been drawn is indicated at the end of each transcription by a reference number, the list of references being given at the end of the volume." From this it follows that the compiler is responsible chiefly for the selections made, but not only so, for the connective text is a useful discussion of the comparative values and correlation of the tables and standards by the principal authorities.

Part I, on "Wave-Lengths and Wave-Numbers," is taken from Prof. A. Fowler's recent work, "Report on Series in Lined Spectra," followed by notes and a table for "Correction to Vacuum of Wave-Lengths in Air" by the compiler. *Part II* traces in detail the history and movements of the International Committee relative to "Wave-Length Standards," and gives a clear exposition of the primary, secondary and tertiary standards. *Part III*, on "Distinctive Lines of the Elements," embodies chiefly the work of Hartley, Pollok, Leonard and A. de Grammont.

It is observed that only certain lines are required for most practical purposes, and their relative significance in ordinary experimental work is indicated. This part also includes a description of the *modus operandi* for the qualitative and quantitative spectroscopic analysis of solutions of salts and minerals by studying their spark spectra as devised by Hartley and Pollok. The compiler has made a valuable re-arrangement of de Grammont's tables by formulating a new table under three columns, the first giving the wave-length in I.A. (International Angström units), the second the symbols of the corresponding elements, and the third the "next sensitive ray" characterising the element. A somewhat similar table of persistent lines by Pollok and Leonard is also given. *Part IV* is transcribed from Dr. J. S. Plunkett's paper, and relates to "Wave-

Lengths for Use in Determination of Stellar Radial Velocities."

The book is essentially a handy work of reference for those practical details required in the course of ordinary practice, and as such, will prove a valuable aid in the laboratory. Its scope is, however, limited to the spark spectra of saline solutions. One may hope that, in course of time, a companion volume on arc spectra will render the work complete.

S. Judd Lewis

The Examination of Hydrocarbon Oils and of Saponifiable Fats and Waxes. *By* Prof. D. Holde. *Authorised translation from the fifth German edition by* Prof. E. Mueller, Ph.D. *Second English edition. Pp. xix+572. London: Chapman and Hall, Ltd.,* 1922. *Price* 30*s.*

The second edition of Holde's *Hydrocarbon Oils and Saponifiable Fats and Waxes,* translated by Mueller, is much more than a mere reissue. The whole book appears to have been largely rewritten and the contents rearranged. The first edition was a translation of the 1913 German edition, whereas the present issue is based upon the fifth German edition published after the end of the war. The new volume contains about 100 more pages, and a great deal more of the detailed analytical and tabular work is in finer print. It is obvious from the references throughout the book that much of the new work up to 1916 published in German has been made use of, but there are evidences that much of the American and British work has not received full consideration, probably because the means were not then available to the author.

As is well known the work is an attempt to bring into one volume a description of the leading methods for the physical and chemical examination of oils, both mineral and vegetable. An astonishing amount of material has been brought together in a work which in many respects is a model for clearness and conciseness.

The opening chapter on the physical and physico-chemical tests contains much new matter. Under the heading of " Heat and Vaporisation " (page 48) the mean boiling point is taken as the arithmetical mean of the boiling point of each 10 per cent. fraction, but work carried out on the lines suggested by Keith and Whatmough (Proceedings of the Institution of Automobile Engineers, 1922) shows that the equilibrium boiling point cannot be so arrived at, being as a rule considerably higher than the figure obtained by the method suggested by Holde.

Due importance is given to the use of formaldehyde as a means for separating certain classes of unsaturated bodies both in naphthas and lubricating oils. This reagent is likely to become more valuable as time goes on, for it is becoming more and more necessary that we should know something as to the constitution both of motor fuels and lubricating oils, particularly in respect of the amount of those ingredients the influence of which Ricardo and others have investigated.

In the chapter on motor oils (page 163) the statement is made that the asphalt content of the oil does not affect its usefulness, for residues of asphaltum oils have been successfully used in Diesel motors. The statement as it stands is hardly correct, and it is qualified further on in the page, the fact being that the hard asphalts are known to be very deleterious, and hence the attention that is being paid to the standardisation of methods for the determination of hard as distinct from soft asphalts. The specifications of fuels for high-speed internal-combustion engines are counsels of perfection.

The difficulties in which Germany was placed during the war owing to the lack of many materials, and not the least lubricating oil, can readily be discerned from a study of this volume. The large amount of space devoted to the influence of graphite in admixture with oil or water as a lubricant is significant. Considerable attention is paid to special oils and technical material concerning various industrial products. Valuable though the chapters on the examination of vegetable products may be, it is the specialised researches of the author on the petroleum products that have made the reputation of the work.

The new volume is a great advance upon the old one, and in spite of many things to which exception might be taken, such as the possibility of producing formulæ to co-ordinate the results obtained by the various technical instruments for measuring viscosity, the book remains one of the most useful in the library of the oil chemist.

W. R. Ormandy

Kelly's Directory of Merchants, Manufacturers and Shippers of the World. *Vol. I. Pp. cccvii+2382. Vol. II. Pp. cxvi+1868. London: Kelly's Directories, Ltd.,* 1923. *Price* 64*s.*

Kelly's Directory of Merchants, Manufacturers and Shippers needs no introduction as it is so well known and has proved its value for many years. As far as can be judged the volumes have been kept well up to date, and alterations made wherever required. Information is given relating to 2000 foreign and colonial towns, so that the work involved has been by no means small. The volume is provided with a brief introduction in four languages describing the arrangement and methods of use. In the present edition the towns and cities of Canada have been arranged in one alphabetical list throughout the Dominions, instead of by provinces. The work conforms to the usual standard of printing and presentation of previous issues, and can be recommended to all those occupied in trade within the Empire or abroad.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Business in the home and export markets remains very restricted. Makers' prices are practically unchanged in spite of the unpromising nature of the outlook. The demand from the textile trades is particularly poor, and in general practically no interest is displayed in forward purchasing.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d. - 5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw.	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d. - £8 per ton. Comparatively good demand.
Arsenic (White)	£72 - £73 per ton. Not much doing.
Bleaching Powder	Spot £11 7s. 6d. d/d. ; Contract £10 7s. 6d. d/d. Quiet.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d.
Copper Sulphate	£27 per ton.
Potash Caustic	£30 - £33 per ton. Poor demand.
Potass. Bichromate	5¾d.-6d. per lb. d/d.
Potass. Chlorate	3d. per lb. Very dull.
Salt Cake	£4 10s. - £5 per ton. Remains a very firm market.
Soda Caustic 76%	£19 - £21 10s. according to quality. Fair business.
Soda Crystals	£5 5s. - £5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton. Very scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	2½d. - 3d. per lb. Very dull.
Sod. Nitrate refd. 96%	£13 5s.-£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Rather lower in value but very quiet.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25-£29 per ton according to quantity.
Carbon Black	Cheaper at 10½d. - 1s. 1d. per lb. Ample supplies now available.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

In sympathy with most trades, this market is now a little easier.

Acetate of Lime—	
Brown	£11 5s. - £11 10s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8 - £10 15s. per ton d/d, according to locality of market and type of charcoal. Demand easier.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2s. per gall. 24° Tw.
Red Liquor	1s 3d. „ „ 14/15° Tw.
Wood Creosote	2s. 7d. „ „ Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. „ „ 60% O.P Firm market as to price but demand quiet.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5-£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d. per lb. spot. 1s. 1½d. per lb. for forward delivery
Crude 60's	3s. - 3s. 6d. per gall. Market firmer for early delivery.
Acid Cresylic—97/99	2s.-2s. 5d. per gall. Steady demand.
Pale 95%	1s. 10d.-2s. 4d. per gall.
Dark	1s. 10d. - 2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.

Anthracene Oil—	
Strained	8¾d -11d. per gall. Supply short. Plenty of inquiries.
Unstrained	8¼d - d. per gall.
Benzole—	Market uncertain. Prices doubtful.
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.
Pure	2s. 1d. - 2s. 2d. per gall.
Toluole—90%	1s. 8d.-2s. per gall. Not many inquiries.
Pure	2s.-2s. 4d. per gall. Not much inquiry.
Xylol	2s. 3d. - 3s. 3d. per gall., according to quality.
Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil	8½d. - 9d. per gall. Market steady. Good demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.-9d. per gall.
Solvent 90/160	1s. 5d. - 1s. 7d. per gall. Quiet.
Solvent 90/190	1s. 4d. - 1s. 7d. per gall. Market quiet.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Very little business passing.
Whizzed or hot pressed	£11 - £13 per ton. More inquiries.
Naphthalene—	
Crystals	£21 per ton.
Flaked	£17 10s. per ton
Pitch, medium soft	140s.-150s. per ton. Autumn delivery. Market steady.
Pyridine—90/140	18s. per gall. Demand good.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

Depression in the textile trade continues, but business in dyestuffs has improved slightly during the week.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 8d.-1s. 9d. per lb.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	5s. 3d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Quiet.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb. Fair demand.
p-Cresol 32/24° C.	2s. 1d.-2s. 3d. per lb. Fair demand.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
p-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market remains exceptionally dull and orders continue to be very scarce.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. per lb. for cwt. lots. Market weak.
Acid, Benzoic	2s. 6d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8d. per lb., less 5%. Demand improved.
Acid, Gallic	3s. per lb. Down to 2s. 11d. for large quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d.-2s. 3d. per lb. Limited demand.
Acid, Tannic	3s. 1d. per lb. would now be accepted.
Acid, Tartaric	1s. 3d.-1s. 3½d. per lb., less 5%. Demand below normal but improving. Stocks accumulated during the cold spring now being used up and a rise in price not improbable.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 5d. per lb. Market very weak.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz.
Barbitone	20s. 6d. per lb.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Position unchanged. Prices vary according to quantity and source. Market for foreign rather weaker.

Calcium Lactate	2s. 6d. per lb. for best makes.
Chloral Hydrate	3s. 9d. per lb., duty paid.
Chloroform	2s. 2d. per lb. for cwt. lots. Very dull.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	£96 per ton. Quiet.
Guiacol Carbonate	8s. 6d. per lb. Spot supplies short.
Hexamine	3s. 9d. per lb. In fair supply on a quiet market.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots.
Magnesium Carbonate—	
Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	70s.-80s. per cwt., according to quality and quantity.
Menthol	40s. per lb. spot.
Methyl Salicylate	2s. 3d. per lb. for carboys.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Morphine	Alkaloid—Cryst. 10s. 11d., Precip. 10s. 8d., Acetate 8s. 6d., Hydrochlor. 8s. 6d. Sulphate 8s. 6d. per oz.
Paraformaldehyde	3s. 9d. per lb. Lifeless.
Paraldehyde	1s. 5d. per lb.
Phenacetin	6s. 3d. per lb. Lower in value.
Phenazone	7s. per lb.
Phenolphthalein	6s. 6d. per lb. Firmer.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	94s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d. per lb. Good demand. Steady market.
Potass. Permanganate	10½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d. - 2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	5s. 6d. per lb.
Salol	2s. 9d. per lb. Very quiet.
Silver Proteinate	10s. per lb.
Sod. Benzoate	2s. 3d. per lb. Slow of sale.
Sod. Citrate, B.P.C. 1923	2s. 2d. per lb. for cwt. lots. In better demand.
Sod. Hyposulphite—	
Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.-87s. 6d. per cwt. Fairly good demand. Expected to improve with continued warm weather.
Sod. Salicylate	Powder 2s. 6d. per lb., and Crystal at 2s. 7d. per lb. Market stagnant.
Sod. Sulphite, anhydrous	£27 10s.-£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.-1s. 4d. per lb.
Thymol	15s. 6d. per lb. for cwt. lots of natural recryst.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.	
Aubepine	14s. ,, ,,	
Amyl Acetate	3s. ,, ,,	
Amyl Butyrate	7s. 3d. ,, ,,	
Amyl Salicylate	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	2s. 9d. per lb.	
Benzyl Benzoate	3s. 3d. ,, ,,	
Cinnamic Aldehyde	18s. 6d. ,, ,,	Advanced.
Coumarin	18s. 6d. ,, ,,	
Citronellol	19s. 6d. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate	15s. ,, ,,	Cheaper.
Ethyl Phthalate	3s. 9d. ,, ,,	,,
Eugenol	11s. ,, ,,	
Geraniol (Palmarosa)	32s. 6d. ,, ,,	Advanced.
Geraniol	5s. 6d.-12s. 6d. per lb.	
Heliotropine	8s. per lb.	
Iso Eugenol	16s. 6d. per lb.	
Linalol ex Bois de Rose	21s. ,, ,,	
Linalyl Acetate	21s. ,, ,,	
Methyl Anthranilate	7s. ,, ,,	
Methyl Benzoate	8s. 6d. ,, ,,	
Musk Xylol	11s. ,, ,,	Dearer.
Phenyl Ethyl Acetate	10s. ,, ,,	
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,	
Rhodinol	45s. ,, ,,	
Safrol	2s. 4d. ,, ,,	
Terpineol	3s. 1d. ,, ,,	
Vanillin	22s. 3d.-23s. 6d. per lb. Firm with steady demand.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.	
Anise Oil	2s. ,, ,,	
Bergamot Oil	12s. 6d. ,, ,,	apot.
Bourbon Geranium Oil	29s. ,, ,,	
Cananga Oil, Java	9s. ,, ,,	
Cinnamon Oil, Leaf	4½d. per oz.	
Cassia Oil 80/85%	11s. 6d. per lb.	
Citronella Oil—		
Java 85/90%	4s. 2d. ,, ,,	
Ceylon	3s. 8d. ,, ,,	
Clove Oil	8s.-8s. 6d. per lb.	
Eucalyptus Oil 70/75%	1s. 10d. per lb.	
Lavender Oil, Mont Blanc 38/40%	13s. ,, ,,	
Lemon Oil	3s. 1d. ,, ,,	
Lemongrass Oil	2¾d. per oz.	
Orange Oil, Sweet	13s. 7d. per lb.	
Otto of Rose Oil—		
Anatolian	24s. per oz.	
Bulgarian	30s. per oz.	
Palma Rosa Oil	19s. per lb.	
Peppermint Oil—		
English	80s. ,, ,,	
Wayne County	13s. ,, ,,	
Japanese	7s. 1½d. ,, ,,	Advanced.
Petitgrain Oil	7s. 3d. ,, ,,	

TRADE NOTES

Water Treatment

Messrs. Brunner, Mond and Co., Ltd., have issued a pamphlet of 32 pages devoted to water treatment. After considering the impurities present in natural water and the causes and effects of hardness in water, the quantity, measurement and removal of hardness are discussed, the chief methods of water-softening being described in considerable detail. The particular methods advocated in this pamphlet require the use as reagents of soda ash, caustic soda, calcium chloride, silicate of soda, chemicals which are all produced by Messrs. Brunner, Mond and Co. The Company's research department has been specially engaged upon the investigation of the action of natural waters on lead and iron. Special grades of silicate of soda are manufactured with varying proportions of silica and soda to suit the requirements of different types of water, and advice as to the most suitable methods of treatment can be obtained from the Company.

Trade of Canada in 1922—1923

Imports during the fiscal year ended March 31, 1923, were valued at $802,465,043, compared with $747,804,322 in 1921–22. The bulk of these imports were derived from the United States and the United Kingdom, the values supplied being as follows:—Fibres and textile products, United Kingdom, $69,339,824, United States, $77,285,998; wood, wood products and paper, U.K. $270,838, U.S.A. $31,841,957; iron and products of, U.K. $12,671,433, U.S.A. $124,371,885; non-ferrous metals, U.K. $3,595,638, U.S.A. $31,791,237; non-metallic mining products, U.K. $12,508,655, U.S.A. $114,641,860; chemicals and allied products, U.K. $3,636.013, U.S.A. $18,347,545. The value of the exports was $931,451,443, as against $740,240,680 in 1921—1922. Here again trade was mostly with the United Kingdom and the United States, the United States taking by far the larger proportion of the exports of chemicals and related products. The value of the exports of chemicals and allied products was $1,984,441 to the U.K. and $7,951,543 to the U.S.A. The other figures were as follows:—Wood, wood products and paper, U.K. $19,834,368, U.S.A. $191,363,061; iron and its products, U.K. $11,556,627, U.S.A. $9,409,265; non-ferrous metal products, U.K. $8,107,032, U.S.A. $27,889,699; non-metallic mineral products, U.K. $728,674, U.S.A. $20,817,688.—(*Bd. of Trade J., June* 21, 1923.)

Chemical Trade of Finland in 1922

During 1922 the value of the imports into Finland was 3953 million Finnish marks, and of the exports 4461 mill. mk., compared with 3953 mill. mk. and 3389 mill. mk. in 1921. Imports of chemicals and drugs increased in value from 72·33 mill. mk. to 121·16 mill. mk., whilst the value of the export of explosives, matches, etc. increased from 21·52 to 29·17 mill. mk. and of asphalt, tar, rosin, etc. from 10·88 to 11·23 mill. mk.

Imports of Indigo into Shanghai

In 1922 the imports of indigo into Shanghai totalled 211,895 piculs (picul = 132·3 lb.), which originated as follows:—Germany, 156,122 piculs; Switzerland, 37,822 piculs; United States, 12,637 piculs; France, 230 piculs; England, 85 piculs; Japan, 40 piculs; Hongkong, 4939 piculs. As the German agents also represented the Swiss producers, 90 per cent. of the import passed through German hands. The price of indigo fell from 60—90 taels in 1921 to 45 taels in 1922, but rose again in 1923 to 50 taels. Since January, 1923, roughly 1500 piculs of indigo per month has been imported from the United States.—(*Chem. Ind.*, **46**, No. 28.)

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Department of Scientific and Industrial Research. *Food Investigation Board, Special Report No.* 13. *Studies in Sweetened and Unsweetened (Evaporated) Condensed Milk. By* W. G. Savage, M.D., B.Sc., *and* R. F. Hunwicke, B.Sc., A.I.C. *Pp.* iv+103. *H.M. Stationery Office*, 1923. *Price* 4*s.*

Insect Pests in the Cacao Store (*pp.* 16). The Separation and Uses of Cacao Shell (*pp.* 8). The Application of Science to Cacao Production (*pp.* 8). *By* A. W. Knapp, B.Sc. *Publication Department, Bournville Works, Birmingham*, 1923. *Price* 6*d. each.*

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EDITORIAL

SOME months have passed since Messrs. D. Coster and G. von Hevesy announced in a letter to *Nature* their discovery of a new element of atomic number 72, which they proposed to designate as Hafnium. This announcement at once called forth a protest from Professor Urbain, who pointed out that the element he had discovered in 1911 and named Celtium, had prior claim to the atomic number 72, as had been shown by Dauvillier in 1922. The question promised to be very thorny, as at one time it was uncertain whether two or three elements were in question. But the discussion was soon narrowed down to two elements and the question of the claims of the French and Scandinavian chemists. On March 16, we were able, through the kindness of Professor Biilmann, to publish an article on the subject by Messrs. Coster and Hevesy, who, it seems, lay stress on the following points: (1) the discovery of celtium could not be reconciled with Bohr's theory and (2) the optical spectrum of hafnium obtained by them was entirely different from that described by Urbain for celtium. So far only one side of the case has been stated and we are glad to draw attention to the interesting contribution, beginning on p. 764 of this issue, in which Prof. Urbain reviews the whole question and replies to the evidence adduced by Messrs. Coster and Hevesy. This completes the case, but judgment has still to be delivered. We, therefore, propose to print in our next issue an article in which the evidence is examined dispassionately and an attempt made to indicate the logical conclusion to which it leads.

* * *

The saying that of the making of books there is no end, was never so true as it is to-day. And what a gulf there is between methods old and new! Gone are those spacious days when, as a volume in our possession assures us, Henry Pemberton could issue *A View of Sir Isaac Newton's Philosophy,* dedicating it to Sir Robert Walpole with the warning that "if it were performed suitable to the dignity of the subject, (it) might not be a present unworthy of the acceptance of the greatest person," and hoping that "this attempt, imperfect as it is, to give our countrymen in general some conception of the labours of a person, who shall always be the boast of this nation, may be received with indulgence . . ." in a huge, leather-bound volume of 407 pages, illustrated with choice mythological engravings. What would be thought if some active person were to publish a "view" of the work of a modern scientist, incorporating a poem ("received from a young gentleman") beginning,

> "To X's. genius and immortal fame
> The adventurous muse with trembling pinion soars,"

and following a dedication to the Prime Minister with a list of subscribers, including peers, colonials, clergymen, lawyers and even merchants. Gone, too, are the times when it was possible to say, as did Gibbon of Adam Smith's *Wealth of Nations:* "An extensive science in a single volume and the most profound ideas expressed in the most perspicuous language." These thoughts were called up by Sir Edward Thorpe's most interesting review of *Roscoe and Schorlemmer,* which we print in another column and which awakened many memories, some painful, some pleasant. A new edition of the invaluable Thorpe's *Dictionary* is approaching completion. Richter's *Organic Chemistry* has gone through eleven editions in German alone and, not least, *Roscoe and Schorlemmer* is now in process of rejuvenation. We wondered, thinking of X-ray spectra and of many other modern developments, what kind of library a chemistry student would have in 2023. Nowadays, a single volume can contain but a very small part of any science, so extensive has knowledge become, and to treat a subject adequately implies the preparation and analysis, not to mention the control, of an enormous mass of material. Think of the pages of references in Mellor's Treatise on inorganic and theoretical chemistry alone !

* * *

Another instance of modern complexity is provided by Dr. F. W. Aston's letter to *Nature* of August 4 on the mass-spectrum of copper. After referring to the empirical rules that, without exception so far, none of the elements of odd atomic number consists of more than two isotopes and that, with the exception of nitrogen, the more abundant of the two constituents, or both (except the weaker constituents of lithium and boron), will be of odd atomic weight, Dr. Aston states that he has examined the mass-spectrum of copper and has found faint lines appearing at the expected positions 63 and 65. Professor Dempster recently announced that the above rules would not hold as he found that copper had the three isotopes 62, 64 and 66. Dr. Aston suggests, however, that the lines described by Prof. Dempster agree exactly with those of the strong isotopes of zinc and were possibly due to the presence of traces of that element, either in the copper or more probably in the furnace material.

* * *

This is a time when the professor finishes correcting examination papers and the manufacturer takes no interest in process costs, flow sheets and market reports. Every morning we receive notes expressing the happiness the writer will feel in submitting an article when he comes back from Appin or Kinloch Rannoch, from Llangollen or Tromso. For our part there is a little dale in the North of England, which is more restful than the more expensive and luxurious watering places scattered about the South and East Coasts. One favourite haunt we have in mind, a little smiling corner which above all others cheers us, whose honey is not inferior to that of Hymettus, and whose fruits rival the grapes of Italy. *Cur valle permutem Sabina divitias operosiores?* Why should we exchange our simple dale for the great hotel where we must dress for dinner ? Some we know are already on their way to Bordeaux and the Pillars of Hercules; some have started for Madagascar and the still-vexed Bermoothes ; some favoured by the winds will reach, after a pleasant voyage, Flensburg and Kiel ; others leave for Ostend or Paris : a favourable wind will speed them from the harbour, already the haughty captain calls impatiently, cursing the delay ; hurry up, the ship will wait for no single passenger ! But wherever we go, let us come back refreshed, there is much to be done a month hence. The task calls to us : "Make the most of your holiday, I am waiting for you." Does not the poet in a loftier strain tell us, "Grim death approaches and one of these days, 'Make the most of your life, I am coming,' he says."

SHOULD THE ELEMENT OF THE ATOMIC NUMBER 72 BE CALLED CELTIUM OR HAFNIUM?

By Professor G. URBAIN

It will be useful to summarise briefly the note "On Celtium, a New Element accompanying Lutecium and Scandium in Gadolinite Minerals," which I published in 1911 (*Comptes Rendus*, **152**, p. 141).

After very numerous fractional crystallisations of nitrates of elements of the ytterbium group derived from gadolinite, I separated a few oily drops of last mother-liquors which refused to crystallise. By the well-known methods for separating the rare earths from the other elements, which are indeed only approximate methods, I extracted some centigrammes of a mixture of oxides which, from a study of their arc spectra, was shown to contain a good deal of lutecium, less ytterbium and very little scandium. In addition, I observed a considerable number of new lines which did not appear in any table giving the lines of known elements. I concluded from this and some other observations of less importance that a new and unknown element had been concentrated in the mother-liquors from the fractionation. I gave this the name of Celtium, and supposed that it formed the last term of the series of the rare earths.

My article only mentioned the strongest of the new lines observed ; more than ten years afterwards, however, it became evident that the lines properly belonging to the new element were among the faintest of the lines.

The strongest lines mentioned must be attributed to lutecium. They are spark lines which it had been impossible for me to observe in other samples, however rich in lutecium. I have kept the very small quantity of material which remained after the many experiments made in 1911, and an occasion to make use of this was presented in 1914, when Moseley announced his celebrated law. Thenceforward, the atomic number of every element is determinable by the position of the high frequency lines or X-ray spectra.

I therefore visited Oxford in July, 1914, and Moseley made an X-ray spectrum from my material (G. Urbain, *C.R.*, 1922, 174, p. 1349). This spectrum reveals solely—for the method was at that time not very delicate—the presence of some ten lines at the most, all of which were attributed to lutecium and ytterbium. Without a knowledge of the atomic number, the existence of celtium remained in suspense. I hoped to clear up this question by every possible means, when the war broke out. I was mobilised, which cut short all scientific research, but after the war I communicated with M. de Broglie, who is particularly experienced in X-ray spectra, and explained to him the interest there would be in a repetition of the experiments of Moseley on celtium, making use of a more delicate method. With the aid of such an improvement, where Moseley had been able to see for some element four or five lines of the X-ray spectrum, M. de Broglie was able, in 1922, to observe 30. The examination of substances containing celtium could therefore be attempted afresh, and M. de Broglie asked his collaborator, M. Dauvillier, to make the experiment. M. Dauvillier obtained a very extended exact spectrum in which he observed two new lines attributable to the element 72. On this subject he wrote (Dauvillier, *C.R.*, 1922, **174**, p. 1347), ... "two extremely faint lines demonstrate the existence of celtium and assign to it the atomic number 72. These lines are $\beta_2 = 1319{\cdot}4$ and $\alpha_1 = 1561{\cdot}8$."

He showed that these two lines could neither be attributed to erbium nor to holmium, the presence of which would have added to the confusion. These two elements were entirely absent, since their principal lines could not be detected.

A comparison of my article of 1911 with that of M. Dauvillier shows the corrections which the latter affords; on the main point, that is to say, the existence of a new element, we agree. M. Dauvillier is quite positive on this point. He assigns the number 72 to this element and calls it celtium.

Nevertheless, M. Dauvillier only distinguished a trace of celtium in a substance where I had originally supposed much to be present. It, therefore, became probable that the strong new lines which I had mentioned in 1911 did not belong to the new element, but to some other element which accompanied it (G. Urbain, *C.R.*, **176**, p. 469). Experiments subsequently made in my laboratory have now convinced us that these lines belong to the spark spectrum of lutecium (J. Bardet, *C.R.*, **176**, p. 1711).

We can draw from these preceding observations certain conclusions which will be helpful in the latter part of this memoir.

1. My material did indeed contain, as I have stated, a new element; its X-ray spectrum showed that this was the element whose atomic number is 72.

2. M. Dauvillier and I agreed in calling this element Celtium, because we were certain that it was the same new element which had been detected by me in 1911.

3. The lines which I had mentioned in 1911 did not belong to celtium but to lutecium.

The mistake in interpreting my work of 1911 was corrected by these observations of 1922 (Dauvillier, *loc. cit.*; G. Urbain, *C.R.*, **174**, p. 1349). In effect, to define an element it is sufficient, in the present state of our knowledge, to know its atomic number. The X-ray lines of No. 72 having been observed and this element having been called celtium by those who discovered it, it is inadmissible that the number 72 should be now called by another name, unless some priority is duly established.

I think I should insist on the point that it is logically absolutely futile to complain about what was written in 1911, since the results of 1922 provided a definite answer to the question.

But now, Messrs. Coster and von Hevesy in 1923 (*Nature*, January 20, 1923) observe in zirconium minerals the same X-ray spectrum of the element 72, that is to say, the spectrum of celtium, already observed by us in 1922 in a different material. They were led to choose zirconium by the theoretical ideas of Prof. Bohr, who, from *a priori* reasoning, considered the element 72 should be a satellite of zirconium. Is that a sufficient reason for changing the name of the element 72, which had already been called celtium ?

It is not of great importance in the discovery of a new element whether one finds it associated with the rare earths or with zirconium. There is no law which compels the elements to associate themselves strictly in accordance with their classification, however excellent this may be, and chemistry presents far too many cases to the contrary to justify such an argument.

Besides, the merit of bringing together celtium No. 72 with zirconium belongs either to Mr. Bury (*Journal of the Chemical Society*, 1921) or to Prof. Perrin, who after consulting me made this suggestion and indicated this in 1921 in the last edition of his book, "Les Atomes," 1921 (1921, *Liste des Elements*, p. 512), that is to say two years before Messrs. Coster and von Hevesy dealt with the matter.

So it seems the idea which guided the Danish men of science was not new, and, on the other hand, the spectrum which they have obtained does not differ from that obtained by M. Dauvillier, so that their argument is not justified in any way.

The question is, do the lines in the X-ray spectrum observed in my material belong to the element No. 72, or do they not ? This is the whole question, and it only leads to confusion if one gets away from it. Let us see then what Messrs. Coster and von Hevesy have said on this essential point.

Messrs. Coster and von Hevesy (*Nature*, January 20, 1923): "The only lines which Dauvillier claims to have detected are the lines $L\alpha_1$ and $L\beta_2$, both of which he finds to be extremely faint. The wave-lengths he gives, however, for these lines are about 4 X-units ($X.u = 10^{-11}$cm.) smaller than those which are obtained by a rational interpolation in the wave-lengths of Hjalmar and Coster, for the elements in the neighbourhood of 72."

Messrs. G. Urbain and A. Dauvillier (*Nature*, February 17, 1923): "On their side, Messrs. Coster and Hevesy have observed in certain zirconium compounds of Norwegian origin six high frequency lines characteristic of the element 72. This result was immediately tested by one of us with a sample of zirconium. The lines attributed to element 72 coincide exactly with those found in the ytterbium minerals, with this sole difference that the proportion of element 72 contained in them is notably larger." And in the note, "A photograph of the spectrum obtained with another fraction of ytterbium mineral with an improvement of the experimental conditions (the oxides strongly compressed and calcined in vacuo, in a linear anticathode furnace) has already furnished us with a clearer and more intense line measurable with greater precision. We have thus found: $\beta_2 = 1322{\cdot}8$ and $\alpha_1 = 1564{\cdot}1$ X. u., figures which coincide with the values obtained by interpolation."

It follows from this that the argument put forward by Messrs. Coster and von Hevesy cannot concern anything except the accuracy of the measurements, which is of no consequence in the question of the existence of the lines which alone is of interest in the question of priority.

The accuracy of the measurement is really of secondary importance. It is sufficient to observe one line of the X-ray spectrum in a given spectral area to identify an element, unless some other element has lines in this particular area. What have Messrs. Coster and Hevesy replied to this? We read in *Nature* of February 24, 1923, p. 252, one phrase which proves that they avoid our reply. They say in effect: "Our main reasons for believing that the element celtium, the detection of which was announced by Urbain in 1911, is altogether different from the element detected by us and named hafnium, are . . ."

Messrs. Coster and Hevesy obviously forget that they named the element 72 hafnium because they had observed later than we did the lines of its high frequency spectrum. But in our note which appeared in *Nature* of February 17, and which Messrs. Coster and Hevesy were acquainted with (because they say in their second letter that the Editor of *Nature* had had the courtesy to communicate our reply to them before publishing it), we said:—

"2. The examination of the high frequency spectrum of compounds containing celtium had the definite aim of finding out if this element could be identified with element 72. It would have been very remarkable after having observed this high frequency spectrum not to have attributed it to celtium. But even if the arc-spectrum and the high frequency spectrum in question could not be attributed to the same element (as we have logically admitted), it remains none the less true that we were the first to discover the element 72. In consequence Messrs. Coster and Hevesy have not the right to give it a new name themselves. But Messrs. Coster and Hevesy leave one to understand that the high frequency lines observed by Dauvillier do not exist on our photographs, or that he has been mistaken as to their origin. They say, in fact, in the same note:—'Quite apart from the possibility of accounting for these lines as due to a higher order spectrum of other elements, it seems to be very unlikely that these lines should be due to a contamination of Urbain's preparation by a trace of hafnium.'" (*Nature*, January 20, p. 79.)

It seems to be necessary to indicate precisely the nature of the elements whose X-rays lines of a superior order could be confused with those which we have attributed to element 72. It is strange that these gentlemen keep less to the question of fact than to the probabilities which they deduce from their theoretical opinions, but what is even more surprising is that they systematically neglect our very clear reply on the exact coincidence of the lines of 72 observed in my celtium samples, and those finally observed by us in a celtium-bearing zirconium. They say a little later on:—

"They do not coincide within the limit of experimental error with our measurements of the hafnium X-ray lines $L\alpha_1$, and $L\beta_2$, but also the reason given by Dauvillier for not detecting the line $L\beta_1$, which is stronger than $L\beta_2$, can scarcely be maintained. In fact, our measurements for this line give a value which differs about 3 X-units from the Lu-line denoted by Dauvillier as $L\beta_2$, and with the dispersion used it should be easily separated from the latter line."

Can Messrs. Coster and Von Hevesy believe that an experimenter can be found who does not prefer to identify his lines by a method of coincidences (which does not admit of error), rather than by a method of measuring which necessarily admits of errors? If, on the other hand, Messrs. Coster and Hevesy do not take into account the definite replies which we have made to their criticisms, to whom are they addressing their remarks? We cannot leave without any reply the criticisms of those who have disagreed with us.

In his letter on "The high frequency spectrum of celtium," Dauvillier (*C.R.*, 176, p. 676) says: "In a new letter to *Nature* (February 24, 1923), Messrs. Coster and Hevesy question our having attributed to celtium the lines 1319·4 and 1561·8 X-units which we have observed in a preparation of oxides of ytterbium of M. Urbain. They base their argument on the three following statements:—

1. These lines do not coincide, within the limits of experimental error, with the theoretical interpolation values and the wave-lengths observed in zirconiferous ores.
2. They might come from spectra of superior orders from other elements.
3. We have not observed line β_1, which ought to be visible on our photograph.

We are therefore obliged in this letter to explain in detail the reasons which justify the conclusions which we drew.

(1) There is an effective disagreement of about 3 X-units (10^{-11} cm.) between the wave-lengths published by us and their most

probable values for the lines β_2 and α_1 of celtium, but this difference is by no means outside the limits of possible error. These limits vary in effect a good deal in accordance with the intensity, the nature and the positions of the lines. Our dispersion corresponded with 7 X-units per millimetre. Normally-placed lines with distinct margins can in these conditions be measured by their centres to an accuracy of about 0·1 millimetre, but very feeble lines like those which are here in question can only be measured to an accuracy of about two-tenths or three-tenths of a millimetre.

With the point light source (1·2 mm.) and the wide slit (0·4 mm.) which we then used, these very fine lines appear always diffuse. They cannot be distinguished when viewed too closely and can only be read when viewed from a certain distance. They are besides a little irregular (which makes their definition difficult), by reason of the defects of structure of the salt crystals and an alteration of the reflecting surface which is difficult to avoid. The lines in question are nevertheless beyond doubt, and we have measured many such (γ_9, γ_{10}, γ_{11}, β_7, and β_5 in the group of the rare earths, β_{11}, etc.) which can be classed in the series and are capable of theoretical interpretation. We have besides improved our experimental method. . . . In these conditions the lines have appeared less diffused and have permitted of better definition. We have thus found $\beta_2=1323$ and $\alpha_1=1564$ X-units, figures which coincide with the probable values. The photographs obtained by both methods show no difference appreciable to the eye in the position of the lines when one compares them directly with a more intense spectrum of celtium obtained from the zirconiferous preparation.

(2) Can the lines in question belong to a spectrum of a high order of some other element ?

(*a*) Line β_2. This line cannot belong either to the first or second order of the K spectrum of any element known or unknown. It cannot be a third order of the feeble line K of indium, according to an ancient measurement by Friman, because the limit of K absorption measured by Duane indicates for this line, in accordance with other considerations, the value of 445 X. Another line of the fourth order is not compatible with the tension made use of. In the L series this line cannot be β_1 of tantalum, nor γ_7 of erbium, for the strong lines γ_1 and α_1 of the first of these elements, and β_1 and β_2 of the second element are absent, in accordance with the results obtained from special study of the arc spectrum of these elements. This line cannot belong to a second order of the L series of another element.

(*b*) Line α_1. No line of the K series of the first order shows this wave-length. It is not a line Kα_1 of zirconium of the second order, for this element has been vainly sought for in its first order spectrum with an exposure which should have made its lines two or three times more intense than is the line in question. The arc spectrum has confirmed its absence. It cannot be the line Kβ of palladium in the third order because the line Kα_1 is not visible in the second order. Finally, it is not the line Kα_0 of barium in the fourth order because the lines in this element have not been observed in the third. In the L series this line coincides only with β_2 of holmium, of which the line β_1 should be notably stronger. Only a very doubtful trace appeared in this position on a photograph from another preparation rich in thulium in which no ray of erbium was visible. The ray in question is certainly not β_2 of holmium. The possibility of an L line in the second order is excluded.

(3) The line β_1 β_6 of celtium is not plainly visible on the first of our photographs, although it differs by three X-units from the satellite of β_2 of lutecium, but one must remark that it ought to have appeared between a very strong and persistent line β_2 of lutecium $=1366·7$ and a sufficiently intense, wide and diffuse line Kγ of copper$=1377·7$ in a spectral region of a theoretical width of 11 X-units. But it is impossible to distinguish a fine line under these conditions, and this is proved by the fact that β_6 of lutecium, which ought also to be placed in the centre of an interval existing between two strong persistent lines β_2 Yb$=1412·4$ and β_1 Lu$=1420·5$ ($\Delta=8x$) is absolutely invisible, although it was previously much more intense, *i.e.*, when viewed alone. On the other hand, in a photograph obtained with a linear source, avoiding the presence of the lines of copper and dealing with a preparation not so rich in lutecium, we have observed one more fine line measuring 1378 X-units and having the same intensity as β_5 of ytterbium. This line is neither γ_4 of dysprosium nor any other L line of the second order. It does not correspond with any possible K line of the first order. It is neither Kγ of zirconium of the second order nor Kα of tellurium of the third order, nor Kβ of barium in the fourth order."

To this closely-reasoned and rigorous argument, what have Messrs. Coster and Hevesy replied ? Nothing, at least so far as our knowledge goes. The question of fact is therefore as follows :—

(1) The X-ray lines observed by Dauvillier are without dispute characteristic of element 72.

(2) Messrs. Coster and Hevesy cannot have discovered it, and have no right to give it a new name. In fact, it is reserved to those who have first observed the characters of the element hitherto unknown to give it a name, and from the time that element 72 received the name of celtium, it is this name that ought to be preferred.

All that remains of the arguments of Messrs. Coster and von Hevesy are their purely theoretical considerations. I have already stated that no purely theoretical reasoning ought to prevail against a well-established question of fact, and the fact is the following :—

The sample of material rich in lutecium, which is the subject of this dispute, contains, notwithstanding any doubt cast upon it by Messrs. Coster and von Hevesy, a trace of a new element, foreseen and designated by Moseley under the atomic number 72 and named celtium by Dauvillier and me. In the theoretical considerations of Messrs. Coster and von Hevesy, one must separate those which are well founded and those which are exaggerated. Celtium is, it appears, a homologue of zirconium. On this point Bohr has some ideas, the value of which I contest less because I had accepted the similar opinion of Perrin long before I knew the ideas of Bohr on this subject. I accepted this opinion without the least difficulty because there is no sort of objection—not even Bohr's theory of atomic constitution—to the fact that elements with distinct valencies accompany each other in various chemical reactions. Do we not know that thorium, which is tetravalent, is always accompanied by [the rare earths ? It would be futile to make a list of the elements with distinct valencies which are very difficult to separate chemically and which cling so closely together that one cannot separate them in a state of spectroscopic purity except by very laborious treatment.

Messrs. Coster and von Hevesy cannot be ignorant of such well-known facts. Besides, Bohr's theory is only concerned with facts which have some relation to the atom, and chemical phenomena hardly come under this category, unless the elements are taking part in the reactions as simple ions. It is altogether improbable that zirconium can in aqueous solution act as a simple ion Zr^{++++}. On the other hand, it is highly probable that, in aqueous solution, zirconium is always present in some complex ion. It remains to be seen whether Bohr's theory enables one to foretell how complex ions can behave chemically. It is not less certain that there exists a very large number of cases of isomorphism, which escape the law of Mitscherlich, and which one cannot interpret without the supposition of complex isomorphous groups, as, for instance, in the fluorides of titanium (valency 4) and the oxyfluorides of niobium (valency 5).

Besides these facts, there exist others which relate to the phenomena of adsorption by precipitates. I have found celtium in rare earths which had been submitted to numerous precipitations and previous crystallisations, and I naturally supposed that I was dealing with a rare earth, the doctrine of Bohr being at that time unknown.

In conclusion, I may recall a little piece of history. Crookes, who discovered thallium in mixtures of selenium and tellurium, which certainly did not contain more of it than my ytterbium earths contained celtium, took thallium as a homologue of selenium. I do not suppose that there was any chemist who, under the same conditions, would not have made the same mistake. After some time, Lamy rediscovered thallium, and as he recognised that in its metallic state it resembled lead and as an ion resembled potassium, he tried to do to Crookes what Messrs. Coster and Hevesy are trying to do now with Monsieur Dauvillier and myself. He claimed that thallium did not belong to the same group as tellurium, that the reactions cited by Crookes were illusory, that his green line emanated from an impurity in his material, and that in consequence the true discoverer of thallium was Lamy. Nevertheless those who were competent to judge did not agree and thallium is now universally credited to Crookes, though this does not imply that the work of Lamy was not work of the very first order.

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CHEMISTRY IN THE ELECTRICAL INDUSTRY

By ALAN A. DRUMMOND, M.Sc.

The value of the chemist's work in the electrical industry is not always recognised, particularly when the branch concerned is that of the manufacture of electrical machinery as distinct from electrochemical manufactures. The construction of electrical machinery, however, involves the use of a wide variety of materials, and a knowledge of the chemical properties of such materials and their behaviour under varying chemical and physical conditions is of great importance in the control of manufacture and in ensuring uniform and standard results from the manufactured products.

The uses, for instance, of metallurgical chemistry are apparent in providing suitable specifications for the metals to be used in the construction of electric motors, transformers and the like, and in studying the causes of faults and breakdowns. Again, chemistry both organic and inorganic is involved in the manufacture of electrical insulating materials, as these are made from a great range of different substances. The more the specific properties of these substances are known and appreciated, the greater the efficiency of the insulators manufactured and the greater the economy that can be effected in the manufacture. Such knowledge and appreciation can be satisfactorily supplied by the chemist.

Insulating varnishes offer great possibilities of variation in quality and behaviour, and unless carefully checked and tested in the laboratory, are likely to cause a great deal of trouble, expense and annoyance, especially if each new batch requires some alteration in the factory routine in order to give satisfactory results. A pre-determination in the laboratory of the behaviour to be expected will obviously allow of economy of time and materials. Experiments on the factory scale that interrupt the usual factory routine are to be avoided wherever possible.

In respect of insulating varnishes alone a brief consideration of the properties which require to be investigated and tested in the laboratory will reveal the large field for the work of the chemist in the electrical industry. Thus, for example, the properties of viscosity and density are important in their influence on the penetrating power of the varnish. It will be realised that varnishes of equal insulating properties will show the superiority of one over another by the value of the penetrating power. Again, with dried varnishes tests are required of flexibility and durability during use not only under ordinary conditions, but at high temperatures and in moist atmospheres. Heat insulation and resistance to the action of chemicals (acids, alkalis and solvents such as petrol, benzol and oils) must be tested. A vital factor is the time required for drying. Insulating varnishes which possess good air-drying properties are extremely valuable. The majority of these varnishes require stoving and this treatment requires laboratory control, as too little stoving will tend to give sticky films and over-stoving may detract from the flexibility and wearing properties of the varnish.

Although the determination of the dielectric strength, the breakdown voltage and the electrical resistance is strictly a matter for the electrical engineer, the chemist is able to appreciate the significance of the figures obtained and is able to correlate them with the values obtained in determining the chemical properties. In this way it is possible to specify the most closely suitable material for the particular object in view.

Softening point and inflammability are two remaining tests that must be applied to these varnishes.

The variety of properties requiring study in insulating varnishes may be better realised on considering the different groups into which such varnishes can be divided. Fleming and Johnson (" Insulation and Design of Electrical Windings," Longmans, Green and Co.) make the following classification according to the applications :—(A) For impregnating windings; (B) for treating papers and fabrics; (C) for cementing purposes; (D) finishing varnishes. Division can also be made according to properties into: (*a*) oxidising, and (*b*) non-oxidising, and again into (1) air-drying and (2) stoving. It is easily realised that varnishes of class (A) and class (B) must be capable of withstanding the action of oil and moisture and, preferably, high temperatures, and that other special properties are called for when varnishes of classes (C) and (D) are specified.

The remarks on insulating varnishes apply also to insulating compositions for moulded work, from the ordinary pitch and asbestos mixtures to the more efficient products made with high melting resins, more particularly those obtained from the condensation of phenolic bodies with formaldehyde. With such compositions the properties of softening point, inflammability and water-absorption are among the first to be tested by the chemist who is called upon to criticise any such new material.

The manufacture of formaldehyde condensation products for the electrical industry calls particularly for chemical control. The delicacy of the reactions involved, say, in the manufacture of "Bakelite" is well known. Without the chemist such a manufacture is hardly to be undertaken. Chemical checking of the quality of the raw materials and of the exact condition of the condensation products at the various stages in their manufacture, is of paramount importance.

After the condensation product has been prepared the methods of application require to be controlled from the laboratory. Suitable mixtures and processes of mixing can only be made in a uniform manner by means of careful and systematic tests. Faults in manufacture are often in such cases to be explained on chemical grounds, and their prevention and cure can only be guaranteed by the constant attention of the trained chemist.

The extended employment of the chemist in the manufacture of formaldehyde condensation products has resulted in much improved and simplified methods. Control of the reaction has been made more certain, so that considerably increased charges are being worked than was formerly possible, with the result that economy of manufacture in time of operation and labour required has been effected. The plant required has been simplified. For instance, in the final stoving of articles containing phenol-formaldehyde resins it was originally recommended that the temperature of operation should be 140°–180° C. and at pressures of 100 to 150 lb. per sq. in. It is now, however, easy to obtain resins, suitable for impregnating coils, in such a condition that the final non-reactive state can be arrived at by means of lower temperatures and at atmospheric pressure and consequently with less elaborate plant. The time of operation is necessarily increased by this less vigorous treatment. W. S. Flight (*Beama*, 9, 1921, p. 542) quotes a table showing the effect of temperature on the time taken to complete the condensation and polymerisation :—

Temperature ° C.	Time. hrs.
90	14
100	11½
110	9½
120	7½
130	5½
140	3½
150	1
160	30 minutes
170	20 minutes

As a means of checking the condition of the initial condensation of phenol and formaldehyde during its syrupy stage, viscosity values have been used and a large amount of working data has been accumulated controlling these processes. The following table gives some idea of the order of the viscosities looked for by the chemist in dealing with these products :—

Stage of reaction	Viscosity in c.g.s. units
Early	8·6
Intermediate	122
Final syrup	185

In addition to formaldehyde resins the following materials are used in the manufacture of insulating varnishes :—Asphalt and bitumen, stearin pitch, linseed oil and other drying oils, ozokerite, ceresin, paraffin, the natural gums and resins such as copal, dammar, rosin, shellac, and the numerous animal and vegetable waxes. It is not difficult to realise that unless chemical knowledge and skill is made use of in dealing with such a variety of materials troubles inevitably befall the electrical insulating-varnish manufacturer and user. Coffignier ("Les Vernis," 1921, p. 513) has classified the faults often occurring in varnishes when skilled supervision is absent :—

Faults	Possible causes
Lack of drying properties	Wrong proportions of the different constituents. Lack of driers. Wrong boiling of the oil or adulterated oil.
Settling of the varnish	Excess of volatile solvent.
Wrinkling of the varnish	Shortage of volatile solvent.
Streaking of varnish	Excess of drier.
Whitening of the varnish	Poor gums, addition of colophony, and excess of driers.
Dull varnish	Wrong heating of the gums. Lack of elasticity.
Blistering of varnish	Insufficient oil, poor quality of gums.
Varnish exuding grease	Excess of oil.
Cracking of varnish	Poor quality of raw materials.

Insulating varnishes are often used as binding agents for powdery and fibrous materials (so-called "fillers") to form the insulating compounds which are moulded into the various shapes required for insulating fittings in electrical work. Among these "fillers" may be mentioned asbestos, mica, silica, powdered glass, sand, slate, wood and cork dust, and china clay. It is for the chemist to apply chemical principles and examine the respective specific properties so that some order may emerge from this heterogeneous collection of substances. Many of the existing compositions are obtained by the "hit-or-miss" method and do not result from the application of scientific method and knowledge.

This brief and general survey of some of the chemical problems connected with the electrical industry may draw renewed attention to the necessity for making use of chemical knowledge in a realm where engineering has held sole sway.

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS

The Society of Chemical Industry has in each of the past two years held a dinner in London in the month of October, but for the present year arrangements have been made for an Informal Dinner and a Social Gathering of Chemists under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, which members of these, and of any other of the Chemical Societies, with their friends (including ladies) may attend.

This dinner will be held in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on the evening of Wednesday, October 31, at 7 for 7.30. The price of tickets for ladies or gentlemen will be 12s. 6d. each, not including wine.

Further particulars will be issued later, and the Councils hope that Members of the Societies mentioned, who intend to be present, will make early application for tickets, which must be limited to 300. These will be issued in the order in which applications accompanied by payment are received.

Applications should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2.

CHEMICAL SOCIETY'S LIBRARY

Owing to the work of redecorating the rooms of the Society, the Library will be closed during the entire month of August.

The Library will therefore close on Tuesday, July 31, at 9 p.m., and reopen on Saturday, September 1, at 10 a.m.

The Library, in accordance with the usual practice, will be closed at 5 p.m. from September 1 to 17, on and after which date it will remain open until 9 p.m. every day except Saturday, when it will close at 5 p.m.

ROTHAMSTED LIBRARY

By the courtesy of the Lawes Agricultural Trust, any member of the Society of Chemical Industry on presenting a card from the General Secretary shall be allowed access to this Library. The rules of the Library preclude journals and periodicals from being sent out, and these are therefore always accessible.

A catalogue of the journals and periodicals is in the Society's Offices, at Central House, and may be consulted there by members.

THE FARADAY SOCIETY

On July 13 and 14 a conference on the "Electronic Theory of Valency" was held at Cambridge, the attendance numbering 120 and including several foreign guests as well as representative British chemists and physicists.

The first session, on the afternoon of July 13, was devoted to the application of the electronic theory to the problems of inorganic chemistry. Sir J. J. Thomson, who presided, observed that a limit was set to the number of electrons that one atom could contain. When the number of electrons was small, the octet grouping was particularly stable, but with a different law of force, a sextet might be more stable than an octet. The problem of molecular structure could be best investigated by examining cases of substitution; thus the electric moment introduced in replacing hydrogen by chlorine could be calculated and measurements of the specific inductive capacity of various types of molecules showed that the moment was of constant magnitude. "Valence of the Electrons" was discussed by Prof. G. N. Lewis, who said that Bohr's view that the rare gases from neon to niton and all the stable elementary ions, possessed 8 electrons in the outer shell, fully justified the octet theory. The fundamental phenomenon of chemistry was the formation of pairs of electrons; only about six out of the thousands of known substances contained uneven numbers of electrons. Prof. Lewis then spoke of the conversion of a covalence into an electrovalence, but objected to the use of the term "valence" to express the electrical state of the atom, as he considered the ionised bond was no longer a bond. Papers read by R. H. Fowler on "Bohr's Atom in Reference to the Problem of Covalency," and by Dr. N. V. Sidgwick on "The Nature of the Non-polar Link," led to an interesting discussion in which Sir J. J. Thomson said that two electrons were not necessary to make a bond, as H_2^+ was one of the most persistent aggregates in positive rays, but Mr. Fowler objected that such aggregates appeared incapable of resisting chemical combination. Prof. W. A. Noyes outlined the history of the theory of ionisation and urged that the distinction between polar and non-polar union was one of degree and not of kind, the basic factor in both unions being the pairing of electrons. Sir W. Bragg discussed the lengths of the carbon chains in fatty acids and esters, and advanced explanations for the observations that each additional carbon atom in the alcohol radical increased the length of the carbon chain by 1·22 A.U., whereas the average increase for the acid radical was only 0·97 A.U.

On July 14, applications of the electronic theory of valency to organic chemistry were discussed, Sir R. Robertson presiding. Prof. Lowry showed how the electronic theory enabled two types of valency to be discriminated and said he believed that only two types of valency were needed, the other types of valencies, bonds, etc., being manifestations of electrovalence. Further evidence was needed before a third mechanism of transmission need be admitted. In a paper on "Some Recent Contributions to the Theory of Induced Alternate Polarities in a Chain of Atoms," Prof. Lapworth considered six theories advanced to explain these phenomena and criticised some of the views upheld by Prof. Lowry. Prof. Robinson discussed "Octet Stability in Relation to Orientation and Reactivity in Carbon Compounds," observing, as had Prof. Lapworth, that optical activity was often retained in chemical changes, although it should disappear because the intermediate product, according to convention, would be symmetrical. This retention could be explained by the preservation of asymmetry in one atom by means of partial valencies until stabilised either in the same or another atom. Dr. E. K. Rideal examined the bearing of the theory of polarity on the reactivity of organic compounds, and Mr. R. G. W. Norrish described an experiment in which interaction of bromine and ethylene was almost stopped by lining the vessel containing the gases with paraffin wax, although the gases react at once when in contact with the polar surface of a glass vessel.

During the ensuing discussion, Prof. J. F. Thorpe claimed that the theory of polarity explained everything but predicted nothing, in marked contrast to the stereochemical theories of van't Hoff; a contention which was vigorously opposed by Messrs. Heilbron, Lapworth, Noyes and Robinson. Dr. Flürscheim replied to Prof. Lowry's criticism of his explanation of the influence of substitution on the strength of carboxylic acids, and Prof. Lewis pointed out that breaking a double bond does not necessarily remove *cis* and *trans* isomerism, an observation that was supported by Mr. Bury. In conclusion, Prof. V. Henri presented a remarkable paper on "Molecular Polarity deduced from the Study of Absorption Spectra," in which he concluded that quantified motion may occur in electrons, atoms or molecules, giving rise to broad absorption-bands, narrow absorption-bands and a fine structure of these bands respectively. Many photographs were shown to illustrate the various types of absorption spectra.

ACADÉMIE DES SCIENCES

Prof. Perrin presented two papers at the meeting held on July 23. The first was by Monsieur Job, who explained that the blackening of phosphorescent zinc phosphide is due to a series of intermediary reactions. In the second paper Monsieur Wertenstein indicated that the boiling point of carbon, instead of being, as has been previously thought, the same as that of the electric arc, is much higher; in fact the temperature of the arc has been shown by very accurate measurements to be 3500° C., and by applying the formula of Clapeyron, M. Wertenstein has shown that the temperature of boiling carbon is 5000° C. A note by MM. Demolon and Boischot was presented by M. Lindet. This note attributed the inactivity of peat towards biological reactions not to toxins or to protozoa, but to the lack of food materials.

PERSONALIA

Prof. J. Reid, M.A., Ph.D., professor of organic chemistry (pure and applied) in the University of Sydney, has been appointed to succeed Prof. Robinson in the chair of chemistry at the United College and in the directorship of the chemistry research laboratory in the University of St. Andrews.

Monsieur F. Bollaert, president of the board of directors of the Mines de Lens, has been nominated president of the Conseil d'Administration des Forges et Aciéries du Nord et de l'Est.

Dr. A. T. McPherson has been appointed associate chemist in the Bureau of Standards, to investigate rubber and gutta percha as insulating materials.

Mr. A. L. Burns has been appointed chief of the New Orleans Food Investigation Station of the United States Bureau of Chemistry.

Dr. S. C. Lind has been appointed chief chemist and chief of the division of mineral technology of the United States Bureau of Mines, to succeed Dr. R. B. Moore, and Mr. E. S. Leaver has succeeded Dr. Lind as superintendent of the rare and precious metals experimental station at Reno, Nevada.

Dr. H. Nicklas has been appointed professor of agricultural chemistry at the *Hochschule* for agriculture and brewing at Weihenstephan; Dr. A. Benrath has been appointed to a professorship in the Aachen Technical *Hochschule*; and Dr. J. Herweg has been nominated to a chair in the Hannover Technical *Hochschule*.

* * *

From Germany the following deaths are announced:—Dr. H. Scholl, professor of Applied Physics in the University of Leipzig; F. C. Correns, director of the Accumulatoren-Fabrik A-G.; Dr. K. Klimmer, director of the Deutschen Solvaywerke, Osternienburg (Cöthen); Prof. F. Krafft, of the University of Heidelberg; Dr. H. Liebmann, chemist to the Bayer Co. at Leverkusen; Dr. F. Collischonn, director of the Verein für Chemische Industrie A.-G., Frankfort; Dr. C. Hess, director of F. Bayer and Co.; and Dr. A. Ellinger, professor and director of the Pharmacological Institute of Frankfurt.

CORRESPONDENCE

THE "VINEGAR PLANT"

Sir,—Your editorial suggestion to sow vinegar plants among the lettuces was very rich, but *Biochemist's* comment thereon is far richer.

As a humble, but regular, reader may I beg that such *jeux d'esprit* be always given to the world as being too priceless to be lost ? Some of our biochemists should try to cultivate another rare but fragrant plant, humour.—I am, Sir, etc.,

Reginald G. Johnston
Scientist in Charge.

Midland Laboratory Guild, Ltd.,
Birmingham. August 4, 1923.

A CORRECTION

Mr. F. J. Cooper calls attention to one point in our review (in the issue of July 27) of his book, *Textile Chemistry*, and states that he had sufficiently distinguished between the work of Mercer and the mercerising process as carried out at the present day. From the quotations mentioned it is evident that Mr. Cooper has some ground for complaint, but our reviewer writes that he does not think the fact is sufficiently emphasised that Lowe's discovery of the lustring of cotton by means of caustic soda is quite distinct from any previously known process. In short, mercerising of to-day is wrongly named.

GERMAN IRON-ORE CONSUMPTION

Through the loss of Lorraine and Eastern Upper Silesia, Germany is now in possession of only 74·3 per cent. of its former iron-ore reserves. Political causes have led to the development of home deposits and to increased imports from other countries, particularly Scandinavia, as is shown in the following table, which gives the quantities imported from certain countries and the percentages of the total for the year :—

Source	1913 1000t.	Per cent.	1920 1000t.	Per cent.	1922 1000t.	Per cent.
France (incl. Lorraine) —	5,000	33	1,183	20	2,069	18·7
Luxembourg ..	—	—	1,331	22·5	766	7·0
Scandinavia ..	4,867	32	2,725	46·1	5,508	50·0
Spain ..	3,632	24	585	9·9	1,339	12·1
America ..	121	1	—	—	350	3·2
Africa ..	618	4	—	—	681	6·2
Other Countries ..	975	6	91	1·5	311	2·8
Total ..	15,213	100	5,915	100·0	11,014	100·0

The home production of ore in Germany was about 5 mill. tons in 1913 and 5·16 mill. t. in 1920. The use of German ores increased very largely in 1922. The increasing use of high grade Scandinavian ores has important possibilities in respect of fuel economy.

NEWS AND NOTES

CANADA

The Mining Industry in Quebec

The general condition of the mining industry in Quebec at the end of the past year showed a decided improvement as compared with the beginning of 1922, when it was at a low ebb. Although still far from normal, the industry is much healthier than it was a year ago. The total value of the mineral production of the Province of Quebec in 1922 was $17,898,062, an increase of $2,375,074, or 15 per cent., as compared with the figures for 1921, when the value was $15,522,988, the lowest recorded since 1916.—(*Official.*)

UNITED STATES

Cadmium in 1921 and 1922

The production of metallic cadmium in the United States in 1921 decreased to 65,101 lb. (129,283 lb. in 1920), whereas the production of cadmium sulphide increased from 32,133 lb. to 65,446. Prices of the metal decreased considerably, but that of the sulphide fell only slightly. Imports amounted to only 101 lb. ; no exports were recorded, but it is known that a considerable quantity was shipped abroad. The production in 1922 rose to 131,509 lb. of metal and 134,774 lb. of sulphide, prices rising in sympathy. Further progress is reported in the application of the Udylite process of cadmium plating, more than 50 plants being in operation at the end of 1922, new installations taking place at the rate of six to eight a month No progress was made in the production of the pigment cadmium lithopone, as only experimental quantities were produced. A source of intense monochromatic red light for use in physical investigation has been developed by the Bureau of Standards in the new quartz cadmium vapour lamp. Competition from cadmium produced by the electrolytic plant at Risdon, Tasmania, is said to have seriously disturbed United States producers. (*Cf. J.*, 1921, 234 R.)

FRANCE

The Sugar and Fermentation Industries

On the occasion of the 122nd anniversary of the Société d'Encouragement pour l'Industrie Nationale, Monsieur L. Lindet described the present state of the reconstruction of the agricultural industries in the devastated regions. Out of 213 factories producing 100,000 metric tons of sugar per 24 hours, 148 were destroyed, representing a loss of 6800 t. of sugar per day ; 66 of these destroyed factories have been restored and are now producing 32,000 t. per day. Of the remaining factories 110 have been grouped in twos, fours, eights, or even thirteens, the grouping being usually accompanied by an increase in the productive capacity. Out of 300 distilleries, 152 were destroyed, representing over 50 per cent. of the French output in 1913. Here, however, reconstruction is slow, as alcohol (exception being made of the quantities necessary for industry) can only be imbibed. Since June 30, 1916, the State has created a monopoly of industrial alcohol, and thus has greatly decreased alcoholism. Alcohol in excess of requirements will be used for making "national fuel." Out of 2570 breweries, 1767 were destroyed, but the present production has attained 78 per cent. of the pre-war level, although the French consumption of beer has decreased, the tendency being to produce low-gravity beer.

The Congress of Industrial Heating

This Congress was held at Paris from June 10 to 20 and also included an exhibition similar to that held last year on the occasion of the Congress on Liquid Fuels. Amongst the questions treated by the Congress were: "The Utilisation of Mine Waste and of Poor Fuels," "Fuel Briquetting," "The Study of Ash" and "Powdered Fuels." The meetings on June 14 were devoted to the papers of the English delegates presented by Dr. Lander, director of the Fuel Research Board, who described the work of that organisation, whilst Prof. Wheeler spoke of his experiments on the reactivity and combustibility of coke. Dr. Marie Stopes described her work on the constitution of coal, and Mr. Lomax also described the work done in Cheshire and Lancashire on the same subject. At other meetings of the Congress, the questions discussed included "The Measurement and Control of Heating," "The Scientific Definition of Heat and of Temperature," "Calorific Power," "Experiments on Boilers and Furnaces," "Investigation of Refractory Production and Special Materials," and "The Use of Crude Oil as Fuel in the Pottery Industry." Visits were paid on June 18 to mines in the Pas de Calais district and on June 19 and 20 to gas works in the Parisian region and to the boiler factory of Babcock and Wilcox. The exhibition illustrated the practical application of the conceptions discussed during the Congress, particularly plant for producing and conserving heat, and controlling and measuring apparatus.

GENERAL

Gas Undertakings in Great Britain

The Board of Trade has issued Part I. of the Return relating to authorised gas undertakings in Great Britain during 1922 (H.M. Stationery Office, 5s. net). This book gives particulars of the manufacture and supply of gas by nearly 800 undertakings. Part II., which is not yet issued, will deal with the finance of the undertakings and the prices of gas. During 1922 authorised undertakings in Great Britain manufactured 252,070 million cb. ft. of gas, of which 80 per cent. was coal and nearly 18 per cent. water gas. Excluding consumption at the gas works, the quantity sold was 232,603 million cb. ft., as against 229,077 million cb. ft. in 1921, and the residual products included 10,475,000 tons of coke and breeze, and 167,771,000 gallons of tar. The figures show there are nearly 8,000,000 consumers. The Return gives details of the make of gas materials used, quantities of residuals made, and the number of consumers for each of 796 undertakings.—(*Official.*)

The Chemical Industry in Poland

Before the war the Polish chemical industry was not of great importance, and during the war the existing factories suffered heavily. Since then reconstruction has progressed vigorously, so that the chemical industry is becoming more and more independent of supplies from abroad, particularly from Germany, England and France. The country is particularly favourably situated for the creation of a strong chemical industry owing to the important deposits of salt, coal, petroleum, and other raw materials in Galicia, the abundant water power, and the already developed productive capacity of Upper Silesia, which manufactures large quantities of sulphuric acid. On January 1, 1923, there were 120 factories finding employment for 15,875 persons, and other factories are being built, particularly in former Prussian territory.

The following figures of the productive capacity per annum of some of the more important branches will give an idea of the state of the industry:—*Inorganic chemicals:* Ammonia soda, 70,000 metric tons; caustic soda, 8000 t.; sulphuric acid, 50,000 t.; superphosphates, 60,000 t. *Electro-chemical products:* Carbide, 3000 tons; bleaching powder, 500 t.; caustic soda, 1200 t. *Dyestuffs:* The production totals 150 tons per month, part being manufactured from imported intermediates. *Wood-distillation products:* Wood charcoal, 15,000 t.; acetate of lime, 1600 t.; wood spirit, wood tar, rosin and turpentine, 350 t. About 1000 cartloads of bones are worked up each year, yielding 6000 tons of bone-meal as well as other products. There are sixteen match factories employing 3000 workers, and the monthly production amounts to 50,000,000 boxes, of which 15 per cent. is exported. The single artificial silk factory provides employment for 4000 workers and produces 1500 kg. of artificial silk per day, most of which is consumed locally.—(*Chem. Ind.*, 46, *No.* 17.)

Oil-shale Firing in Esthonia

The technique of firing boilers with Esthonian oil-shale appears to have reached such a pitch that hopes have been raised that coal imports might be considerably reduced, with important results to the finances of the country, though it is unlikely that imported coal will ever be dispensable. In practice the utilisation of the shale deposits will have to be carried out either by gasification of the shale or by utilising it to generate electrical power; in any case the low calorific value of the natural shale renders transport unprofitable.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Aug.* 2)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Steel wire, corrugated sheets	157
Australia	Surgical dressings, drugs, chemists' sundries	126
British India	Steel, copper, malleable cast-iron (tender)	*
British West Indies	Leather goods	131
Netherlands	Domestic hollow-ware	145
Norway	Steel and brass tubes	146
Yugoslavia	Copper and brass sheets, tin ingots	147
Spain	Druggists' sundries	148

* The Director-General, India Store Department, Branch No. 10, Belvedere Road, London, S.E. 1.

TARIFF CUSTOMS EXCISE

Germany.—The specific taxes on lighting apparatus, including electric incandescent lamps and burners for Nernst lamps, mercury-vapour lamps, carbons for electric arc lamps and incandescent mantles, are altered to an *ad valorem* tax of 20 per cent.

The sugar tax is increased to 24,000 marks per 100 kg. of starch sugar and 60,000 marks per 100 kg. of other sugar.

Madagascar.—The treatment to be accorded to imported compound medicines is to be modified in accordance with a Decree issued by the Governor-General of Madagascar and Dependencies.

Portugal.—The ordinary rates of customs duty are now payable on the following articles, owing to the termination of the Franco-Portuguese *modus vivendi* :—Malleable iron and steel, dyeing extracts, substances for use in medicine and perfumery, instruments, implements and tools, rubber tyres, medicines, medicinal extracts, etc.

Tariff Revisions.—The issue of the *Board of Trade Journal* for August 2 contains a special article devoted to the revision of the Customs Tariffs in various countries, including changes made or pending since the end of 1921. Most European countries are affected, save Holland, and changes have been or are to be made in most of the Colonies, the United States, South American Republics, China, Japan, etc.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Imports of Russian Petroleum

Answering Captain Morcing, Sir P Lloyd-Greame said that the imports of petroleum into the United Kingdom from Russia during 1921-1922 amounted to 10,480,601 gallons. of which 9,081,555 galls. were from Batum and none from Novorossisk. He was unable to say how much of the petroleum was produced from wells owned or developed by English capital.—(July 31.)

Dyestuffs

Sir. P Lloyd-Greame, replying to Mr. Collison (who asked whether he was aware that users in Japan of 99-100 per cent. synthetic indigo could buy from British dye makers at 5s. per lb., whereas 8s. 6d. was charged to the British user and that this difference in price was due to the fact that British dye makers have a monopoly in this country both in manufacturing and in the distribution of imported German dyes), said that he had been informed by the only British makers of synthetic indigo that none of that product was being sold by them in Japan.—(July 31.)

Merchandise Marks Bill

In a written answer to Mr. Hannon, Sir P. Lloyd-Greame said that the question of a suitable time for introducing the Merchandise Marks Bill was under consideration, but he did not think it would be possible to proceed with it during the Autumn Session.—(July 31.)

Coal Supplies of France

Lieut.-Colonel Lane-Fox, in a written answer to Mr. W. Thorne, gave the following figures showing deliveries of German coal and coke to France for 1922-1923 and purchases of English coal and coke by France, in tons, for the same period :—

	1922 metric tons	1923 metric tons
Delivered by Germany at French Frontiers :—		
Coal	4,247,483	643,372
Coke	4,338,943	722,087
Lignite briquettes	490,299	69,447
Imported by France from Great Britain :—		
Coal	13,891,483	10,683,000
Coke	72,552	341,000
Briquettes	151,359	81,000

—(July 31.)

Sulphate of Ammonia (Export Regulations)

Viscount Wolmer, in a written answer to Mr. Shinwell, said that the official control of the export of sulphate of ammonia, instituted during the war, was now at an end, and the export was, accordingly, subject only to the ordinary customs regulations which he had no reason to think were not being observed.—(Aug. 1.)

Lead Poisoning in Electric Accumulator Works

Replying to Lord H. Cavendish-Bentinck, Mr. Bridgeman said he was aware of the number of cases of lead poisoning in electric accumulator works which were reported by the Factory Department. The matter had been taken up strongly with the firms, which were re-organising the departments affected. The cases mostly occurred amongst workers newly engaged, and were not serious. The Factory Department had for some time been dissatisfied with the results obtained under existing Regulations and a special inquiry was commenced some time ago to see in what respects the Regulations could be strengthened. This inquiry had now been completed and further action would be considered in the light of its results. The Chief Inspector was satisfied that the increase of lead poisoning cases in the works in question was not attributable in any way to any lack of inspection.—(Aug. 2.)

REPORTS

Report on the Industrial, Commercial, and Economic Situation in Poland. Dated February, 1923. *By* R. E. Kimens, *H.M. Commercial Secretary, Warsaw. Pp.* 48. *Department of Overseas Trade. H.M. Stationery Office,* 1923. *Price* 1*s.* 6*d.*

The events of most importance in the economic life of Poland during 1922 were the incorporation of a portion of Upper Silesia and the deterioration of the financial situation due to depreciation of the currency. Nevertheless, most industries were prosperous, and with the large industrial resources of the newly acquired territory, all the necessary assets for recovery from the present financial situation are at hand. The Upper Silesian area contains most of the Silesian coal resources, as well as highly developed chemical, zinc, iron and steel industries.

In general, industries improved in 1922, though in Upper Silesia transport difficulties reduced output when the region was first taken over. The output of pig-iron reached 40 to 60 per cent. of the pre-war figure. The cement industry made satisfactory progress in spite of depression in the building trade, on account of increased application at home and also to the growing export trade. Poland is now an important mining country. The coal output in the first three quarters of 1922 exceeded that of 1921 by 26 per cent., but the production of lignite in these periods fell from 195,259 t. to 155,729 t. The output of zinc in 1922 was maintained at the 1921 level, ore being raised at the rate of about 60,000 t. per annum. Important potash resources are being developed, but the salt deposits of the country could be further exploited. The output of petroleum decreased from 586,257 t. in 1921 to 517,873 t. in 1922, largely owing to the disappointing results given by the new Horodyszeze and Mragnica fields. The output of alcohol increased from 15,838,000 gallons in 1921-2 to 31,676,000 galls. in 1922-3, largely owing to the abundant potato crop. An increase in the area under sugar-beet led to an output of 320,000 t. of sugar, compared with 225,000 t. in 1921. The crops in 1922 were very satisfactory and more than sufficient for home needs. It is considered that, notwithstanding the advantage held by countries with a low "valuta," it should be possible by means of suitable organisation for British merchants to compete in Polish markets.

Report on Economic Conditions in Rumania, March, 1923. *By* A. Adams, *H.M. Commercial Secretary, Bucarest. Department of Overseas Trade. Pp.* 62. *London: H.M. Stationery Office.* 1923. *Price* 2*s.*

The situation in Rumania is still unsatisfactory, though some efforts were made during the year under review to improve the financial condition of the country (*cf.* J., 1922, 335 R). Since the armistice Rumania has had an adverse trade balance, and there has been no encouragement to foreigners to invest capital in the country, as large sums are owing abroad by Rumanian traders.

The petroleum industry is of great importance, though at present labouring under some difficulties arising out of the war. In 19 the production of crude oil was 1,137,184 tons, against 1,168,414 t. in 1921. Drilling was handicapped by lack of electric power, shortage of labour, and bad weather, though more was done than in 1921. Up to September 30, 1922, 910,095 t. had been treated at the refineries, producing 214,538 t. of benzine, 159,234 t. of lamp oil, 82,493 t. of gas oils, etc., and 433,831 t. of residues. The internal consumption in the same period was 604,791 t., while 315,512 t. were exported. Statistics of the mining production of Rumania for 1922 are not yet available, but in 1921 there were obtained 1,594,719 t. of lignite, 209,968 t. of coal and anthracite, whilst iron, copper, lead, manganese, and antimony were also mined.

In 1922 the tendency to make quotations for international trade with Rumania in pounds sterling increased. To some extent a departure is being made from the credit system, importers paying in cash. No complete figures are available for imports or exports in 1922. Among the exports, however, cereals, petroleum products, and timber are most important.

A committee was appointed during the year to advise the Minister of Industry and Commerce as to the constitution of joint-stock companies and of branches of foreign trading companies. Owing to delay on the part of the committee in formulating a policy, hindrance has been caused to the foreign merchant in obtaining the necessary permission to trade.

REVIEW

A Treatise on Chemistry. *By* The Right Hon. Sir H. E. Roscoe, F.R.S., *and* C. Schorlemmer, F.R.S. *Vol. II.* The Metals. *Parts I & II. New edition, completely revised by* B. Mouat Jones *and others. London: Macmillan & Co., Ltd.,* 1923. *Price 50s., 25s. each volume.*

The position of Roscoe and Schorlemmer's monumental Treatise as a standard text-book on Inorganic Chemistry is now so well assured that no words of commendation are needed to extol its merits. It is without question the leading work in the language on the subject of which it treats. Its excellence is due, in the first place, to its plan and arrangement, to its comprehensiveness, wealth of detail and accuracy of statement, to its admirable illustrations, its attractiveness of style and the manner of its presentation in the matter of paper and printing. Originally published in 1878, no pains have been spared to keep it up to date and to maintain its reputation as a faithful reflex of contemporary knowledge. The books under review are now in their sixth edition, the last edition having appeared in 1913, when the late Sir Henry Roscoe, as the survivor of the original authors, superintended its preparation, in which he was assisted by Professor Philip, Mr. P. V. Barker, Dr. Makower, Messrs. Spencer and Baker, and Drs. Keane and Mollwo Perkin—all eminent authorities in the several departments of the science which they undertook to revise.

During the ten years which have elapsed since the publication of the fifth edition, many important changes have occurred, and considerable additions have been made to our knowledge of the chemistry of the metals and their compounds. Practically a new chemistry and a new physics have arisen in the interval. As Mr. Mouat Jones points out in the preface which accompanies the new edition, great advances have been made in our fundamental ideas of atomic and molecular structure, of valency, and of chemical affinity, and in the interpretation of the Periodic Law, largely as the result of the rapid development of the science of radioactivity, and of the introduction of new methods of investigation, notably of positive ray analysis and X-ray spectroscopy. No attempt is, however, made to give a complete account of the new theories in the present volumes, as these are held to be mainly devoted to a systematic account of the metals and their compounds. At the same time such matters as the classification of the elements, valency, atomic numbers, isotopes, atomic structure and spectrum analysis have received attention and have been revised by Mr. L. J. Hudleston. The section on crystallography has again been dealt with by Mr. Barker. Professor Bannister has also revised the metallurgical sections and Dr. Makower that on the radioactive elements. Special groups of the metals have been entrusted to Professor J. F. Spencer and Messrs. Eldridge, Bury and Howell.

Of the two volumes under review the first is concerned with the discussion of the general principles already referred to, such as the modes of determining the atomic weights of the metals, the fixation of their equivalents, the molecular weights of their compounds; atomic heat and molecular heats, isomorphism and its bearing on molecular weights; valency of the elements, their classification and natural arrangement; the periodic system, chemical properties, valency and physical properties in relation to the periodic system; atomic numbers, isotopes, structure of the atom; crystalline forms of the metals; colloidal solutions; alloys and amalgams; constitution of salts, acids and bases; metallic oxides, hydroxides and salts; solubility, fusibility and volatility of salts, generic properties of salts; chemical change and the law of mass action; the spectroscopy of the metals and their compounds. The section on crystallography deals with the symmetry of crystals, enantiomorphism, the optical, thermal and electrical properties of crystals, polymorphism, crystallochemical analysis, crystal structure, and chemical crystallography. A comparison of the present methods of dealing with these subjects with that employed in the earlier editions, and especially with that of the edition of 1878, reveals the extraordinary growth of knowledge which the last four decades has witnessed, not so much, perhaps, in minor details respecting the discovery of additional metallic compounds and the elucidation of their chemical and physical properties as in the establishment of the broad general principles which govern the mutual relations of the metallic elements. It is on questions relating to what may be termed the chemical philosophy of the metals that the most striking advances have been made. The remaining portion of Part I deals with the systematic description of the metals and their derivatives; of Group I (the alkali metals), Group II (the alkaline earth metals) and Group III (the aluminium group) of the periodic system. In the accounts of the several metals of these groups due attention is paid to their technical applications and that of their compounds, and we have accordingly adequate and up-to-date descriptions of alkali manufacture, the metallurgy of copper, silver and gold, the manufacture of glass, earthenware, pottery and porcelain, and the industrial applications of the compounds of the metals of the rare earths. As regards Group I, advantage has been taken of the analogies existing between ammonium compounds and those of the alkali metals properly so-called to include accounts of hydroxylamine and hydrazine salts which, although strictly speaking not metalline substances, have doubtless as much right to be so regarded as the derivatives of ammonia. To remove these substances from the section on organic chemistry is a new departure which can only be justified on the ground of its convenience. They at least serve to illustrate the essentially irrational nature of the sub-division of chemical compounds into organic and inorganic derivatives.

Part II of Volume II deals with Groups IV, V, VI, VII and VIII of the metals, and with the sub-groups into which these are divided. As in the previous volume the modes of extraction, metallurgy, and technical applications and methods of manufacture of industrially important derivatives are treated in adequate detail, and the various processes are illustrated when required by suitable diagrams and figures. Indeed, the wealth and character of the pictorial material in the volumes remains, as hitherto, one of the most commendable features of the work. As regards its technology it is evident that every effort has been made to bring it up to date. From the very outset of its existence the work was characterised by its judicious mixture of sound and accurate science with a keen appreciation of the material benefits of its practical application, and this characteristic, which was zealously preserved in the successive editions for which Sir Henry Roscoe was mainly responsible, has been maintained in the present issue.

It may be interesting to recall the circumstances which led to the inception and existence of this treatise as these are known to the writer of this notice. In a sense the work may be said to owe its origin to the famous report of the Duke of Devonshire's Commission on the teaching of science, and especially physical science, in our schools and colleges. At the date of the issue of the Commission the importance of science as an educational instrument was hardly recognised by those who directed and controlled our educational systems. Education in our public schools and Universities was largely under the influence of a medieval system which had suffered no material change since the revival of learning in the Middle Ages. Whilst classical learning and scholarship continued to be deservedly fostered, there had grown up a new knowledge based upon the systematic study of natural phenomena. This knowledge was found to be rich in its potentiality of material benefit to mankind. It was capable of adding enormously to the welfare of humanity. But strangely enough our educational system failed to recognise this fact fully. The public mind was gradually led to appreciate it by the lessons of successive international exhibitions beginning with the celebrated exhibition of 1851. A careful comparison of the progress made in the industrial applications of science, as shown in the various exhibitions which followed that of 1851, revealed that our commercial and industrial supremacy was seriously threatened in consequence of our apathy and by our continued neglect to realise the importance of physical science as a factor in national progress. The public mind was greatly perturbed. It was gradually recognised that the fault was mainly due to our educational system. It was on too restricted a scale and wholly failed to adapt itself to the changed conditions of modern life as shown in the application of the new knowledge which had been accumulated with marvellous results over a period of time, comparatively limited as history goes. The Royal Commission already alluded to was the outcome of the agitation of the public mind. The effect of the Commission's report was profound and immediate and led to what was practically a revolution in our schools and University systems. One result was the creation of a special class of school literature. It was the absence of books suitable for class instruction which was one of the causes of the neglect of science teaching in our schools and colleges. Enterprising publishers, like the eminent firm to whom we owe the issue of the volumes now noticed, recognising the trend of public sentiment, were quick to realise the importance of supplying a demand now regarded as inevitable, and under the able guidance of Huxley, Roscoe and Balfour Stewart as editors, books in almost every department of physical science which lent itself to class instruction in schools soon made their appearance. Roscoe's Lessons in Elementary Chemistry was phenomenally successful and rapidly ran through successive editions. It was widely adopted in each of our public schools, which in deference to public opinion, adopted what came to be known as a " modern side." The book was translated into practically every European language and into a number of the languages of the East, and in spite of the competition of a host of imitators it still remains a favourite text-book for class instruction.

The success of this venture induced Roscoe to attempt the compilation of a work more suitable for advanced instruction and for the needs of secondary schools and Universities. For this purpose he associated himself with his friend and colleague, Carl Schorlemmer, then lecturer and subsequently Professor of Organic Chemistry at Owens College, Manchester. No selection could be more happy. Schorlemmer was a remarkably well-read man with a profound and accurate knowledge of the literature of chemistry. He was an excellent and judicious critic who wrote our language with ease and precision. To him is mainly due the historical introduction largely based upon the classical history of Hermann Kopp, which constitutes the initial portion of the treatise, and he contributed extensively to the descriptive sections of the work.

The Treatise on Chemistry is, and will remain, the most enduring monument to the genius for organisation, capacity and industry of its projector. To him is mainly due not only its inception, but the details of its plan and arrangement. It was one of the earliest works of its kind to recognise the value of the Periodic Law as a system of classification, and the book is a striking exemplification of the value of Mendeleeff's great generalisation.

So long as the work continues to be revised and edited with the care and judgment displayed in the volumes before us, so long will its pre-eminence as a standard treatise be assured, and so long will Roscoe's memory as the prime mover in its creation be preserved and perpetuated.

T. E. Thorpe

Technical Methods of Ore Analysis. *By* Albert H. Low, Sc.D. *Ninth edition. Pp. xlix+348. London; Chapman and Hall, Ltd.*, 1922. *Price* 17*s.* 6*d.*

For the purpose of making this well-known book better adapted to the requirements of students, the author has devoted some 38 pages of the present edition to suggestions regarding the training of students in rapid technical analysis, to a specimen lecture and to methods for the determination of 16 elements, fully detailed and in the author's step demonstration method. This new matter is in the form of an introductory chapter, and the arrangement, as well as additional notes throughout the book of an explanatory nature, are introduced in such a way as not to be the least source of annoyance to the technical chemist. The present edition has been entirely rewritten and is a considerable improvement on the 8th (1919) edition. Much of the appendix in the latter has now been transferred to the text, and the miscellaneous determinations have now increased from 2 to 10 in number. The factors have been brought up to date and based on the International Atomic Weights for 1921. The book is well got up and contains remarkably few printers' errors. It can be confidently recommended to teachers as well as to the technical chemist, to whom it has been known, through past editions, as an authoritative and practical guide.

COTTON RESEARCH AND SOIL PROBLEMS

The Empire Cotton Growing Corporation has made a grant of £1000 for five years to the Rothamsted Experimental Station to investigate the fundamental physical properties of the soil and other problems likely to be of importance in connexion with cotton growing. The soil physics department at Rothamsted will undertake these investigations as part of its general research work on the fundamental properties of the soil, and the money will be used to increase the staff and equipment so that progress may be made more rapidly.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Business in the home and export markets remains very restricted. Makers' prices are practically unchanged in spite of the unpromising nature of the outlook. The demand from the textile trades is particularly poor, and in general practically no interest is displayed in forward purchasing.

Acetic Acid, 40% tech. ..	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric ..	3s. 6d. - 5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw. ..	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali ..	£7 12s. 6d. - £8 per ton. Comparatively good demand.
Arsenic (White) ..	£72 - £73 per ton. Not much doing.
Bleaching Powder ..	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Quiet.
Bisulphite of Lime ..	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride ..	£5 17s. 6d. per ton d/d.
Copper Sulphate ..	£27 per ton.
Potash Caustic	£30 - £33 per ton. Poor demand.
Potass Bichromate ..	5¾d.-6d. per lb. d/d.
Potass. Chlorate ..	3d. per lb. Very dull.
Salt Cake	£4 10s. - £5 per ton. Remains a very firm market.
Soda Caustic 76% ..	£19 - £21 10s. according to quality. Fair business.
Soda Crystals	£5 5s. - £5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98% ..	£24 per ton. Very scarce for spot delivery.
Sod. Bicarbonate ..	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	2⅞d. - 3d. per lb. Very dull.
Sod. Nitrate refd. 96%..	£13 5s.-£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.

Sod. Sulphide conc. 60/65	About £15 per ton. Rather lower in value but very quiet.
Sod. Sulphite, Pea Cryst.	£16 10s.-£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.-1s. 3d. per lb.
Crimson	1s. 6d.-1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25-£29 per ton according to quantity.
Carbon Black	Cheaper at 10½d. - 1s. 1d. per lb. Ample supplies now available.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.-6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16-£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

In sympathy with most trades, this market is now a little easier.

Acetate of Lime—	
Brown	£11 5s. - £11 10s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8 - £10 15s. per ton d/d, according to locality of market and type of charcoal. Demand easier.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2s. per gall. 24° Tw.
Red Liquor	1s. 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. ,, ,, 60% O.P. Firm market as to price but demand quiet.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5-£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d. per lb. spot. 1s. 1½d. per lb. for forward delivery
Crude 60's	3s. - 3s. 6d. per gall. Market firmer for early delivery.
Acid Cresylic—97/99	2s.-2s. 5d. per gall. Steady demand.
Pale 95%	1s. 10d.-2s. 4d. per gall.
Dark	1s. 10d. - 2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	8¾d - 11d. per gall. Supply short. Plenty of inquiries.
Unstrained	8¼d.-9d. per gall.
Benzole—	Market uncertain. Prices doubtful.
Crude 65's	1s. 1d.-1s. 1½d. per gall.
Standard Motor	1s. 6½d.-1s. 8d. per gall. Business slack, abundant supplies.
Pure	2s. 1d. - 2s. 2d. per gall.
Toluole—90%	1s. 8d.-2s. per gall. Not many inquiries.
Pure	2s.-2s. 4d. per gall. Not much inquiry.
Xylol	2s. 3d. - 3s. 3d. per gall., according to quality.
Creosote—	
Cresylic 20/24%	11d.-1s. per gall. Not much business.
Middle Oil	8½d. - 9d. per gall. Market steady. Good demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.-9d. per gall.
Solvent 90/160	1s. 5d. - 1s. 7d. per gall. Quiet.
Solvent 90/190	1s. 4d. - 1s. 7d. per gall. Market quiet.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Very little business passing.
Whizzed or hot pressed	£11 - £13 per ton. More inquiries.
Naphthalene—	
Crystals	£21 per ton.
Flaked	£17 10s. per ton
Pitch, medium soft	140s.-150s. per ton. Autumn delivery. Market steady.
Pyridine—90/140	18s. per gall. Demand good.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

Depression in the textile trade continues, but business in dyestuffs has improved slightly during the week.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 8d.-1s. 9d. per lb.
Acid Sulphanilic	1s. 1½d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	5s. 3d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.-6½d. per lb. Quiet.
m-Cresol 98/100%	2s. 1d.-2s. 3d. per lb. Fair demand.
p-Cresol 32/24° C.	2s. 1d.-2s. 3d. per lb. Fair demand.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
d-Dichlorbenzol	£70 per ton.

Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.-9d. per lb. naked at works.
66/68	1s. 2d.-1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market remains exceptionally dull and orders continue to be very scarce.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. per lb. for cwt. lots. Market steady.
Acid, Benzoic	2s. 3d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 8d. per lb., less 5%. Demand improved.
Acid, Gallic	3s. per lb. Down to 2s. 11d. for large quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d.-2s. 3d. per lb. Limited demand.
Acid, Tannic	3s. 1d. per lb. would now be accepted.
Acid, Tartaric	1s. 3d.-1s. 3½d. per lb., less 5%. Demand below normal but improving. Stocks accumulated during the cold spring now being used up and a rise in price not improbable.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 5d. per lb. Market very weak.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.-3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz.
Barbitone	19s. per lb. now quoted with little inquiry.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31-£33 per ton, carriage paid buyer's station.
Bromides	Position unchanged. Prices vary according to quantity and source.
Calcium Lactate	2s. 6d. per lb. for best makes.
Chloral Hydrate	3s. 9d. per lb., duty paid.
Chloroform	2s. 2d. per lb. for cwt. lots. Very firm. Higher prices expected.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	£96 per ton. Quiet.
Guiacol Carbonate	8s. 6d. per lb. Spot supplies short.
Hexamine	3s. 9d. per lb. In fair supply on a quiet market.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.
Magnesium Carbonate—	
Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	70s.-80s. per cwt., according to quality and quantity.
Menthol	38s. per lb. spot, less 2½%. Slightly weaker.
Mercurials	Very much weaker.
Methyl Salicylate	2s. 3d. per lb. for carboys.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Morphine	Alkaloid—Cryst. 10s. 11d., Precip. 10s. 8d., Acetate 8s. 6d., Hydrochlor. 8s. 6d. Sulphate 8s. 6d. per oz.
Paraformaldehyde	3s. 9d. per lb. Lifeless.
Paraldehyde	1s. 5d. per lb.
Phenacetin	6s. per lb. Lower in value.
Phenazone	7s. per lb. In better demand, especially for small quantities.
Phenolphthalein	6s. 9d. per lb. Firmer. Supplies short.
Potass. Bitartrate—99/100% (Cream of Tartar)	94s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s. 3d.-3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d. per lb. Good demand. Steady market.
Potass. Permanganate	10½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d. - 2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	5s. 6d. per lb.
Salol	2s. 8d. per lb. Very quiet. Lower in value.
Silver Proteinate	10s. per lb.
Sod. Benzoate	2s. 3d. per lb. Slow of sale.
Sod. Citrate, B.P.C. 1923	2s. 2d. per lb. for cwt. lots.
Sod. Hyposulphite—Photographic	£15-£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.-87s. 6d. per cwt. Fairly good demand. Expected to improve with continued warm weather.
Sod. Salicylate	Powder 2s. 6d. per lb., and Crystal at 2s. 7d. per lb. Market stagnant.
Sod. Sulphite, anhydrous	£27 10s.-£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.

Sulphonal	14s. per lb.	
Tartar Emetic	1s. 2d.-1s. 4d. per lb.	
Thymol	15s. 6d. per lb. for cwt. lots of natural recryst.	

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.	
Aubepine	14s. ,, ,,	
Amyl Acetate	3s. ,, ,,	
Amyl Butyrate	7s. 3d. ,, ,,	
Amyl Salicylate ..	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	2s. 9d. per lb.	
Benzyl Benzoate ..	3s. 3d. ,, ,,	
Cinnamic Aldehyde ..	18s. 6d. ,, ,,	Advanced.
Coumarin	18s. 6d. ,, ,,	
Citronellol	19s. 6d. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate ..	15s. ,, ,,	Cheaper.
Ethyl Phthalate ..	3s. 9d. ,, ,,	,,
Eugenol	11s. ,, ,,	
Geraniol (Palmarosa) ..	32s. 6d. ,, ,,	Advanced.
Geraniol	5s. 6d.-12s. 6d. per lb.	
Heliotropine	8s. per lb.	
Iso Eugenol	16s. 6d. per lb.	
Linalol ex Bois de Rose ..	21s. ,, ,,	
Linalyl Acetate	21s. ,, ,,	
Methyl Anthranilate ..	7s. ,, ,,	
Methyl Benzoate ..	8s. 6d. ,, ,,	
Musk Xylol	11s. ,, ,,	Dearer.
Phenyl Ethyl Acetate ..	10s. ,, ,,	
Phenyl Ethyl Alcohol ..	17s. 6d. ,, ,,	
Rhodinol	45s. ,, ,,	
Safrol	2s. 4d. ,, ,,	
Terpineol	3s. 1d. ,, ,,	
Vanillin	22s. 3d.-23s. 6d. per lb. Firm with steady demand.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.	
Anise Oil	2s. ,, ,,	
Bergamot Oil	12s. 6d. ,, ,,	spot.
Bourbon Geranium Oil ..	29s. ,, ,,	
Cananga Oil, Java ..	9s. ,, ,,	
Cinnamon Oil, Leaf ..	4½d. per oz.	
Cassia Oil 80/85% ..	11s. 6d. per lb.	
Citronella Oil—		
Java 85/90% ..	4s. 2d. ,, ,,	
Ceylon	3s. 8d. ,, ,,	
Clove Oil	8s.-8s. 6d. per lb.	
Eucalyptus Oil 70/75%	1s. 10d. per lb.	
Lavender Oil, Mont Blanc 38/40% ..	13s. ,, ,,	
Lemon Oil	3s. 1d. ,, ,,	
Lemongrass Oil	2¾d. per oz.	
Orange Oil, Sweet ..	13s. 7d. per lb.	
Otto of Rose Oil—		
Anatolian	24s. per oz.	
Bulgarian	30s. per oz.	
Palma Rosa Oil ..	19s. per lb.	
Peppermint Oil—		
English	80s. ,, ,,	
Wayne County ..	13s. ,, ,,	
Japanese	7s. 1½d. ,, ,,	Advanced.
Petitgrain Oil	7s. 3d. ,, ,,	

TRADE NOTES

British Industries Fair, 1924

It is announced in the *Board of Trade Journal* of August 2 that the organising authorities for the London and Birmingham sections of the British Industries Fair have decided not to hold the Fair at the end of February, 1924, but to postpone its opening in London till April 28 (continuing until May 9), and to open the Birmingham section on the Monday following the closure of the Fair in London. It is considered that the holding of the British Empire Exhibition from April to October will materially affect the attendance of overseas buyers, and the change is made so that they can visit both Exhibition and Fair during a single visit. The schedules of trades for the two sections of the Fair are similar to those of last year, London covering mainly the lighter lines of goods, such as pottery, leather goods, stationery and chemicals, whereas the exhibits at Birmingham will include hardware, engineering, metals, power, building and mining implements.—(*Official.*)

Imports of Coal-tar Dyes into British Malaya

Statistics (furnished by the Malay States Information Agency) of the values of imports of coal-tar dyes into British Malaya, showing countries of origin, during 1921, 1922 and the first four months of 1923, are interesting. Although the market for coal-tar dyes in British Malaya is not an important one, the figures are noteworthy as showing from what sources such supplies as are required are forthcoming:—

Imported from:—	1921	1922	1923 (4 months)
	£	£	£
United Kingdom ..	398	454	243
British Possessions ..	770	697	6
Continent of Europe ..	7,771	4,597	6,044
U.S.A.	20	nil	nil
Japan	nil	9	nil
Other Countries ..	1,735	708	181
Total	£10,694	£6,465	£6,474

The value of coal-tar dyes imported from Germany in 1921 was £6195. Separate statistics for Continental countries in 1922 and 1923 are not yet available.

PUBLICATIONS RECEIVED

Report on the Activated Sludge Process of Sewage Purification: Its Efficiency and Applicability to the Glasgow Works. *By* F. W. Harris, F.I.C. *Pp.* 24. *Corporation of Glasgow* (*Sewage Department*). *Glasgow: Robert Anderson.*

Bulletin of the Bureau of Biotechnology. *Vol. II, No.* 10 *and Index to Vol. I. London: Murphy and Son, Ltd.*

Annual Report of the Chief Inspector of Factories and Workshops for the Year 1922. *Pp.* 153. *H.M. Stationery Office*, 1923. *Price* 5*s.*

Publications of the United States Geological Survey. *Department of the Interior. Washington: Government Printing Office*, 1923.

Lead in 1922. *By* C. E. Siebenthall *and* A. Stoll. *Part I. Pp.* 27—36. *No.* 1 : 4.

Zinc in 1922. *By* C. E. Siebenthall *and* A. Stoll. *Part I. Pp.* 37—52. *No.* 1 : 5.

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EDITORIAL

IN considering the problem of smoke abatement, it is often forgotten to ask whether a remedy for the evil—and no one will deny that it is an evil, even if sometimes unavoidable—is to be found in prevention of the emission of black smoke or in prevention of air pollution by noxious but invisible fumes. Attention has recently been called to this latter aspect of the question by Mr. C. E. Stromeyer, chief engineer to the Manchester Steam Users' Association, who, writing in the *Manchester Guardian*, pleads that the hydrocarbons and sulphuric acid in coal smoke are not injurious to health and lays all the blame on the content of sulphur dioxide. He further observes that the effect of replacing coal by coke as fuel would be to increase the amount of sulphur dioxide in the atmosphere, with the result that fogs would be "white," not black. The smoke could be washed, but this would be too costly to be economic and the substitution of coal-gas for coal would, he claims, mean doubling the boiler-plant capacity, owing to the loss on converting fuel into gas and the lower temperature of the gas flame compared with that of coal. Whether this aspersion on coal gas could be substantiated can be safely left to the gas industry. Mr. Stromeyer, however, concludes by asking for research on the removal of the sulphur-bearing minerals in coal. Sulphur is a strange element: it is a commercial product manufactured on a large scale, but it has an obnoxious habit of making its presence felt sorely when not wanted, whether in coal-gas, hydrocarbons or iron. Well did "rare" Ben Jonson ask, "What makes the devil so devilish . . . but his being perpetually about the fire, and boiling brimstone and arsenic ?" But sulphur is not the only constituent of coal which requires investigation, for, as Dr. Charles Carpenter insisted so eloquently in his address to the Society at Cambridge, we know a great deal about the products of coal, but have little insight into the constitution of the coal itself. Smoke abatement, considered from this aspect, would seem but one feature of the vast problem of the conservation of our coal resources. One can quote the names of many workers in the field, but the fundamental problems have received attention that seems very limited.

* * *

The conservation of coal constitutes but one aspect of the much greater problem, every day more urgent, of utilising *all* the many sources of energy that are supplied so generously by nature. Timber, petroleum, coal are "wasting assets" so we are told, and our methods of converting heat into energy are far from perfect, but yet only a fraction of the available water power has been harnessed, abundant stores of volcanic heat and energy remain untapped, and, not least, our knowledge of the wonderful mechanisms by which plants build up complex products so economically with the aid of a minimum of external energy is far from being complete, though researches such as those of Irvine and his school on the constitution of cellulose or of Baly on the photosynthesis of carbohydrates are helping to shed light in the prevailing darkness. Sir William Ramsay's suggestion to convert coal-mines into huge gas-retorts has never been tried (although a similar experiment with oil-shale is reported from Australia), but some beginnings have been made. Prince Ginori-Conti is utilising the natural jets of steam at Larderello, in Italy, for the production of both power and borax, and projects are being put forward to make use of natural sources of heat in other parts of the world. It has even been reported in the daily Press that the staff of the Engineering Department of one of the Japanese Universities is about to initiate experiments to test the commercial possibility of producing power from volcanic heat. . . . . We have wandered a long way from smoke abatement, but enough has been said to emphasise once more the need for regarding it as part only of the problem of fuel conservation.

CELTIUM OR HAFNIUM ?

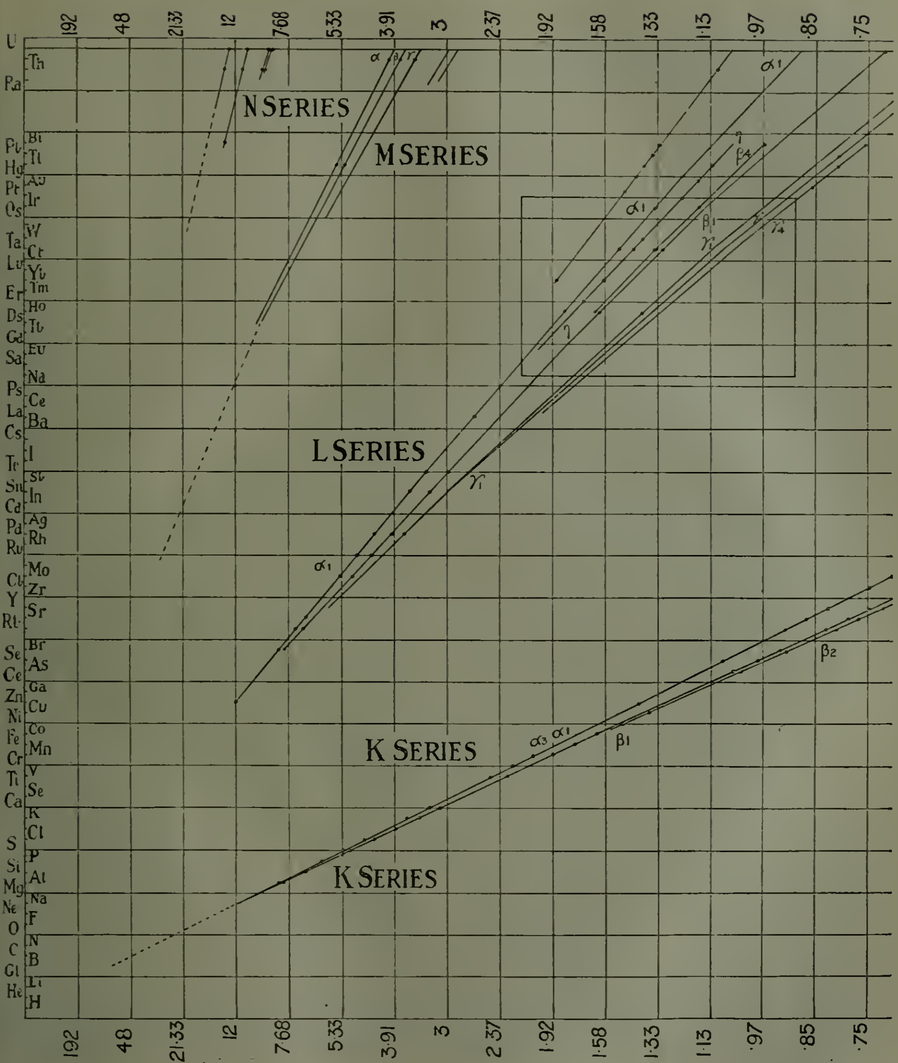
We have received a number of reprints of letters and articles by Profs. Coster and von Hevesy on their discovery of hafnium, an article by Prof. Urbain, the discoverer of celtium, which we published last week, and some other notes on these two names which we have not published. There seems to be some interest in the various claims to the right to christen the element whose atomic number is 72, and in order that our readers may have some of the essential data included in one article instead of scattered about in a variety of journals of different dates we present the following summary :—

In the year 1911, when Prof. Urbain first suggested the name celtium for an element which had prior to that time been neither described nor named, our knowledge of the elements of the rare earths group was less accurate than it is at the present time. It was well known that many elements, possessing obvious features of similarity, existed and that these formed an exceptional group lying between barium and tantalum in the periodic table, but it was not known how many such elements existed nor was it easy to be sure that all the then so-called elements really had elementary characters. In the years from 1896 to 1906 quite a number of new " elements " were suggested which afterwards turned out to be old elements or mixtures of old elements. Among such erroneous new " elements " we may mention lucium, kosmium, neokosium, glaukodymium, the elements Γ, Δ, Ω and Θ of Demarçay, and the incognitum and ionium of Crookes. In the years 1905, 1906 and 1907 two skilful students of this branch of chemistry, namely, Auer von Welsbach and George Urbain, independently investigated compounds of the element ytterbium which was discovered by Marignac in the year 1878 ; each showed that the " ytterbium " of Marignac was a mixture of two elements. Von Welsbach called the two new elements aldebaranium and cassiopeium ; Urbain called them neo-ytterbium and lutecium respectively. A few years afterwards (1911 or 1912) the International Committee for Atomic Weights decided that, notwithstanding some error in his description, Marignac had substantially discovered one of these elements which should retain his name of ytterbium and that the name suggested by Urbain for the other, lutecium, should be officially adopted.

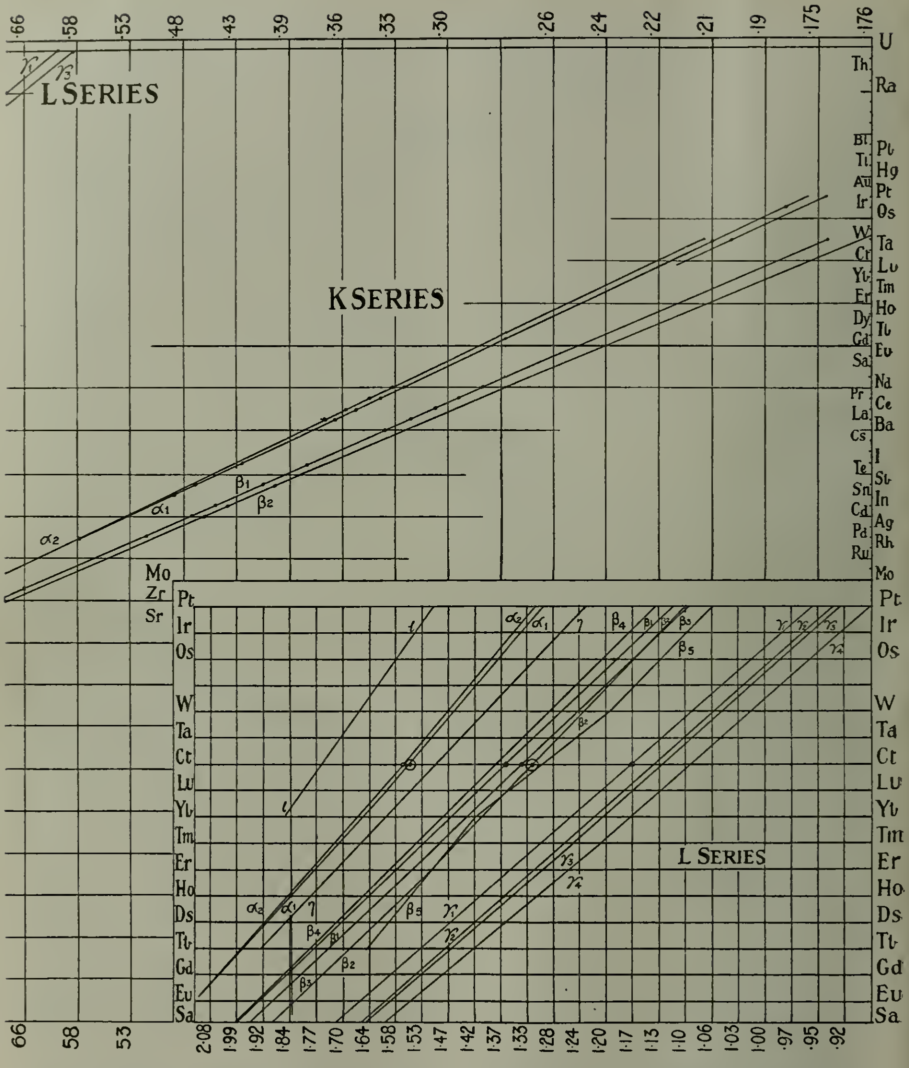
In 1911 Urbain announced that in the mother liquors left after crystallising certain rare earth salts he had found a new element which he called celtium. He described some of its chemical properties and its arc spectrum, giving measurements of some sixteen lines contained in it. As it was derived from a mixture of rare earths of the ytterbium group, he assumed the new element was analogous to lutecium, ytterbium and the other rare earth elements.

In the winter of 1913-14 and the spring of 1914, Moseley published his very remarkable and fundamental work on X-ray spectra of the elements. X-rays were discovered by Röntgen in 1895, and it was noted by Moseley in 1913 that each individual element had its own characteristic X-ray spectrum which could be obtained by allowing the cathode rays to strike solid compounds of the element. Moseley in 1913 proved that the square roots of the frequencies of the lines in these X-ray spectra were approximately proportional to the number of the place in the periodic table occupied by the element in question. From certain other physical considerations it had been suggested independently by Barkla and Van den Broek in 1911 that the elements could be arranged in a consecutive order of " atomic numbers " which would denote the true place of the element in their sequence ; the work of Moseley enabled these atomic numbers to be determined accurately. It was soon ascertained that the element erbium was No. 68 and that tantalum was No. 73, but the accurate measurement of the X-ray spectra of the intermediate elements took some time to effect. The elements supposed to fill these places were thulium, ytterbium, lutecium and the newly discovered element, celtium. At first different authors filled in these four spaces, either partially or wholly according to their individual tastes ; and as most of the rare earth elements are known to be tervalent and as tantalum is quinquevalent, the one, or perhaps more than one, element preceding tantalum must be quadrivalent. Rydberg and Brauner each had his own plan, and Benedicks, Meyer and others put forth various suggestions, but by the year 1917, at any rate, it seemed to several who had studied the subject that the four elements existing between erbium and tantalum were thulium, ytterbium, lutecium and celtium in the order given. If this idea were accepted, it followed that celtium must be quadrivalent as suggested by Rydberg, Brauner, Benedicks and others in what seem to us now rather confused and difficult terms.

The X-ray spectra of thulium, ytterbium and lutecium were all measured with considerable accuracy before the year 1922, and it must have been obvious to anyone who was familiar with Moseley's work that if celtium occupied the position No. 72 immediately preceding tantalum, it was a quadrivalent element. The chief point of doubt—say in 1920 or 1921—was whether the existence of celtium was proved or not ; when the X-ray spectra of thulium, ytterbium and lutecium became known, it was equally known that the element 72 was either celtium or an element so far not discovered and that it was a quadrivalent element. It is no easy matter to search through back numbers of the *Comptes*



Rendus and the *Philosophical Magazine* and keep in touch with the complex tables which replace the once simple diagrams which illustrate the law of Moseley. The large diagram given above shows the general law, the vertical distances showing the elements in due order. The horizontal distances are proportional to the squares of the frequencies, but have been marked out in wave-lengths for greater convenience in plotting. The small diagram shows on an enlarged scale a portion of the L-series of spectra of some of the rare earth and neighbouring elements; no attempt has been made to show all the lines. It is clear from these diagrams that for short lengths the various lines are so nearly straight that if the spectral lines of adjacent elements on each side are known the wave-lengths of the middle element



can be predicted with considerable accuracy and conversely, if new lines are found, the place of the element to which they belong can be predicted with equal accuracy. The publication in 1922 of de Broglie's book on X-rays provided in a convenient form a mass of information which was previously unobtainable otherwise than by long search by someone thoroughly familiar with the subject.

We will now consider the X-ray spectrum of celtium and see how this affects the problem. Urbain tells us that he preserved a small quantity of his original 1911 mother liquor and visited Moseley at Oxford in July, 1914. Moseley obtained an X-ray spectrum which showed only about 10 lines which were attributed to lutecium and ytterbium. Both Moseley and Urbain were in a short space of time mobilised. Moseley was, unhappily for science, killed in Gallipoli in 1916. Urbain fortunately is still able to pursue his favourite study. After the war Prof. Urbain visited de Broglie, taking with him the original 1911 material and asked for a new X-ray spectrum with all the refinements and additional accuracy which the improvements effected since 1914 had made possible. M. de Broglie persuaded his collaborator M. Dauvillier to make the experiment, and the spectrum so obtained shows two lines with wave-lengths 1319·4 and 1561·8. A reference to the smaller of the diagrams shows that the line 1561 might either be an α line of element 72, a β line of erbium or of holmium or even a γ line of europium. The line 1319 might be either a β line of element 72 or a γ line of erbium. If erbium were present the spectrum should show the most persistent of the α and β lines of erbium, which according to Dauvillier it did not. The same is true of holmium. M. Dauvillier therefore attributed these two lines to the element 72, and as Urbain said the sample contained celtium, the obvious and true inference was that celtium was element 72. An account of this work was published by Dauvillier in the *Comptes Rendus* of 1922 and summarised by de Broglie in his book on X-rays published the same year (pp. 110, 111). In January, 1923, Messrs. Coster and von Hevesy announced that they had discovered a new element called hafnium which occupied the 72nd place in the list of elements and had an X-ray spectrum containing lines α_1=1565, α_2=1576, β_1 1371, β_2 1323, β_3 1350 and γ_1=1177 X units. (See *Chem. and Ind.*, 1923, p. 67.) These lines are shown by a dot on the small diagram, those already detected by Dauvillier being marked by a small circle. These values differ by some few units from the earlier measurements by Dauvillier, and further experiments made by Urbain and Dauvillier this year yielded the presumably more accurate values, β_2 1322 and α_1 1564.

Now if Messrs. Coster and von Hevesy claim the right of naming element No. 72 by reason of priority it seems in the circumstances they ought to prove that Urbain's celtium does not exist, or does not occupy the place 72 in the periodic table. Instead of this, it seems to us they have proved (1) that the element No. 72 (whether called hafnium or celtium) is quadrivalent and not tervalent as originally supposed by Urbain and (2) that the optical spectrum originally attributed by Urbain to celtium really belongs to lutecium.

(1) Messrs. Coster and von Hevesy state in their letter of March 20, 1923, to *Nature*, that it was the theoretical conclusion of Bohr (see his *Theory of Spectra and Atomic Constitution*) which led to the anticipation that the element 72 should be a homologue of zirconium. Prof. Urbain thinks the credit for treating celtium as an analogue of zirconium is due to Bury or Perrin in 1921. But we are not sure, with great respect to Prof. Urbain, Coster and von Hevesy that this suggestion is not prior to Bohr, Bury and Perrin. Since the time of Mendeleef or possibly earlier it has been assumed, in accordance with a law to which there seems to be no exception, that the valency of an element is increased by one unit over the valency of the preceding element if there is any increase at all. So that if lutecium is tervalent and tantalum is quinquevalent it is reasonable to suppose the intermediate element is quadrivalent. What has been in doubt is not whether the element No. 72 is quadrivalent, but whether possibly elements 71 and 70 and some others also may be quadrivalent and this really is the problem discussed by Rydberg, Hicks, Brauner, Biltz, Meyer, Benedicks and others. Celtium had been provisionally assigned to the 72nd place in the list of elements at least as early as the year 1917 (at any rate) and we think that any one who in the years 1918, 1919, or 1920 tried to construct a periodic table, which included celtium in it, would have been obliged to take note of the law of Moseley and put celtium in the place immediately preceding tantalum, which means placing it in the same series as zirconium and thorium. In publications by Little in 1917, by Caven in 1917, by Darwin in 1920, by H. E. Armstrong in 1922, and doubtless many others during the few years prior to 1922, either celtium or the last of the rare earths was indicated, sometimes more or less provisionally, as occupying the place 72 in the list and forming part of the series which includes zirconium and thorium.

(2) Prof. Urbain agrees that the lines in the optical spectrum which he thought belonged to celtium really belong to lutecium. There is no dispute about this.

Now let us review the whole situation. In 1911, Urbain came to the conclusion that a certain substance contained a new element which he called celtium. His reasons were (1) faint chemical and magnetic observations which carry no conviction, (2) an optical spectrum containing a number of hitherto unknown lines.

In 1911, 1912, 1913, and 1914 the work of Barkla, Van den Broek, Moseley and others led to a list of atomic numbers, which show that an element of atomic number 72 must be added to the list of those which were already accepted; this element must come between lutecium and tantalum and unless it is quadrivalent it is the one exception to the law which has been noticed as to valency. A number of writers between 1914 and 1922 assume with very little proof that Urbain's "celtium" is the element in question, place it in the space No. 72 and either say nothing about its valency or put it in the list of the zirconium-thorium group, because space No. 72 comes there and nowhere else.

In 1922, Urbain has his original material more carefully examined both by X-rays and the ordinary spectroscope. The X-rays show that his material contains a proportion of element 72, the ordinary spectroscope shows that the unknown lines really belong to lutecium. Urbain and those who made these experiments retain the name "celtium" for the element. A few months later Messrs. Coster and von Hevesy, searching for the new element in a fresh direction, find it in considerable quantity and make a careful investigation of some of its properties by methods and to a degree hitherto believed to be impossible.

Any ordinary man would draw from these facts the following conclusions. Urbain stated that in 1911 a certain material contained a new element. He gave a number of reasons at that time in support of his statement. As time went on all his original reasons turned out to be mistaken or without foundation, but his statement was true nevertheless and before he had shown all his original evidence to be worthless he, with the assistance of M. de Broglie and M. Dauvillier, had obtained one important piece of new evidence, which proves the truth of his statement.

The fact that Urbain thought in 1911 the element celtium to be more allied to ytterbium than to zirconium seems to be of little importance. It was not until 1914 that one could say what places in the periodic table all new elements ought to occupy and not until the X-ray spectra of ytterbium and lutecium had been measured that the position of the element in question could be fixed with certainty.

The question of priority might have been much more difficult had some third party shown, say, in 1913 or 1914, that the new spectra found by Urbain really belonged to lutecium. Urbain would then very likely have acknowledged that his new element was as mythical as kosmium or incognitum and it would have been difficult for him to re-establish its genuineness. Fortunately for him, no one seems to have shaken the credit of his new element until it was too late and he was able to supply it with the necessary authenticity before he himself withdrew certain of his earlier reasons for believing in its existence. We are inclined to think that Prof. Urbain discovered celtium rather luckily in 1911, but that his claim to be discoverer would have been very unsubstantial had he not, with the assistance of Dauvillier, provided a firm foundation for it by identifying its X-ray spectrum in the spring of 1922. Both the work of Urbain on the rare earths and the work of Coster and von Hevesy are of first-rate importance and every student of accurate X-ray work knows how much we are indebted to Coster, Hjalmar, Dauvillier, de Broglie and the others who have placed this subject on the high level of accuracy it has now reached.

It is a little singular how highly specialised the study of the elements in this particular region of the periodic classification remained until the researches of Moseley, Rutherford, Bohr, Langmuir, Lewis, Dauvillier, Somerfeld, Kossel and some others showed how closely all the elements are related constitutionally. In pursuing the history of celtium we find that in pre-war days many of those who studied the rare earths had no particular interest in X-ray methods, whilst the men who studied X-rays had no time for ordinary spectroscopy or the electronic theory of valency. We cannot conceive any dispute as to the family of elements to which No. 43, No. 61, No. 75, No. 85, and No. 87 respectively belong, and we think no one who was acquainted with the great progress made in the years 1914, 1915, and 1916 could have really disputed the relationship of No. 72 at any time after, say, 1916 if he had for a moment stopped to consider the meaning of the work which had been published up to date. We do not know what decision the International Committee on the Elements will announce, but we think that Urbain and Dauvillier are quite justified in attaching the name "celtium" to No. 72 until reasons far more disingenuous than any yet adduced are advanced to prove that they did not discover the existence of this element.

HYDROGENATION FLAVOUR

By KAPIBRAM H. VAKIL, M.Sc.Tech., B.A.

Hydrogenation of oils and fats has assumed such considerable importance that there exists an ever-growing volume of literature on this branch of applied chemistry, covering almost every aspect of the process, but it seems that on one point, viz., "hydrogenation flavour," most of the observers are silent; though there are certain references on this subject in recent publications many of them are very vague.

The use of hydrogenated oils for edible purposes, specially in confectionery, in biscuit manufacture, and in the preparation of butter and ghee substitutes and other milk products[1] such as compound milk will depend largely on the removal of this process flavour from hydrogenated oils and fats. Though hydrogenated oils are largely used in the United States in the preparation of vegetable shortening and lard substitutes, the difficulty regarding the removal of the hydrogenated flavour does not seem to have been completely solved.

The development of hydrogenation flavour is not noticeable in small-scale laboratory experiments under varying conditions, and particularly when the gas is not returned to the autoclave or flask, the product obtained does not exhibit the characteristic hydrogenation flavour. But on the application of the process on a larger works scale, when for economical reasons the gas is used over again or totally absorbed, the resulting product is entirely different from that obtained in the laboratory and shows a marked characteristic odour which is not confined to any particular class of oil nor does it result from the very small quantity of impurities which is usually present in neutral refined oils. Even highly purified and deodorised oils give rise to this hydrogenation flavour.* A variation of the four important factors which control the process of hydrogenation, viz., time, temperature, pressure, and agitation, does not in any way materially lower the development of the process flavour, indicating that the flavour does not originate in any selective hydrogenation of the different glycerides.

The origin of the flavour must, therefore, be traced to the formation of certain volatile bodies during the process. These volatile substances in the laboratory experiments are removed with the gas as they are formed and have no chance of flavouring the final product, whereas in works practice, as the gas is used over again till completely absorbed, these volatile substances remain in the oil and give rise to the peculiar odour.

This particular feature of the process of hydrogenation does not seem to have been systematically dealt with by the observers, though Wilbuschewitsch[2] tries to overcome this inherent defect in the process by passing the circulating hydrogen through caustic soda solution. Fahrion[3] also suggests the use of alkaline solutions for the purification of the excess gas.

During hydrogenation on a large scale water is formed. Lush[4] regards this formation as due to the further reduction of nickel oxide or sub-oxide. This water is removed by cooling the circulating gases coming out of the converter and before they are sent back into the process. The condensates thus obtained are very strongly odoriferous, even though a considerable amount of the volatile odoriferous substances pass on uncondensed with the gas. To strip the hydrogen completely of these odoriferous substances effective scrubbing with caustic soda or similar substances is necessary. A solution of 10 per cent. ferrous sulphate was successfully used as a scrubbing agent in a centrifugal scrubber. The odour is not very apparent in a warm sample taken out from the filter press, but after cooling and standing, the flavour becomes distinctly pronounced. The use of a purified gas, therefore, does not give such a completely odourless substance as is obtained on a laboratory scale. For this reason a further treatment of the material after hydrogenation seems necessary.

It is now the general practice to remove this flavour by superheated steam, and in certain American plants provision for the steam deodorisation of hardened oil is a distinct feature of the lay-out. The use of superheated steam for deodorisation does not seem to have given completely satisfactory results, as is evidenced by the pronounced hydrogenation flavour in many of the American brands of vegetable shortening. Many of the workers had, therefore, to resort to a further treatment[5] with whole or skimmed milk, butter milk, or sour milk.

Scrubbing of gases in the process, vacuum steam deodorisation and a treatment with milk and similar substances have not yet satisfactorily solved the problem, as the hydrogenated product still requires various flavouring substances, such as cumarin, vanilla, orange or lemon oils, butyric acid or various esters of lower fatty acids. It is generally noted that however carefully a steam deodorised hydrogenated product is prepared and stocked the characteristic flavour reverts in a comparatively short time. Samples of American vegetable shortening and lard substitutes invariably develop in course of time the hydrogenation flavour. It is on this account that the use of hydrogenated oils is not preferred in biscuit manufacture. A well-known British firm of biscuit makers very nearly ruined its business on account of the development of hydrogenation flavour in its biscuits. An interesting feature is that the hydrogenation flavour does not easily blend with other flavouring substances and cannot therefore be completely masked by them.

Joslin[6] suggests the treatment of the hydrogenated oils with alcohol and a further purification by means of steam or an inert gas. It is found, however, that treatment with carbon dioxide or a mixture of carbon dioxide and nitrogen, between 145° and 150° C., under normal pressure for 45 to 50 minutes, completely removes the hydrogenated flavour. Samples treated by this method have on long standing shown no signs of reappearance of the odour as is noticeable in steam deodorisation.

It seems natural to conclude that the hydrogenation flavour originates in the formation of a volatile product. In the absence of any systematic research work on this subject it would be premature to hazard any opinion as regards the composition and properties of the odoriferous substance, though it is regarded by some authorities as of aldehydic or ketonic character. It may be due to polymerisation of the oil at high temperatures used in the process, and or to the breaking up of certain triglycerides into di- or mono-glycerides and their reduction into aldehydes or ketones. The fact that most carefully refined and deodorised neutral oils give rise to this hydrogenation flavour indicates that the origin of the flavour must be traced not to any foreign substances occurring as impurities in oils but to the formation of an intermediate product in the process itself.

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* Fahrion[3] has described the hydrogenation flavour, "Härtungsgeruch," of different oils.

Tata's Laboratory, Bombay
July 14, 1923

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(2) Wilbuschewitsch	U.S. Patent 1,079,278. Nov. 18, 1913.
(3) Fahrion.. ..	*Die Härtung Der Fette,* 1921.
(4) Lush	This *J.*, 219 T., 1923.
(5) Ellis	U.S. Patent 1,058,738. April 15, 1913.
(6) Joslin	U.S. Patent, 1,152,023. Aug. 31, 1915.

THE WORKS OF GEBER

By Prof. J. R. PARTINGTON, M.B.E., D.Sc.

A recent issue (1923, 42, 502) of this *Journal* gives an abstract of a reply by Prof. E. O. von Lippmann (*Chem. Z.*, 1923, 47, 321) to a letter of mine on the subject of Geber. Since no account of my original arguments, published in *Nature* (1923, **111**, 219), nor of my reply (*Chem. Z.*, 1923, 47, 429) to Prof. Lippmann's article, has appeared in this journal, it seems reasonable that I should have an opportunity of examining the observations of Prof. Lippmann to which attention was directed. In my first letter to *Nature* I gave (as far as I am aware for the first time) an analysis of the arguments used by Berthelot against the identity of the author of the Latin works attributed to Geber with the Arabic writer Jabir ibn Hayyan, to whom they were formerly attributed. I suggested that Berthelot's arguments were unsound, with one possible exception, viz., the alleged difference between the translation and one which could have been made from Arabic. Prof. E. Wiedemann, of Erlangen, has been good enough to express an opinion, in a letter to me, which appears to support this view. Because of this, and also of the contents of the translations of the Arabic writings of Jabir ibn Hayyan, to which I referred in the *Chemiker Zeitung*, I suggested that the original author of the Latin works *may* not have been Arabian. In a note at the end of my letter to the *Chemiker Zeitung* (p. 429) Prof. Lippmann again assumes the contrary, in spite of the definite statement in my letter, and he adds the following remark : " The question what views *Berthelot* has entertained is a matter of secondary importance and can lead *alone* to no decision. *My* position is based on the *whole* of the facts known to me, and cannot be designated as resting on prejudice." (Emphasis as in original.) In his first article he also stated that the account of the matter given in his " Alchemie " leads necessarily, step by step, to the conclusion first reached by Berthelot. It now seems necessary to examine Prof. Lippmann's account. In the first place, it is evident that he has made use of only a limited amount of the available information, as a glance at the literature quoted by Ferguson (" Bibliotheca chemica," vol. 1, pp. 302–4) will show. In the second place, even this limited field has not been very accurately covered.

The short section (pp. 485–488) devoted to the subject by Lippmann begins by quoting the opinion of Stahl (" Gedancken und Bedencken von dem so genannten Sulphure," Halle, 1718, p. 48 : quoted as " Vom Sulphure " by Lippmann), who merely remarks that Geber could hardly have been a " King of Arabia," since he would have had no subjects, but does not, as far as I can see, throw any doubt on the authenticity of the *writings* of Geber, as Lippmann says he does. The latter next quotes a statement of Reiske's, through the medium of a later work, *i.e.*, at third hand. In the original work of Reiske, a note in the edition of the " Annales moslemici " of Abulfeda, Copenhagen, 1790, vol. 2, p. 629, the editor quotes another " opinion, that the name may be fictitious, invented by the alchemists," and refers to d'Herbelot's " Bibliothèque orientale," Paris, 1697, p. 387, where Geber is said to have written a large number of works on the philosopher's stone. " Our chemists, who have never read these books, nevertheless make a great noise about them in their works." He is here referring, I imagine, to the works of Jabir ibn Hayyan, the authenticity of which is admitted. The remarks of Beckmann, to which Prof. Lippmann refers, are not concerned with the " Sum of Perfection " of Geber ; those of Sprengel are not supported by any reasoning. Davy is next said to have regarded the works of Geber as " compilations of the alchemists of the 15th and 16th centuries," but he is referring to the MSS. of these dates in the British Museum, which are late copies. In the " Geschichte der Botanik " of E. Meyer (vol. 3, p. 98, 1856), who relies on Reiske to some extent, it is said that it " is just possible that neither G'abir nor Chalid Ben Jazid ever lived or wrote " (the quotation given by Lippmann does not occur), but he is referring to Jabir ibn Hayyan. As to the opinion of Latz (in his confused and superstitious book, " Die Alchemie," Bonn, 1869, p. 438), it is sufficient to say that he refers to " Kallid," and that Prof. Lippmann has substituted " Geber " in the quotation which he gives in parentheses ! When it is added that Latz believed in alchemy and that he interpreted Genesis in an alchemical sense, his value as an historical authority may be questioned, and when he is misquoted it is still further diminished. We are next told by Prof. Lippmann that Steinschneider held Geber to be " an almost mythical person," and remarked that the knowledge referred to him does not occur in the works of Jabir. Steinschneider is referring to Jabir ibn Hayyan, and merely remarks that a book on poisons attributed to Jabir does not occur in Borel's "Bibliotheca chemica" ("Hamburg, 1656, 97"; in my edition, Paris, 1654, p. 102, the works of *Geber* are given). Steinschneider does not seem to have separated Geber and Jabir. Prof. Lippmann now states, as he has done on several occasions, that the remark of Steinschneider led Kopp to revise his views on Geber, that in doing so he practically arrived at the view expressed by Berthelot, and that the latter merely added the last link in the chain, "if, in view of the above statement, this was really necessary." Kopp's conclusion was that "with reserve I can still regard these works as Geber's and assume that they are translated from the Arabic" (Beiträge, vol. 3, p. 33). Kopp's investigation, although valuable, is based on three late printed texts of Geber and otherwise largely on library catalogues, not on manuscripts. They are summarised by Prof. Lippmann on p. 486 of his "Alchemie," and amount to the observation that the accounts of Geber (Jabir) given by Oriental writers are confused (as was pointed out at least as early as 1851 by Hammer-Purgstall, "Litteraturgeschichte der Araber," vol. 2, p. 185; vol. 3, 1852, p. 299), and that the style of the Latin works, which are not known or mentioned before 1300, is "scholastic." I have dealt with the last point; I cannot express an opinion on the Arabic accounts. Prof. Lippmann has not thought it necessary to do much more than refer to his "Alchemie" as a criticism of my arguments. I must again assert, and I hope the reason will now be quite clear, that I regard that account as untrustworthy, and that, as far as I can see, the views which I expressed as to the validity of the arguments based on the *internal* evidence of the Latin works have not yet been satisfactorily dealt with.

Since the above was written I have read the brief article of Prof. Darmstaedter, of Munich, in the *Chemiker Zeitung* of July 21, in which he refers to my previous letters—unfortunately only through the medium of Prof. Lippmann's article. For the latter reason, probably, Prof. Darmstaedter attributes to me opinions which I have not published. Prof. Darmstaedter's remarks are otherwise very interesting and instructive, and I can only hope that he will make himself acquainted with my original communications. I may add that I intend shortly to publish elsewhere some account of the Latin writings of Geber, since much confusion appears still to exist on the matter; some of the statements of Prof. Darmstaedter, for example, in the introduction to his recent book on the alchemy of Geber, are far from correct. Some of these he has himself corrected in the article to which reference has been made.

BRITISH CHEMICAL PLANT MANUFACTURERS' ASSOCIATION

The third annual general meeting was held on July 18, Mr. L. M. G. Fraser in the chair. The chairman, in moving the adoption of the annual report, said that the membership kept roughly constant and the financial position was increasingly sound; the Association started with a balance of £177 and the carry-forward to next year was £264. Mr. Fraser then discussed methods of improving the usefulness of the Association, and he suggested that members should be invited to participate in the work of theoretical and research bodies, on which their engineering knowledge would help. Referring to the work carried out on standardisation of jacketed pans and of filter presses, the chairman said that the Association had altered their patterns and incurred expenses for the ultimate advantage of chemical manufacturers, and they had hoped that their advances would have been better appreciated. The subject had again been brought to the notice of the Association of British Chemical Manufacturers. After referring to the favourable result of the collective exhibit at the British Industries Fair, 1923, it was stated that sufficient support could not be obtained to have a section at the British Empire Exhibition. The suggestion was made that the Association should be represented on the Cast Iron Research Association, and the importance of research on corrosion was emphasised. Other points dealt with were education, under which attention was called to the doubt as to the true meaning of the term "chemical engineer"; standardisation of chemical plant; and the reductions, etc., in rail rates. The report was unanimously adopted, and Mr. L. M. G. Fraser, Mr. F. R. Blizzard and Mr. E. A. Alliott were re-elected as chairman, vice-chairman and honorary treasurer for the forthcoming year, Messrs. H. Bush, J. H. Rawson, R. Seligman, E. C. Watkins and J. W. Wright being elected members of the executive committee. It was agreed that a scheme should be prepared for the issue of a calendar for the year 1924 to give information on plant produced by the members of the Association.

ACADÉMIE DES SCIENCES

During the meeting on August 6, Monsieur D. Berthelot communicated a note on the "Control of the Action of Fertilisers," by M. Blaringhem, who showed that more accurate results than those obtained by comparing the increase in weight of the crop on manured as against unmanured plots could be furnished by applying methods of experimental genetics to pure lines with constant somatic characters. Thus, using Howano flax, the leaf density of 11 for the controlled plots became uniformly 16 for plots manured with potash and 21 for those manured with nitrogen; similar results being also obtained with cereals. The method makes it possible to trace the influence of fertilisers at all periods of the life of the plant.

At a previous meeting, Prof. Moureu communicated a note by Professor H. E. Armstrong on "The Origin of Osmotic Effects: Hydronodynamic Transformations in Aqueous Solutions." Prof. Moureu also communicated a paper by MM. Helbronner and G. Bernstein, who showed that, in presence of a small amount of a reducing agent, rubber is protected from the action of oxygen both at ordinary temperatures and at the temperature of vulcanisation, the result recalling the work of MM. Moureu and Dufraisse on "Anti-oxygènes," a subject to which MM. A. Gillet and Fernand have devoted some attention in relation to the action of copper salts on dyestuffs. Prof. Perrin described the results obtained by M. Marcellin on the "Measurement of Variations of Surface Tension with the help of traces of Oleic Acid," and announced that M. Holweg had devised a new molecular pump.

FORTHCOMING EVENTS

Sept. 10–13. The Institute of Metals. Annual Meeting at Manchester. *Second Annual Autumn Lecture.* "The Use of Non-Ferrous Metals in Engineering," by Lieut.-Col. Sir Henry Fowler, K.B.E., at 8 p.m., Sept. 10. "The Cause of Red Stains on Sheet Brass," by E. A. Bolton. "Note on 'Brinell Hardness Numbers,'" by H. W. Brownsdon. "The Behaviour of Metals under Compressive Stresses," by H. I. Coe. "On the Measurement of the Change of Volume in Metals during Solidification," by Hikozo Endo. "The Electrochemical Character of Corrosion," by U. R. Evans. "The Constitution and Age-Hardening of the Quarternary Alloys of Aluminium, Copper, Magnesium and Magnesium Silicide," by Marie Gayler. "Investigation of the Effects of Impurities on Copper (Part I—The Effect of Oxygen on Copper)," by D. Hanson, C. Maryatt, and G. W. Ford. "Experiments with some Copper Wire; Cohesion a Function of both Temperature and Cold-work," by D. H. Ingall. "The Effect of Small Quantities of Nickel upon High-grade Bearing Metal," by A. H. Mundey and C. C. Bissett. "Stereotyping," by A. H. Mundey and J. Cartland. "Hardness Tests on Crystals of Aluminium," by H. M. O'Neill. "A Dilatometric Study of the Transformations and Thermal Treatment of Light Alloys of Aluminium," by A. M. Portevin and P. Chevenard. "Effects of Rate of Cooling on the Density and Composition of Metals and Alloys," by R. C. Reader. "Crystallisation Effect on Galvanised Iron Sheets," by E. L. Rhead and J. D. Hannah. "Equilibrium in the System Gold-Zinc (based on Investigations of Electrical Conductivity at High Temperatures)," by Prof. P. Soldau.

CORRESPONDENCE

YOUR PENCIL UNMASKED

Sir,—Like many other old members of the Society, I have followed with interest your efforts to make our publications known to a wider circle of readers, and I now observe that you are striking a distinctly new note in publishing as an article in *Chemistry and Industry* a *resumé* of a paper which was published in the Transactions.

In November, 1919, my communication on "Pencil Pigments and their Examination in Writing" appeared in the Transactions, and in *Chemistry and Industry* for July 20 (p. 710) there is published an article with the title "Your Pencil Unmasked," by Mr. F. Colin Sutton, in which my original work has apparently been summarised, although the writer of the article has missed the opportunity of letting it be known that he was referring to an investigation already published by the Society, and has thus deprived another section of the journal of the publicity to which it is entitled.

Or have two chemists studied the characteristics of pencil writing and, by a curious coincidence, used for the purpose the same MSS. in the British Museum? If so, I should be glad to have the name of this anonymous authority, with whom I have so much in common.

If, however, it is my work only which has been adopted, without acknowledgment, for the purpose of this article, a story which is told of Virgil seems apposite. Virgil (if I am mistaken as to my poet your classical contributors will forgive me) had had some of his poems claimed by someone else. As a test he wrote some unfinished verses, and when the other man could not complete them, Virgil added the missing portions, and concluded with the words: "*Hos ego versiculos feci, tulit alter honores.*"

Possibly the exigencies of metre prevented the use of the word "honoraria" for "honores," or it may be that in those days poets, like the authors of scientific papers to-day, had to be content with the credit for the work—when they could get it.—I am, Sir, etc.,

C. Ainsworth Mitchell

195, Victoria Street, London, S.W. 1
July 28, 1923

CELTIUM

Sir,—In the article "Chemistry," in the current supplement of the *Encyclopædia Britannica*, published, I believe, early in the summer of last year, a table of the elements is given in which these are arranged in the order of the Moseley series numbers and also in homologous series. Celtium is placed at 72 in the zirconium and titanium column. I therefore am to be reckoned among those who placed Prof. Urbain's discovery properly in advance of Messrs. Coster and Hevesy. The article was sent to press about a year before it was published and I never saw a proof. I believe it was printed in America. I was only guided by what I had read and well recollect hesitating to assign an element found in rare earth material to another series—but there was no other place for 72 in my scheme, which I venture to think is the most rational periodic arrangement of the elements yet put forward.—I am, Sir, etc., Henry E. Armstrong

Granville Park,
Lewisham, S.E. 13

THE BRITISH PHOTOGRAPHIC RESEARCH ASSOCIATION

Sir,—You will be pleased to know that since my letter in your issue of July 13, the Department of Scientific and Industrial Research and the photographic manufacturers have been able to arrange a scheme by which the British Photographic Research Association is assured of a further existence of four years. It is also expected that as a further result of this it will be possible to place the Association on a practically permanent basis.—I am, Sir, etc.,

Ilford B. V. Storr
Aug. 13, 1923

PERSONALIA

The Master and Fellows of Gonville and Caius College have elected Mr. W. I. Jones, B.Sc., to a Rhondda Research Studentship for research in organic chemistry.

J. A. Gunton has accepted the professorship of chemistry in the University of Western Ontario.

The following awards for the year 1923-4 have been made by the Salters' Institute of Industrial Chemistry, and approved by the Court of the Company. Fellowships are awarded to Mr. T. B. Philip, B.Sc., Imperial College of Science and Technology, Mr. W. G. Sedgwick, M.Sc., Armstrong College, Newcastle-on-Tyne, Mr. D. T. A. Townend, B.Sc., Imperial College of Science and Technology. Fellowships are renewed to Mr. C. G. Harris, B.A., Jesus College, Oxford, and to Mr. J. H. Oliver, B.Sc., Imperial College of Science and Technology. Mr. W. Randerson, a Fellow for 1922-3, having been elected to an Albert Khan Travelling Fellowship for the year 1923-4 is made an Honorary Fellow for the year.

* * *

Dr. L. Bell, a pioneer in the field of illuminating engineering and power transmission, and the author of numerous articles on photometry, electric motors, etc., died recently in the United States at the age of fifty-nine.

From France the death is announced of Monsieur L. Wolf, vice-president of the Cie des Produits Chimiques et Electro-métallurgiques d'Alais et de la Camarque.

NEWS AND NOTES

UNITED STATES

Chromite in 1921

The U.S. Geological Survey reports that the total sale of domestic ore in 1921 was 282 long tons, equivalent to 245 long t. of 50 per cent. ore. Although this quantity is trifling as compared with that sold during the war, it is close to the average annual production from 1900 to 1913, inclusive, which was 232 tons. Of the quantity sold in 1921 68 long t. came from California and 214 long t. from Oregon. In spite of the large imports in 1920 and the large reserve accumulated, imports in 1921 were remarkably high, amounting to 81,836 long. t., the result doubtless of the low prices, the average price, $8, being even less than the average of $9·56 in 1913. It is thought that a large reserve supply is available, perhaps enough for more than a year's consumption. The imports were derived chiefly from British South Africa, 23,318 t.; Canada, 7554 t.; French Oceania, 35,108 t.; Greece, 8104 t.; and Turkey in Asia, 5822 t. The imports of chromium compounds were small as compared with the consumption. The apparent consumption of chromite during 1921 was 82,118 long t., which compares with 152,777 long t. in 1920. Sales of ferrochrome in 1919 and 1920, the only years for which figures are available, were estimated at 15,763 long t. in 1919 and 16,606 long t. in 1920. The quantity of 50 per cent. chromite required to yield this amount of ferrochrome, on the arbitrary assumption of no loss of chromium in slag, would be 31,700 long t. for 1919 and 33,400 long t. for 1920. The world's output of chromite in 1920 is estimated to have been 190,000 m.t.

FRANCE

Petroleum Exploration

The geological section of the Scientific Petroleum Commission has been requested to draw up a programme of exploration for France and the Colonies. The main outlines of this programme are as follows:—

Prof. Glangeaud will select sites for new borings in Auvergne; apparently in Limagne (where results have already been obtained), the work will be given to the Société Pechelbronn and carried out immediately. A commission, consisting of MM. Viennot-Barabé and Dubar will examine the geology of the Pyrenees, Landes and Gers to determine suitable spots for borings, and another commission will examine the district of Gard and Hérault. In addition, a geological and economic commission will investigate the petroleum deposits in Madagascar, where there are signs of the existence of important deposits of petroleum: the work will be carried out over an area of 1400 to 1500 hectares in the Manche and Cabrados regions.

The Gas Industry

By the Law of July 22, 1923, gas undertakings in France are permitted to supply gas of a lower calorific value than heretofore, so that they can recover valuable by-products such as benzol, a practice hitherto illegal. According to the Law, the minimum calorific value cannot exceed 4500 calories per cubic metre of dry gas, measured at 0° C. and a pressure of 760 mm., nor be less than 3500 calories. However, under certain circumstances, such as the nature of existing plant or the neighbourhood of coke ovens, the calorific value can be varied between 3000 and 4000 calories. A novel feature of the Law is that by joint decree of the Ministers of Commerce and of War any manufacturer supplying gas to the public under permission accorded by the Minister of the Interior can be compelled to extract from the gas the various chemicals or fuels contained in it and necessary to industry or to manufactures of importance to national defence.

Metallurgical Coke

Owing to the importance of the coke problem to France, much interest is being shown in experiments in the manufacture of metallurgical coke from Sarre coal mixed with French lean coal or coal that has been partly distilled or treated in various ways. Important results have already been obtained by the admixture of Sarre dust and lean Auzin coals, as much as 80 and 85 per cent. of Sarre coal being used. The distance of the Sarre basin from sources of lean coal and the fear of interruption in supplies, however, have led to attempts to use native fat coal that has been partially distilled, but so far it has not proved possible to produce semi-distilled coal of sufficiently uniform composition. Further attention has been paid to the system of "progressive carbonisation" introduced by Monsieur Serpy, and designed to distribute the heat as uniformly as possible throughout the coal so as to avoid the excessive cracking that takes place when Sarre coals are heated rapidly. Most of the tests have been carried out at Heinitz, using coke ovens that differ from the usual type only in their relatively small width and in the means for controlling the heat supplied. The oven, at about 600° C., is first charged with a damp "cake" that fills only half the space and cools the walls sufficiently to prevent too rapid heating. After 30 hours the "cake" is pushed back into the oven and replaced by a further half charge. Afterwards coking and degasification take place at the usual temperature. A battery of three ovens of this type has been worked in the Sarre for six months and has yielded coke of satisfactory quality. The by-products obtained are different from those usually obtained; less gas is produced and instead of benzol, an equivalent quantity of a lighter product, resembling petrol, is obtained; there is a higher yield of tar, containing less pitch but more heavy oils.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for Aug. 17)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
British West Indies	Glassware, tinware	165
" "	Window and plate glass	166
Chile	Porcelain, earthenware	182
Far East	Tinware, enamel ware	181
Netherlands	Iron and steel tubes	170
Norway	Wrought iron tubes and fittings	171
"	Leather goods	173
"	Galvanised iron plates, corrugated iron	176
South Africa	Leather goods	11755 /E.D./M.C./2
Spain	Rubber goods	179

TARIFF CUSTOMS EXCISE

Federated Malay States.—Government Notification No. 3591, which is published in the Supplement to the Government Gazette of June 15, 1923, states that the Export of Rubber Restriction Enactment, 1923, shall come into force as from June 25, 1923.

Italy.—The *Gazzetta Ufficiale* (Rome) for July 26, contains a Royal Decree-Law, which provides for certain modifications of the Italian customs tariff that was enforced by the Decree of June 9, 1921. Amongst the goods upon which such reductions of duty apply are iron and steel and manufactures thereof, and these reductions are to be applied, until the termination of the respective Conventions, to goods the produce of, and imported into Italy from, countries enjoying most-favoured-nation-treatment in Italy. They are, therefore, applicable to goods manufactured in the United Kingdom and exported thence to Italy.

Poland.—The excise duty on acetic acid has been increased from 3000 to 6000 Polish marks per kg.

ERRATA.—In the issue dated August 10, on p. 773, col. 2 under "France," line 8, for 6,800 tons read 68,000 t., and on p. 776, col. 2, under "Rumania," second paragraph, line 3, for 19, read 1922.

REPORTS

Report on the Economic and Financial Conditions in Switzerland, December, 1922.

By E. C. D. Rawlins, *H.M. Commercial Secretary, Berne. Department of Overseas Trade. Pp.* 75. *H. M. Stationery Office*, 1923. *Price* 2*s.* 6*d.*

The outlook in Switzerland, though still somewhat disturbed, showed in 1922 more promise of return to a normal state than could be seen in 1921 (*cf. J.*, 1922, 573 R). Depreciated currencies in many countries handicap trade with Switzerland, though this point does not affect Great Britain. Amongst other factors, however, which disturbed the financial equilibrium was the referendum on the capital levy, which, although the proposal was defeated, led temporarily to something of a financial panic.

In 1922 commercial treaties were entered into with Spain, Rumania, and Poland. The system of import restrictions due to expire in September, 1922, was extended to June, 1923, but this had very little effect on British imports. Imports into the country in the first nine months of 1922 amounted to 1356 million francs (the Swiss franc rose fairly steadily during the year from 21·70 to 24·48 to the pound sterling) compared with 2296 mill. fr. during the whole of 1921, whilst exports during the period January to September, 1922, amounted to 1250 mill. fr. (1843 mill. fr. in the whole of 1921). An increase was noted in 1922 in the imports of textiles from the United Kingdom. Imports of coal during the first nine months of the year increased from 801,261 tons in 1921 to 887,530 t. in 1922, and of coke from 167,394 t. to 305,728 t. Imports of metals increased largely: iron and manufactures of, from 150,502 t. to 193,373 t.; lead and manufactures of, from 3581 t. to 5868 t.; zinc and manufactures of, from 1388 t. to 2590 t. Imports of nickel and aluminium decreased, especially of the latter. An increase generally in the imports of chemicals and dyes is to be noted: of pharmaceutical and druggists' wares from 2159 t. to 2846 t., chemicals 64,446 t. to 85,112 t., dyes 7089 t. to 7917 t., technical oils and fats 25,769 t. to 34,702 t. Out of a total of 134 t. of dyestuffs imported in the first nine months of the year, Germany supplied 66 t. and Great Britain 52 t. Petroleum imports increased from 9768 t. in 1921 to 14,271 t. in 1922. Exports of minerals and metals show a general increase, as do also chemicals and dyestuffs. The British Empire heads the list of buyers of Swiss goods, but is fourth as a source of imports.

Most of the Swiss industries continued to suffer from acute depression in 1922. The crisis which began in 1920 in the chemical and dye industry has not abated, in fact is somewhat more severe. Many countries have imposed import restrictions to protect home industries which would in any case prove strong competitors to Swiss goods. German competition is also an important factor.

Report on the Economic, Financial and Industrial Conditions of the Netherlands to February, 1923.

By R. V. Laming, *H.M. Commercial Secretary, The Hague. Department of Overseas Trade. Pp.* 68. *H. M. Stationery Office*, 1923. *Price* 2*s.*

In the year under review the position of agriculture, the chief natural resource of the Netherlands (*cf. J.*, 1922, 297 R), was far from flourishing, and the future is not very hopeful. Several beet-sugar factories were closed owing to the grouping of the principal sugar producers in the Central Sugar Co., which has a working agreement with the Co-operative Beet Producers' sugar factories. From January to November, 1922, 174,888 tons of raw sugar was produced, and this year an output of 275,000 t. of sugar is anticipated. Coal was produced in 1922 to the extent of 4,574,000 t., and several new seams were discovered; the output of lignite for the year was 27,000 t. The Boekels mine yielded 27,507 t. of refined salt.

Industry passed through an anxious time, largely owing to competition from countries with depreciated currencies, but there is opposition to the introduction of protection. Imports in 1922 were valued at 2,026,000,000 fl. (the florin varied during the year between 11·28¾ and 11·70¼ to the pound sterling; par=12·10) and exports at 1,221,000,000 fl., Great Britain supplying 323 million fl. of the imports and taking 302 mill. fl. of the exports. The items include minerals and metals and manufactures thereof—imports 362 mill. fl., exports 95 mill. fl.; chemical products, medicines, paints, and colouring materials—imports 49 mill. fl., exports 39 mill. fl.; oils, resin, wax, pitch, tar and by-products and manufactures—imports 90 mill. fl., exports 118 mill. fl.; glass—imports 13 mill. fl., exports 6 mill. fl.; paper—imports 31 mill. fl., exports 34 mill. fl. Great Britain is the chief source of coal, of which there was a total import of 6,216,000 t. in 1922.

It is becoming more apparent that there is a growing tendency for the Dutch to buy in British markets. The reasons are several, but the falling prices of British goods, the steadiness of British deliveries, and a simultaneous upward tendency in quotations from countries with depreciated currencies are chiefly responsible.

Dr. W. v. Oechelhäuser, whose death was announced some time ago, had played a notable part in developing the gas industry, especially in the introduction of vertical retorts. He also developed the first gas engine to utilise blast-furnace gas directly as fuel.

REVIEWS

Supplementary Notes on Gravimetric Analysis for Beginners. *By* W. Lowson. *Pp.* vi+54. *London: Longmans, Green & Co.,* 1923. *Price* 2*s.* 6*d.*

This little book is packed with that wisdom which the student can only acquire, as a rule, from a sympathetic demonstrator or from tedious experience. There is advice on apparatus and methods in general, and in the notes on typical estimations the reasons for various procedures are clearly stated, in refreshing contrast to the rather haughty directions of some of the standard treatises. A section is devoted to occlusion of dissolved substances by precipitates and the avoidance of errors caused by this common phenomenon. It is noticeable that the author, whilst recommending a double dehydration of silica with intervening filtration, instructs the student to dehydrate only by heating on the waterbath—it is generally accepted that a somewhat higher temperature is necessary to render the silica insoluble. Methods of calibrating volumetric apparatus are briefly described (in defiance of the title!) and a table of solubilities of salts, a table of logarithms and a blank page on which the student is expected to record analytical factors calculated by himself round off a book whose value is greater than the price suggests.

P. C. L. Thorne

The Wet Collodion Process. *By* Arthur Payne. *Second edition. Pp.* 128. *Newcastle-upon-Tyne: Mawson and Swan, Ltd.,* 1923. *Price* 3*s.*

The generality of photographers look upon the wet collodion process as appertaining to a bygone day. From 1855 to about 1881 it was almost the only process used either for landscape work or portraiture; the negatives it produced still arouse the wonder and admiration of the present generation of photographers. But the wet collodion process by no means died on the introduction of the modern dry plate; on the contrary, it took on a new lease of life and to-day holds premier place in process work for the production of line and half-tone negatives.

The book under review, the first edition of which was published in 1907, is looked upon by process workers as a standard instruction book. It is practical, written by a practical man. The description of the apparatus used, the preparation of the plates, the sensitising and the general manipulation leave little to be desired, and with a little care and amplification there is no doubt but that the author could make very much more of it than he has done. It is unfortunate that the issue of a second edition was not made the occasion of a thorough revision and amplification, especially on what the author would probably call the theoretical side. Had this been done, there is no reason why the book should not have become not merely a practical instruction book but a thoroughly sound text book.

Chapter 2 on "Elementary Theory" contains no word of theory and is purely descriptive; it might well contain an account of the theoretical basis of the wet collodion process and should certainly give some account of chemical and physical development and their essential difference. It is true that, on page 106, the author says, "The difference between a physical and a chemical developed plate has already been fully explained," and presumably the author believes that explanation to be in the book, but so far the reviewer has failed to find it.

Chapter 5 on "Chemicals and Materials" would have greater value if a little more detail were attempted and some of the descriptive matter deleted. It is difficult to see just what value there is in the information "potassium chromate occurs in the form of yellow crystals, which are stable." Surely a brief indication of the use of the particular substances, their commoner impurities and their solubility would have real practical value.

Chapter 12, on "Colour Sensitive Collodion Plates," is far from being an adequate account of what to-day is an important subject.

The printing of the book is excellent, the illustrations good and clear, and a full index is given, and one feels that if only the practical side were reasonably reinforced by a simple but adequate theoretical treatment, the book would supply that which we at present lack, namely, a really good text book on the wet collodion process. H. W. Greenwood

Shale Oils and Tars and their Products. *By* Dr. W. Scheithauer. *Second edition, revised and enlarged by* H. B. Stocks. *Pp.* vii+283. *London: Scott, Greenwood and Son,* 1923. *Price* 12*s.* 6*d.*

The publication of a second and revised edition of Mr. H. B. Stocks' translation of Dr. Scheithauer's interesting work on Shale Oils, etc., is in itself evidence of the welcome given to the first edition, and in the absence of any other English book dealing with the German shale products there is no doubt that this book fills a gap in our technical literature that has too long been left empty.

It, however, seems a very great pity that a book which should be of value to so many people—especially to-day when the interest in shale and its products is again very much to the fore—should have much of its value detracted from by what can only be a too hasty passage through the press.

It may perhaps serve a useful purpose to refer to and quote some of the passages which should receive attention when another edition is required.

On p. 12 in the table the ash content of Bovey Tracey lignite is stated to be 10·80 per cent. in the material "as mined" and only 6·85 per cent. in "air dried." There is evidently some confusion here, as the figures cannot refer to the same material or they are not given correctly.

On p. 63, Fig. 4, illustrating the Rolle retort, is printed upside down, and as the description is on the next page one has not only to turn back to see to what part of the figure the reference letters apply but has the further bother of reversing the top and bottom of the book.

It is not conducive to pleasant reading to find carbon bi-sulphide and di-sulphide used practically on the same page, and such expressions as "water of decomposition," "conchoid fracture," "centrifugalised" sound harsh to English ears.

The use of the word "aspirators" on page 165, where vacuum filters is evidently meant will not render the book easier for students.

One is also compelled to ask what is meant by the statement on p. 129: "By the aid of pressure distillation, Engler demonstrated the animal origin of petroleum, a perfect lamp oil having been produced from low grade waste materials, such as stearine pitch and *petroleum* residues."

The description of Krämer and Sarnow's melting point method, on p. 249, is not very lucid when one is directed to put 5 grammes of mercury into a glass tube and *then* to seal one end with "gondron" when the authors prescribe exactly the reverse procedure.

It would have also been much more useful if the figures for costs of production and statistics had been brought nearer to the present time. Costs of working over 25 years old have only an historical value. It also seems strange to find no reference made to the amalgamation of the various Scottish shale companies under the title of "Scottish Oils, Ltd."

One trusts that the reviewer will be forgiven for the perhaps rather severe criticism of those points which seem to him to require a little more care, especially as the expert knowledge and wide experience of both author and translator should, with a very slight extra expenditure of time, have enabled them to produce a book free from the defects alluded to, and one which with all these minor errors remains a remarkably useful and generally reliable epitome of a subject on which there is so little published.

W. H. Coleman

Messieurs F. Roy, industrialist, and L. Lindet, member of the "Institut," have been nominated vice-presidents of the Consultative Committee for Arts and Manufactures.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Business in the home and export markets remains very restricted. Makers' prices are practically unchanged in spite of the unpromising nature of the outlook. The demand from the textile trades is particularly poor, and in general practically no interest is displayed in forward purchasing.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d.—5s. per carboy d/d. Quiet.
Acid Nitric 80° Tw.	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d. - £8 per ton. Comparatively good demand.
Arsenic (White)	£72—£73 per ton. Not much doing.
Bleaching Powder	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Quiet.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d.
Copper Sulphate	£25 10s.—£26 per ton.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass Bichromate	5¾d.—6d. per lb. d/d.
Potass. Chlorate	3d. per lb. Very dull.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.-£5 per ton. Remains a very firm market.
Soda Caustic 76%	£19—£21 10s. according to quality. Fair business.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton. Very scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19-£20 10s. per ton according to quantity, f.o.b London, 1-cwt iron drums included.
Sod. Chlorate	2⅞d.—3d. per lb. Very dull.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Rather lower in value but very quiet.

Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.—1s. 3d. per lb.
Crimson	1s. 6d.—1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Cheaper at 10½d.—1s. 1d. per lb. Ample supplies now available.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.—6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

In sympathy with most trades, this market is now a little easier.

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8—£10 15s. per ton d/d, according to locality of market and type of charcoal. Demand easier.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2s. per gall. 24° Tw.
Red Liquor	1s 3d. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. ,, ,, 60% O.P. Firm market as to price but demand quiet.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5–£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d. per lb. spot. 1s. 1½d. per lb. for forward delivery
Crude 60's	3s.—3s. 6d. per gall. Market firmer for early delivery.
Acid Cresylic—97/99	2s.—2s. 5d. per gall. Steady demand.
Pale 95%	1s. 11d.—2s. 4d. per gall.
Dark	1s. 10d.—2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	8¾d.—11d. per gall. Supply short. Plenty of inquiries.
Unstrained	8½d.—9d. per gall.
Benzole—	Market uncertain. Prices doubtful.
Crude 65's	1s. 1d.—1s. 1½d. per gall.
Standard Motor	1s. 4d.—1s. 6½d. per gall. Business slack, abundant supplies.
Pure	1s. 9d.—1s. 11d. per gall.
Toluole—90%	1s. 8d.—1s. 10d. per gall. Not many enquiries. Easier.
Pure	2s. per gall. Not much inquiry.
Xylol	2s. 3d.—3s. 3d. per gall., according to quality.
Creosote—	
Cresylic 20/24%	11d. per gall. Not much business.
Middle Oil	8½d.—10d. per gall. Market uncertain.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—9d. per gall.
Solvent 90/160	1s. 5d.—1s. 7d. per gall. Quiet.
Solvent 90/190	1s. 4d.—1s. 7d. per gall. Market quiet.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Very little business passing.
Whizzed or hot pressed	£11—£13 per ton. More inquiries.
Naphthalene—	
Crystals	£21 per ton.
Flaked	£17 10s. per ton
Pitch, medium soft	140s.–150s. per ton. Autumn delivery. No buyers at present.
Pyridine—90/140	18s.—20s. per gall. Demand good.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 8d.-1s. 9d. per lb.
Acid Sulphanilic	1s. 1½d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb.
Benzidine Base	5s. 2d. per lb. 100% basis d/d.
Benzyl Chloride	1s. 4½d. per lb. 100% basis.
p-Chlorphenol	4s. 6d. per lb.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.—6½d. per lb. Quiet.
m-Cresol 98/100%	2s 1d.—2s. 3d. per lb. Fair demand.
p-Cresol 32/24° C.	2s. 1d.—2s. 3d. per lb. Fair demand.
Dichloraniline	2s. 2d. per lb. 100% basis.
Dichloraniline S. Acid	2s. 4d. per lb. 100% basis.
d-Dichlorbenzol	£70 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£95 per ton.
Dinitrotoluene—48/50	8d.—9d. per lb. naked at works.
66/68	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£65 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.

m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market remains exceptionally dull and orders continue to be very scarce owing to holidays and disturbed shipping conditions.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	2s. 11d.—3s. 1d. per lb. for cwt. lots. Market much weaker.
Acid, Benzoic	2s. 3d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 5½d.—1s. 8d. per lb., less 5%. Market weaker.
Acid, Gallic	3s. per lb. Down to 2s. 11d. for large quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d.—2s. 3d. per lb. Limited demand.
Acid, Tannic	3s. 1d. per lb. would now be accepted.
Acid, Tartaric	1s. 3d.—1s. 3½d. per lb., less 5%. Demand below normal but improving. Stocks accumulated during the cold spring now being used up and a rise in price not improbable.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 5d. per lb. Market very weak.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz.
Barbitone	19s. per lb. now quoted with little inquiry.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31—£33 per ton, carriage paid buyer's station.
Bromides	Position unchanged. Prices vary according to quantity and source.
Calcium Lactate	2s. 6d. per lb. for best makes. Better inquiry.
Chloral Hydrate	3s. 9d. per lb., duty paid.
Chloroform	2s. 2d. per lb. for cwt. lots. Very firm. Higher prices expected.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	The Referee has decided that it must in future be excluded from the list of dutiable articles under the Safeguarding of Industries Act.
Guiacol Carbonate	8s. 3d. per lb. Spot supplies short.
Hexamine	3s. 9d. per lb. In fair supply on a quiet market.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.
Magnesium Carbonate—Light Commercial	£37 per ton net.
Magnesium Oxide—Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	65s.—75s. per cwt., according to quality and quantity.
Menthol	38s. per lb. spot, less 2½%. Slightly weaker.
Mercurials	Very much weaker. Reduced 6d. lb. all round. Quicksilver reduced to £8 12s. per bottle.
Methyl Salicylate	2s. 3d. per lb. for carboys.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Metol	8s. 9d. per lb.
Morphine	Alkaloid—Cryst. 10s. 11d., Precip. 10s. 8d., Acetate 8s. 6d., Hydrochlor. 8s. 6d. Sulphate 8s. 6d. per oz.
Paraformaldehyde	3s. 9d. per lb. Lifeless.
Paraldehyde	1s. 5d. per lb.
Phenacetin	6s. per lb. Lower in value.
Phenazone	7s. per lb. In better demand, especially for small quantities.
Phenolphthalein	6s. 9d. per lb. Supplies still short.
Potass. Bitartrate—99/100% (Cream of Tartar)	94s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s. 3d.—3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d. per lb. Good demand. Steady market.
Potass. Permanganate	10½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	5s. 6d. per lb.
Salol	2s. 8d. per lb. Very quiet. Lower in value.
Silver Proteinate	10s. per lb.
Sod. Benzoate	2s. 3d. per lb. Slow of sale.
Sod. Citrate, B.P.C. 1923	2s. 2d. per lb. for cwt. lots.
Sod. Hyposulphite—Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—87s. 6d. per cwt. Fairly good demand. Expected to improve with continued warm weather.
Sod. Salicylate	Powder 2s. 6d. per lb., and Crystal at 2s. 7d. per lb. Market still very quiet.
Sod. Sulphite, anhydrous	£27 10s.—£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.—1s. 4d. per lb.

Thymol	15s. per lb. for cwt. lots of natural recryst.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. 9d. ,, ,,
Amyl Butyrate	7s. 6d. ,, ,,
Amyl Salicylate ..	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	2s. 9d. per lb.
Benzyl Benzoate ..	3s. 3d. ,, ,,
Cinnamic Aldehyde Natural	18s. 6d. ,, ,,
Coumarin	18s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate ..	15s. ,, ,,
Ethyl Phthalate ..	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa) ..	35s. ,, ,, Advanced.
Geraniol	5s. 6d.—12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. 6d. per lb.
Linalol ex Bois de Rose..	21s. ,, ,,
Linalyl Acetate	21s. ,, ,,
Methyl Anthranilate ..	7s. ,, ,,
Methyl Benzoate ..	8s. 6d. ,, ,,
Musk Xylol	11s. ,, ,,
Phenyl Ethyl Acetate ..	10s. ,, ,,
Phenyl Ethyl Alcohol ..	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	2s. 1d. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	22s. 3d.—23s. 6d. per lb. Firm with steady demand.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A...	14s. 6d. per lb.
Anise Oil..	2s. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil..	29s. ,, ,,
Cananga Oil, Java ..	9s. ,, ,,
Cinnamon Oil, Leaf ..	4½d. per oz.
Cassia Oil 80/85% ..	11s. 6d. per lb.
Citronella Oil—	
Java 85/90% ..	4s. 2d. ,, ,,
Ceylon	3s. 8d. ,, ,,
Clove Oil..	8s. ,, ,,
Eucalyptus Oil 70/75%	2s. per lb.
Lavender Oil, Mont Blanc 38/40% ..	18s. ,, ,,
Lemon Oil	3s. 1d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet ..	13s. 7d. per lb.
Otto of Rose Oil ..	30s.—60s. per oz, according to quality.
Palma Rosa Oil ..	20s. per lb.
Peppermint Oil—	
English	80s. ,, ,,
Wayne County ..	13s. ,, ,,
Japanese	7s. 1½d. ,, ,,
Petitgrain Oil	7s. 3d. ,, ,,

TRADE NOTES

French Company News

It is reported from France that the Cie des Produits Chimiques et Electrometallurgiques d'Alais et de la Camargue has made an agreement with English and American producers of aluminium for the joint control of the Société Norvégienne des Nitrures.

The Société Industrielle du Celluloid has the extension of the productive capacity of its factories under consideration and is reported to be discussing amalgamation with an important competitor, the Société Génerale pour la Fabrication des Matières Plastiques.

Chlorobenzene for the manufacture of sulphur black is now being produced by the Société d'Electrochimie, d'Electrométallurgie et des Aciéries Electriques d'Ugine. During 1922 this company sold 15,000 t. of cyanamide in France, as well as quantities of carbide, aluminium and ferro-alloys.

The output of dyes by the Cie Nationale des Matières Colorantes et des Produits Chimiques increased by 125 per cent. during 1922. The company has recently greatly increased its research department.

The Société Chimique Usines du Rhône, which, with the Comptoir des Textiles Artificiels, has established a company for the manufacture of *Rhodiaseta* cellulose acetate silk, has now begun to market this silk. The Société has purchased the sequestrated factory of the A.-G. für Anilin Fabrikation at Fons to provide room for development and has extended its power station at Roussillon by oved 400 kw.

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications made in July for licences under the Dyestuffs (Import Regulation) Act, 1920, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 371, of which 264 were from merchants and dealers. To these should be added 24 applications outstanding on July 1, making a total for the month of 395. These were dealt with as follows:—

Granted, 246 (of which 227 were dealt with within 7 days of receipt).

Referred to British makers of similar products, 70 (of which 66 were dealt with within 7 days of receipt).

Referred to Reparation supplies available, 50 (all dealt with within 2 days of receipt).

Outstanding on July 31, 29.

Of the total of 395 applications received, 336, or 85 per cent., were dealt with within 4 days of receipt.

PUBLICATIONS RECEIVED

Women's Labour in Bengal Industries. *By* Dagmar F. Curjel. *Bulletin No.* 31. *Indian Industries and Labour. Pp.* 40. *Calcutta: Superintendent Government Printing,* 1923. *Price* 8 *As.*

Monthly Report of Coal Statistics for Canada, April, 1923. *Dominion Bureau of Statistics. Mining, Metallurgical and Chemical Branch. Vol.* 2, *No.* 4. *Pp.* 12. *Ottawa: F. A. Acland,* 1923.

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EDITORIAL

AN interesting, but by no means novel point has been raised by a letter from an anonymous correspondent which we print in another column. He writes: "To science the importance lies in the facts, the honour of priority being quite subsidiary." It would be hard to find anyone to dispute the importance of "facts," but we are certain that the more human side is not quite so subsidiary as our correspondent thinks. The reference in this case is to the question whether the element of atomic number 72 shall be called celtium or hafnium. Two names cannot be used, so the facts relating to the question have been published so that those who run may read. This is only just, and is, moreover, necessary. It is possible, however, that, a few centuries hence, it may not matter who first discovered this or that element. But unless human nature undergoes a sea change, there will assuredly be no lack of learned men who will toil to rediscover the names of the original discoverers if they have been forgotten. At one time history consisted largely of the study of the battles and doings of kings, and although the economic side is now no longer neglected, names such as those of Paston or Pepys merely replace those of dignitaries of the court. The personal element still remains. Archimedes, it is said, regarded his mechanical discoveries as beneath the dignity of "pure science," and attached most importance to his treatises; but every one, except a few specialists, at once thinks of his water-screw when his name is mentioned. What must our correspondent think of Prof. J. R. Partington and Mr. E. J. Holmyard (a letter from whom is also printed in this issue) and some others for trying to ascertain the identity of Geber and even thinking that his identification is one of the most important problems in the history of chemistry? It is no new thing for scientists to be told that they must be content—anonymously—with the beauty and delight of their discoveries for reward. Yet what interest is aroused when the authorship of a work of art is questioned! One can readily imagine the eagerness to know whether it was genuine or not. No one will, we think, deny artistic merit to great scientific discoveries, and it is not stretching the point to claim that the intuition necessary to the scientific investigator is not unrelated to the inspiration of the artist. And as there is no reason to claim that Clio or Urania were in any way inferior to their sister muses, so we cannot justly demand from science an abnegation which besides being unnecessary and unnatural, is not requested from other departments of human activity.

* * *

Of interest in this connexion is a recent announcement in *The Times* to the effect that the Intellectual Co-operation Commission of the League of Nations has decided to submit to the Council and Assembly of the League a draft convention "to establish for scientific discoveries a copyright similar to that granted for literary and artistic work." We must confess that the precise meaning of the proposal is not very clear, as under English copyright law, at least, the scientist is reasonably well protected. Many scientific ideas, however, are not suitable subject matter for a patent, but if the proposal, as it would seem, leads to the general enforcement of the principle that credit is to be given where credit is due, it will be welcomed. As our contemporary, *Nature*, remarks, "even if the proposal should be found to concern itself only with the literary expression of a discovery, it may yet serve a useful purpose, since it may result in directing public attention once more to the callous neglect of the interests of those to whom the world in the past has been so vastly indebted." Evidently there is a dislike of anonymity amongst scientific men, but even if their wishes are abundantly realised it is most devoutly to be hoped that there will be no extension of the increasing custom of labelling reactions or theoretical deductions with the names of their authors.

DENATURED ALCOHOL IN CANADA*

By ROSS E. GILMORE†

Denatured alcohol, according to the definition of the Canadian Inland Revenue, means "alcohol in suitable admixture with such denaturants as to render it . . . . non-potable and to prevent recovery of the ethyl alcohol." The object of denaturing is to permit, free from duty, the use of ethyl alcohol for purposes other than drinking, *i.e.*, for use in the arts and industries and for fuel, light and power. Denatured alcohol may also be termed industrial alcohol. It is, however, mainly that part of the total non-potable industrial alcohol which is tax free that is known as denatured alcohol. A full discussion of the manufacture, etc., of industrial alcohol is beyond the scope of this paper, and apart from reference to special regulations for using commercially pure, taxable ethyl alcohol in bond for certain industrial purposes the following will deal with "denatured alcohol" rather than "industrial alcohol" in general.

Completely and Specially Denatured Grades

The definition for "denatured alcohol" given above is to be found in Article 368, Part X, Chapter 52, Inland Revenue Act, Canada. According to the same article, "specially denatured" means "alcohol in suitable admixture with such special denaturants as have been approved by the Minister." According to Article 371, "denatured alcohol is sold without restriction while specially denatured alcohol is sold only to licensed dealers to be used in the arts and industries in cases where denatured alcohol would be unsuitable, and under such conditions as the Minister may by regulations prescribe"; in other words its sale is restricted. In the United States the terms "completely denatured," "specially denatured" and "formula" are used. The completely denatured formulæ are those which have been denatured in accordance with fixed formulæ, for sale to the general public with very little supervision, and the specially denatured formulæ are those, not so completely denatured and not for sale to the general public, that can be obtained only under a heavy bond. For the purpose of this paper the word "unrestricted" will apply either to the Canadian "denatured alcohols" or to the U.S. denatured alcohols and "restricted" will apply to the specially denatured grades or formulæ.

The use of commercially pure ethyl alcohol not denatured is authorised in Canada to be used in bond and under varying rates of excise duties as follows:—

I. For the manufacture of crude fulminate of mercury, pure ethyl alcohol is allowed free. The various regulations controlling use in bond must, however, be strictly adhered to.

II. Hospitals and universities may obtain pure ethyl alcohol on payment of the regular excise duty ($9.00 per proof gallon) with the provision that 99 per cent. of the duty is refundable. Besides the undenatured industrial alcohol obtainable practically tax-free in this way there are two restricted grades of denatured alcohol; No. 1 special and No. 1 F for use in hospitals and universities.

III. Manufacturers of various chemical products may obtain ethyl alcohol or domestic spirits as it is called by the payment of an excise duty ranging from 15 cts. to $2.43 per proof gall. Under the 15 ct. rate come:—Collodion, ethyl bromide, ethyl chloride, chloroform, sulphuric ether, soap, etc., as well as sensitised photographic emulsions in the manufacture of which phenol and methyl alcohol are required to be added to the ethyl alcohol before use. Vinegar comes under the 27 ct. per proof gall. excise and perfume spirits under the 75 ct. rate. Proprietary medicines, pharmaceutical preparations, extracts and essences are the uses listed under the $2.40 to $2.43 rates of excise.

Table I gives a list of the ten grades of denatured alcohol authorised in Canada. It will be noticed that the three unrestricted sale grades, viz., No. 2 Standard, No. 2 Benzol and No. 2 Pyridine, represent roughly 42 per cent. of the total consumption. Grade No. 1 Benzine representing 37 per cent. of the total consumption is a restricted sale grade. No. 1 Standard for the same use as No. 1 Benzine represents an average of about 6 per cent. of the consumption, leaving only 15 per cent. of the total consumption for the remaining five grades of specially denatured alcohol for specially authorised uses.

Denaturants and their Comparative Importance

In the manufacture of denatured alcohol the denaturant must comply with the Government specifications and regulations and then in order to be in demand commercially, it must have the properties peculiar to the use to which it is to be applied.

The Government specifications require that the denaturant when mixed with grain alcohol should (a) render the mixture non-potable and (b) should make the recovery of the separate ingredients, especially the ethyl alcohol, as difficult as possible. Persons "who attempt to reclaim the ethyl alcohol or other ingredients of a denatured alcohol are liable to a heavy penalty." From the health standpoint it would seem a good denaturant is one which when taken internally either purposely or by accident would cause sickness but not death. The relation of toxicity of the denaturant to the non-potability will be referred to later. For industrial use denatured alcohol must be miscible with 95 per cent. grain alcohol, and must have the same general solvent properties as the ethyl alcohol product to which it is added. A special requirement of good denaturants is that they be miscible in practically all proportions with water.

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* Paper read at the March meeting of the Ottawa Section of the Society of Chemical Industry.

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The original and most usual denaturant is wood alcohol, of which methyl alcohol is the main ingredient. The term "wood alcohol" is, however, not allowed in commerce. In Canada the official nomenclature is "methyl hydrate" and in the United States "methanol." As a denaturant the term wood alcohol is more to the point rather than the term methyl alcohol, as "wood alcohol" in industry is an impure product and "pure methyl alcohol" is a highly refined grade. According to the specifications, "methylating spirits," as the denaturant grade of methyl hydrate is called, must contain certain impurities which give the grain alcohol to which it is added a disagreeable odour and other repugnant characters. These impurities are certain ketone and higher alcohols which are necessarily left in the methyl hydrate in order that it may conform to the acetone-content specification on one hand, and the bromine absorption specification on the other hand. Methyl hydrate used for methylating purposes is known by the trade as "Government grade," and is different from other grades of methyl hydrate, the Government grade being the poorest. Columbian spirits and pure methyl alcohol are the best, and their use is permitted in specially denatured alcohol in the United States, but not in the ordinary completely denatured alcohol grades.

Owing to its importance as a denaturant for grain alcohol the question of wood alcohol deserves special attention. Its merits appear to more than balance its more or less objectionable characteristics, and it should be pointed out that most of its disagreeable properties are there because the relevant laws and specifications require them to be present to make it an effective denaturant. The Canadian Government specifications for methyl hydrate (wood alcohol) used for denaturing purposes may be summarised as follows:—*Specific Gravity* at 60° F—not less than 0·815, *i.e.*, not weaker than 95·2 per cent. vol. (Thorpe's tables), which is equivalent to approximately 67 over proof. *Colour*—colourless to pale straw colour. *Volatility*—must be completely volatile on a steam bath at 100° C. *Miscibility*—must give a clear or only faintly opalescent solution on diluting with twice its volume of water. *Acetone content*—not less than 5 g. and not more than 15 g. per 100 c.c. *Bromine Absorption.*—It must contain a sufficient quantity of (pyroligneous and allied) impurities so that not more than 25 c.c. or less than 15 c.c. shall be required to decolorise a standard solution containing 0·5 g. of bromine. *Other requirements.*—It shall be of such a character as to render ethyl alcohol when diluted with water unfit for use as a beverage when methyl hydrate is present in the proportion of one part of ten parts of ethyl alcohol.

The bromine absorption specification may be considered the most important in that it is meant to ensure that the alcohol contains sufficient impurities to render the ethyl alcohol with which it is mixed non-potable. The bromine number is an indication of the purity or refinement of the methyl hydrate used. The higher the bromine number the purer the grade and vice versa; a pure grade ranges over 1000 in bromine number, whereas the most impure grades have bromine numbers as low as 3 to 5. Therefore a methyl hydrate with a bromine number ranging between 15 to 25 cannot be considered other than a poor, impure grade. The impurities present to give this low bromine number range are mostly unsaturated ketones other than acetone, unsaturated alcohols with boiling point ranges above that of methyl alcohol, as well as varying amounts, usually small, of aldehydes and amines. The bromine absorption specification is effective in that it gives the alcohol mixture an objectionable odour and thus helps to render the resultant denatured alcohol non-potable. The impurities necessary, according to the bromine number specifications, also make the resultant methylated spirits less valuable as a solvent for certain specific purposes, and, of course, the larger the percentage of wood alcohol present the more objectionable it is in this respect and vice versa. But to do away with, or even to raise the bromine number specifications more than slightly would be defeating the original and still valid purposes of using wood alcohol as a denaturant.

DENATURANTS OTHER THAN METHYL HYDRATE

In denatured alcohol grades where the percentage of wood alcohol is allowed to be low, other denaturants such as pyridine bases and benzine (kerosene) are present. In Canada these two are the only ingredients used with methyl hydrate. Benzine used as a denaturant in Grade No. 1 Benzine is derived from petroleum. It must be of such a character as to impart a decided odour to ethyl alcohol when mixed in proportion of 0·5 per cent. by volume. The merits of benzine as a denaturant seem to lie solely in its property of giving grain alcohol with which it is mixed an offensive odour and taste. Although the alcohol denatured with benzine finds extensive use as a solvent, the presence of benzine makes the grade unsatisfactory as a solvent in the manufacture of certain soaps, drugs and chemicals. When present in a denatured alcohol in conjunction with wood alcohol it helps to make the ethyl alcohol difficult to refine, which, of course, is one of the main purposes of a denaturant.

Pyridine bases as used as a denaturant in grade No. 2 Pyridine must conform to specifications of colour, reaction with cadmium chloride, behaviour with Nessler's reagent, boiling point, miscibility with water, content of water, and alkalinity. The presence of the pyridine bases is quite effective in giving the ethyl alcohol to which it is added a disagreeable odour. Denatured alcohol containing pyridine bases should find more general use as a solvent but for certain purposes it is quite unsuitable. The alkaline nature of the pyridine bases, which can be neutralised by acids to form salts, and their high boiling points—50 per cent. distillable at 140° C. and 90 per cent. at 160° C.—are not in respect to rendering recovery of ethyl alcohol favourable. When used in conjunction with wood alcohol, however, this defect is somewhat remedied.

Among the denaturants used not in conjunction with wood alcohol are benzol, pine oil and nitrobenzol. These three ingredients are used together in what is known as grade No. 2 Benzol. The benzol is subject to certain specifications in respect to insolubility in water and boiling point range, whereas the pine oil and nitrobenzol used in conjunction with benzol as denaturants must meet specifications mainly in respect to specific gravity. The purpose of these last two substances is to mask the odour of and to impart a burning taste to the alcohol. In this respect a combination of these three ingredients makes an effective denaturant mixture. Alcohol denatured with benzol is used principally for burning and anti-freeze purposes, and although it is used to a certain extent as a solvent, its use for that purpose seems to be limited.

The denaturants hitherto discussed are used in the "denatured alcohols" for unrestricted sale. For the specially denatured grades special denaturants are allowed. Those authorised in Canada are :—Iodine, potassium iodide, ether, cadmium chloride, ammonium iodide, nicotine compounds, brucine sulphate and diethylphthalate. Practically all these special denaturants are effective in making the alcohol poisonous, but they are not nearly as effective in imparting an offensive odour as are the several denaturants previously discussed. Practically all these special denaturants are open to the criticism that they are more or less easy to recover, a defect which is somewhat remedied by the regulations ensuring that their sale and use are under permit and heavy bond.

Recoverability and Toxicity

It is quite possible to recover the different denaturants by special laboratory rectification methods ; some are easy to recover and some are quite difficult. Ease of recovery of the denaturants does not necessarily mean ease of recovery of the ethyl alcohol, but indications are that the more easily the denaturants are removed, the easier it is to recover the ethyl alcohol in a more or less pure state ; and as a general rule rectification on the commercial scale is more efficient than in the laboratory. It is more difficult to separate by rectification, into their component parts, two liquids which are similar in composition and which are both miscible in all proportions in water than two liquids of dissimilar molecular formulæ and of different chemical properties. For this reason it is difficult to separate wood alcohol from grain alcohol. The immiscibility in water of the denaturants tends to make their recovery easier, and the large difference between the boiling point of the denaturants and that of the ethyl alcohol is also an important factor in the ease of recovery of the components. Oils not miscible with water, such as benzol and benzine, and oils or solids with high boiling points such as pyridine bases, iodides and brucine sulphate, are therefore not of high efficiency in making the recovery of ethyl alcohol difficult by ordinary dilution and rectification methods.

The question of toxicity of denaturants is important. All denaturants used in the manufacture of denatured alcohol have toxic properties which make grain alcohol poisonous to drink, the degree of toxicity of the denatured alcohol depending not only on the poisonous properties and quantity of the denaturant ingredient, but also on the amount of denatured alcohol taken internally. Most of the denaturants used give warning by causing characteristic sickness of a more or less violent nature from which recovery is possible, providing too much has not been imbibed. Some maintain that this is the main purpose of a denaturant, in respect to rendering the ethyl alcohol non-potable, but this viewpoint seems to be midway between two extremes, viz., (a) that the denatured alcohol should have such an offensive odour and disagreeable taste that it cannot get past the nose or tongue, and (b) that the main purpose of denaturing alcohol is to make the alcohol extremely dangerous when taken internally. Very few exact data are available, especially on the toxic effect of the different denaturants and of their individual ingredients. If the middle viewpoint is favoured, viz., that a denatured alcohol should not kill but should cause pain and sickness, this would be an argument for reducing the quantity of denaturant to the minimum for this effect when ordinary quantities are taken. All this has a bearing on the analytical work required of the chemist, and until some upper or lower limits of the ratio of toxicity of the denaturant to the quantity present in the final denatured alcohol are agreed on, a great deal of misunderstanding is likely to prevail. For example, why is it necessary, other than for scientific purposes, to use both qualitative and quantitative methods for the determination of methyl alcohol in quantities below, say, 1 per cent. (let alone 0·1 per cent.) unless it is known

TABLE I

DENATURED ALCOHOLS AUTHORIZED IN CANADA

Grade	Composition	General (approved) uses	Conditions of sale	% of total consumption (1922) %
No. 2 standard	70 parts ethyl alcohol 30 ,, methyl hydrate (not more than 50% ,,)	Burning and antifreeze ; paint and varnish industry	Unrestricted	7
No. 2 benzol	100 parts ethyl alcohol 2·5 ,, benzol 0·5 ,, nitrobenzol 0·2 parts pine oil	Burning and antifreeze ; paint and varnish industry	Unrestricted	5
No. 2 pyridine	100 parts ethyl alcohol 2 ,, methyl hydrate 1 ,, pyridine bases	Burning and antifreeze ; paint and varnish industry	Unrestricted	30
No. 1 benzine	90 parts ethyl alcohol 9 ,, methyl hydrate 1 ,, benzine (kerosene)	Manufacture of paint, varnish and shellac	Restricted	37
No. 1 standard	80 parts ethyl alcohol 20 ,, methyl hydrate (not more than 25% ,, ,,)	Same as for No. 1 benzine	Restricted	6
No. 1 special	90 parts ethyl alcohol 10 ,, methyl hydrate	Hospitals only	Restricted	1
No. 1 D (iodine)	100 parts ethyl alcohol 2·5 ,, iodine 1·5 ,, potassium iodide	Tincture of iodine B.P.	Restricted	9
No. 1 A	100 gall. ethyl alcohol 65 lbs. sulphuric ether 3 ,, cadmium iodide 3 ,, ammonium iodide	Collodion ; photographic prints, engravings, enlargements, etc.	Restricted	¼
No. 1 C	100 gall. ethyl alcohol 5 ,, 40% nicotine soln. (plus yellow and blue dyes)	Deodorant solutions for cigars, cigarettes, smoking and chewing tobacco	Restricted	¾
No. 1 F	1 gal. ethyl alcohol 2·5% diethylphthalate 5 grains brucine sulphate	Rubbing alcohol compound	Restricted	4

definitely just how much ethyl alcohol with this percentage can be taken internally without permanent injury ? By qualitative methods dilutions lower than one part of methyl alcohol in 10,000 parts of solution can be detected and the lower limit of 0·1 per cent. appears quite determinable by quantitative methods. It is well known that the impure grades of wood alcohol are poisonous when taken internally, but very little seems to be known of the comparative toxicity of the different ingredients that make up the complex organic mixture known as methyl hydrate (wood alcohol). If it is true that pure methyl alcohol is far less toxic than the higher alcohols, ketone, aldehyde and other impurities, why should the analytical chemist have to prove or disprove the presence of small quantities or traces of methyl alcohol ? The poisonous qualities of a denatured alcohol, in which, say, the presence of methylated spirits is suspected, may be due to impurities normal to grain alcohol, *e.g.*, fusel oils, etc., to a greater extent than to traces of methyl alcohol or other denaturants.

DENATURED ALCOHOLS AUTHORISED IN GREAT BRITAIN

According to the information at hand apparently only three different grades of denatured alcohol are admitted to the tax free list in Great Britain. These are set out in Table II. All three grades contain wood

TABLE II

DENATURED ALCOHOLS AUTHORISED IN GREAT BRITAIN

Name	Composition	General uses	Conditions of Sale
(Grade 1) Industrial methylated spirits	95 parts ethyl alcohol 5 ,, wood naptha	Special manufactures such as artificial leather, varnishes and polishes, soaps, drugs, and fine chemicals, gas mantles, etc.	Restricted
(Grade 2) Mineralised methylated spirits	89⅝ parts ethyl alcohol 10 ,, wood naptha ⅜ ,, petroleum	General industrial purposes, chemical and oil products	Restricted
(Grade 3) Power methylated spirits	92 parts ethyl alcohol 5·0 ,, benzol 2·5 ,, wood naptha 0·5 ,, crude pyridine (plus yellow and red dye)	Motor fuel preparations	Restricted

alcohol, and all come under the class of restricted denatured alcohols, and in this respect they are all to be considered specially denatured alcohols as compared with those of Canada and the United States. The third grade, viz., power methylated spirits is a new grade, authorised since August 18, 1921 (Statutory Rules and Orders, 1921, No. 1318). No considerable quantity of this grade appears to have been consumed and the percentage of total consumption for grade 1 and 2 is given as roughly 70 per cent. and 30 per cent. respectively. British grades 1 and 2 are quite similar to the United States specially denatured formula No. 1 and the Canadian grade No. 1 Benzine.

DENATURED ALCOHOLS IN THE UNITED STATES

As mentioned above the denatured alcohols authorised in the United States are divided into two main classes, viz., completely denatured and specially denatured. There are six different grades of completely denatured alcohol for sale to the general public with very little restriction or supervision. The six U.S.A. completely denatured formulæ are as follows:—

Formula No. 1	100	gall.	ethyl alcohol
	10	,,	approved wood alcohol
	½	,,	approved benzine (kerosene)
Formula No. 2	100	parts	ethyl alcohol
	2	,,	approved wood alcohol
	½	,,	approved pyridine bases
Formula No. 3	100	parts	ethyl alcohol
	5	,,	sulphuric ether
	2	,,	benzene
	1	,,	pyridine
Formula No. 4	100	parts	ethyl alcohol
	2·5	,,	approved benzol
	0·5	,,	nitrobenzol
	0·2	,,	pine oil
Formula No. 5	100	parts	ethyl alcohol
	2	,,	approved wood alcohol
	¼	,,	pyridine bases
	½	,,	benzine (kerosene)
Formula No. 6	100	parts	ethyl alcohol
	2	,,	approved benzol
	½	,,	approved pyridine bases
	½	,,	approved benzine (kerosene)

The following comparison is to be noted:— U.S.A. formulæ No. 1, 2 and 4 are similar to Canadian Grades No. 1 Benzine, No. 2 Pyridine, and No. 2 Benzol respectively.

SPECIALLY DENATURED ALCOHOLS IN THE UNITED STATES

Up to the end of 1922, seventy-five different formulæ of specially denatured alcohols obtainable only under heavy bond for use in manufacturing processes were authorised in the United States. These formulæ range in number from 1 to 47 inclusive, and as high as five different formulæ, all for the same general use, follow the original numbers, *e.g.*, 38, 38A, 38B, 38C, 38D and 38E. Before a manufacturer can obtain supplies, a permit must be obtained and a heavy bond executed in duplicate. The details of these different formulæ can be found in Appendix to Regulations 61, dated Sept., 1922 (Treasury Department, United States Internal Revenue).

The composition of formula No. 1, specially denatured alcohol, is as follows:—100 galls. of pure ethyl alcohol and 5 galls. of approved wood alcohol. This formulæ is authorised for over 225 uses, and is apparently intended to allow the use of tax-free alcohol for articles of commerce in the manufacture of which none of the six completely denatured alcohols is found to be suitable. In Canada there is as yet no grade authorised similar to this U.S.A. specially denatured formulæ No. 1. In Great Britain, however, Grade No. 1—industrial methylated spirits—is practically the same as formula No. 1.

Formula No. 4, of which the denaturing ingredients are nicotine solution, yellow dye and brilliant blue dyes, is somewhat similar to the Canadian grade No. C. It is used for tobacco deodorant solutions. Formula No. 5, containing sulphuric ether, cadmium iodide and ammonium iodide as denaturants, is similar to the Canadian grade No. 1A, and is used for photographic purposes. Formula No. 25, containing iodine and potassium iodide, is similar to the Canadian grade No. 1 Iodine and is used for tincture of iodine. Formula No. 46 containing phenol and methyl salicylate (oil of wintergreen) is the antiseptic and bathing alcohol preparation corresponding to the Canadian grade No. 1F, containing brucine sulphate and diethylphthalate.

A partial list of the denaturants of the other formulæ for the U.S.A. specially denatured alcohols is given below:—

Formula	Denaturants	Uses (list not complete)
2	Camphor and commercially pure methyl alcohol	Celluloid products
3	Castor oil, caustic soda, lye and pure methyl alcohol	Transparent soap and shampoo preparations
13A	Sulphuric ether	Anæsthetic ether, dry food products, extracts, neosalvarsan, etc.
18	Vinegar (9% acetic acid)	Vinegar, acetone, etc.
23 and 23A	Acetone and benzol or acetone alone	Liniments and lotions for external use only
28 and 28A	Benzol or gasoline	Motor fuel
31	Soap and glycerin	Tooth paste
34	Tetrachlorethane	Artificial silk
38 and 38D	Methyl salicylate and zinc chloride or menthol and formaldehyde	Mouth washes and dentifrices
40	Brucine sulphate and acetone	Perfumes and toilet preparations
44	Normal butyl alcohol	Varnishes, varnish removers, etc.
45	Refined shellac	Candy glaze

The denaturants used in these U.S.A. specially denatured alcohols are open to somewhat the same criticism as the denaturants used for the Canadian restricted specially denatured grades in that (a) very few of them impart to the ethyl alcohol with which they are mixed an offensive odour and (b) for very few can the claim be made that it is quite difficult to recover either or both the denaturant and original ethyl alcohol. Practically all, however, render the ethyl alcohol with which they are mixed poisonous when taken internally in quantities other than small doses. Objections both to the lack of offensive odour, to the non-potability and to the comparative ease of recovery of the ingredients of the specially denatured alcohols are, however, met by the permit and bond laws and regulations governing their use.

The denatured alcohols authorised in Great Britain, Canada and United States can be compared as follows :—

	Great Britain		Canada		U.S.A.
Total number of (tax free) grades authorised ..	3	..	10	..	81 (*a*)
(*b*) Number of completely denatured (tax free) grades (sale unrestricted) ..	0	..	4	..	6
Number of specially denatured (tax free) grades (sale restricted by permit and bond) ..	3	..	7	..	75
Number of grades using wood alcohol :					
As sole denaturant..	1	..	3	..	1
As part denaturant..	2	..	2	..	13 (*c*)
Number of grades not using wood alcohol ..	0	..	5	..	67

NOTES

(*a*) One of these, viz., formula No. 7, is reported as revoked and formula No. 1 substituted.

(*b*) Only the unrestricted grades are, for the purpose of this table, considered as completely denatured.

(*c*) The wood alcohol used in 13 part denaturant and 1 sole denaturant formulæ is comprised of both the regular approved quality and the commercial pure methyl alcohol. Out of the total of fourteen, 8 contain wood alcohol as in (approved) specifications and 6 pure methyl alcohol as part denaturant.

INDUSTRIAL ALCOHOL FOR MOTOR FUEL

A grain alcohol product to be used as motor fuel is logically a denatured alcohol. As yet no special grade is authorised in Canada for use as motor fuel, but there is apparently little reason other than price why for example unrestricted Grade No. 2 Pyridine should not be considered for that purpose. In the United States at present, two formulæ, viz., 28 and 28A containing 10 per cent. benzol and 1 per cent. gasoline, respectively, as denaturants, have been authorised as specially denatured grades for use in the manufacture of motor fuels. They are not used alone but are apparently blended before being offered for sale.

The grain alcohol in these denatured alcohols used for motor fuel is 190 proof U.S.A. and not less than 166 proof British (*i.e.*, 95·0 and 94·4 per cent. vol., respectively). A great deal of research work is being done on the use of 95 per cent. ethyl alcohol, benzol, etc., in internal-combustion engines. This work seems to show that the use of ethyl alcohol and benzol, either separately or mixed, allows the development of high compression engines, whereas development appears restricted when using petroleum products and especially when it is desired to utilise more of the kerosene fractions along with the gasoline. Results reported by Ricardo (*The Automobile Engineer*, August, 1921) show that the efficiencies for gasoline, benzol and ethyl alcohol do not vary much when used in an engine of comparatively low compression such as the automobile engines of to-day. On attaining the "highest useful compression," however, the increase of efficiency with 95 per cent. ethyl alcohol is as high as 25 per cent., compared with 17 per cent. with benzol and less than 9 per cent. with gasoline. These results would indicate that while at present ethyl alcohol and benzol are not more valuable per gall. for power purposes than gasoline, they may in the future.

DATES OF AUTHORISATION OF THE DIFFERENT CANADIAN GRADES

Up to 1882 the denaturing of grain alcohol was in the hands of individual licensees. From that date up to 1920 the denaturation and sale of denatured alcohol was carried out at Ottawa by the Inland Revenue Department. During the early part of this period four grades, viz., No. 1 and 2 Standard, No. 1 Benzine and No. 1 Special were authorised, one unrestricted and three for restricted sale under bond. Up to this time all grades were known as methylated spirits. On August 23, 1920, authorisation was given for the manufacture of denatured alcohol by licensed distillers in lieu of the Department.

COMPARATIVE SELLING PRICE AND COST FIGURES

In the following table the comparative prices of two grades of denatured alcohol in Canada, United States and England are given :—

	Quotations per imperial gall., December, 1922					
	Canadian		United States			English
			U.S. gall.	Imperial gall.		(Exchange $4.75)
Completely denatured alcohol—						
10% wood alcohol 0·5 to 1% benzine }	$1.00	..	($0.40)	$0.48	..	2s. 7d. ($0.62)
Specially denatured alcohol—						
Containing as denaturant 5% wood alcohol..	No grade	..	($0.43)	$0.52)	..	3s. 6d. ($0.83)

The quotation for Canada it is to be noticed, is about double that in the United States, while the selling price in England is about six-tenths of that in Canada. Canadian quotations for industrial alcohol used for the manufacture of vinegar are about 80 per cent. of that for the lower priced denatured alcohols. The price per gall. of the wood alcohol used as a denaturant is as a rule higher than the grain alcohol with which it is mixed, and the fact that the specially denatured grade containing less wood alcohol is quoted (both in England and the United States) at a higher price, raises the question as to whether the quality of the ethyl alcohol product used is better.

The chief facters that make the cost of denatured alcohol so much higher in Canada than in the United States may be summed up as follows :—(1) Higher raw material cost; higher freight and duty rates. (2) Higher handling, sales, and distribution costs. (3) Higher overhead costs—mainly higher capitalisation per unit output. The last named factor, viz., higher overhead charges coupled with the necessity of distribution over a large, sparsely populated area, is worthy of note.

QUALITY AND PRICE

In refining industrial grain alcohol from the mash "heads" and "tails" are produced, as well as high grade ethyl alcohol. The "heads" contain the lower boiling-point organic impurities associated with ethyl alcohol produced by fermentation, whilst the "tails" contain the higher boiling alcohols such as fusel oil. A certain amount of the poor grade heads and tails is not marketable, but there is no apparent reason why those higher grades possessing good solvent, antifreeze and other properties should not be used in manufacturing denatured alcohol. The purest grade of ethyl alcohol is apparently used for making products as absolute alcohol and Cologne spirits; and the alcohol to be denatured is known as "commercial grade." This latter grade will contain the heads and tails and the amount used and purity of these will in turn determine the quality of the ethyl alcohol product going to make up the different grades of denatured alcohol.

Although the comparative demand for, first non-potable industrial alcohol (both undenatured and denatured) and second, the different grades of denatured alcohol, will doubtless control the amount of more or less chemically impure heads and tails used, it would seem that if more than one quality of commercial ethyl alcohol were possible, the less pure alcohol should be assigned to the general burning and antifreeze unrestricted grades and the best quality to the specially denatured alcohols to be used for special solvent and other manufacturing purposes.

Specially denatured alcohol U.S.A. Formula No. 1 calls for "pure ethyl alcohol." In England the quality of the ethyl alcohol used in their grades No. 1 Methylated spirits is regulated apparently only by the special demands of the buyers in respect of quality. Therefore the general usefulness of this grain of denatured alcohol depends on the quality of the grain alcohol used, as well as on the quantity and quality of the denaturant. This should be borne in mind when studying and comparing the industrial merits of any denatured alcohol. In Canada commercially pure ethyl alcohol is obtainable at excise duties ranging from 15 cts. to $2.43 per proof gall., *i.e.*, from 25 cts. to $4.00 per gall. of 95 per cent. (vol.) alcohol. These rates, however, apply only for purposes specifically authorised and the undenatured alcohol is obtainable only by special permit and under bond according to rules and regulations of the Inland Revenue Department.

ETHYL ALCOHOL DISTILLATION INDUSTRY IN CANADA

Total alcohol produced in Canada	Proof gall.	Selling value $
1918 (Whiskies and other spirits)	3,702,000	2,782,000
1919 (Potable and non-potable alcohol)	2,057,000	1,250,000
1920 (,, ,, ,, ,,)	3,308,000	2,802,000
1921 (,, ,, ,, ,,)	4,026,000	—

Total industrial (non-potable) alcohol produced in Canada	Proof gall.	Percentage of total potable and non-potable alcohol produced
1919	1,777,000	86
1920	2,223,000	67
1921	1,347,000	33

Estimate for the year 1922	Estimated percentage of total industrial non-potable alcohol produced	Estimated percentage of total potable and non-potable alcohol produced (1921 figures)
Industrial alcohol (taxable)	60	20
Denatured alcohol (tax free)	40	13
	100	33

Note—The proof gallon and selling value figures in the above table are from the Dominion Bureau of Statistics reports on the Liquor Distillation Industry in Canada for the years 1918 to 1921.

The above table indicates what percentage of the total ethyl alcohol produced in Canada is marketed as denatured alcohol. Of the total (non-potable) industrial alcohol produced, it is estimated that 60 per cent. is used in the commercially pure state and is taxable, whereas 40 per cent. is denatured and tax free. These estimates are for the year 1922 and applying them to the 1921 production figures, it appears that the total denatured alcohol sold in Canada represents approximately only 13 per cent. of the total ethyl alcohol produced.

CRYSTALLINE LIQUIDS

PROF. SIR WM. J. POPE, K.B.E., F.R.S.

Experimental Lecture before the Science Masters' Association at Cambridge, January 3, 1923

Everyone is acquainted with what is understood by a solid crystalline material. A crystal is defined as an arrangement of matter in which every point is repeated with a similar environment throughout the structure; this definition furnishes the basis for investigating the number of different types of arrangement of points in space which may be expected to occur amongst crystalline structures.

The investigation of the geometrical possibilities has shown that 230 such types of arrangement exist; these are termed the homogeneous point systems, and may be classified according to their symmetry in the thirty-two known crystal classes, which in turn are distributed among the seven great crystal systems.

The correspondence between the results of the theoretical investigation of the possibilities and of the experimental study of solid crystalline material is so complete that this purely formal side of crystallography is now a completely worked-out branch of science. We are as yet, however, merely on the threshold of that subject for investigation which consists in determining the relation between crystalline structure and chemical constitution, and in this is, of course, included the study of the relation between the physical properties of such structures. More has been accomplished in this connexion during the last twenty years than throughout the whole previous history of science: at the same time, we have even yet but roughly sketched out the outline of the whole great subject which awaits investigation.

In commencing this lecture I should show you one or two of the phenomena met with in the investigation of solid crystalline substances. On allowing a melted chemical substance to cool it generally crystallises and, provided it crystallises in another than the cubic system, the crystals are doubly-refracting and can hence be distinguished by the interference colours which they present between crossed Nicol prisms. (Bromohydroxyhydrindene). It is often observed that one substance affects two crystalline forms each of which is stable throughout a certain range of temperature; cases of this kind are described as instances of dimorphism. Thus, mercuric iodide presents itself at ordinary temperatures as a scarlet substance crystallising in the tetragonal system, which changes suddenly into a bright yellow orthorhombic modification on heating; the conversion from the red to the yellow form occurs abruptly at 126°, the so-called transition temperature, whilst on cooling the reverse change takes place, although not with the same sharpness. [Shown with mercuric iodide.] Many substances undergo several such changes in crystalline form as the temperature is raised; a good example of this so-called "polymorphism" is provided by ammonium nitrate, which exists in five distinct forms, each stable throughout a definite range of temperature. The transition temperatures are 16°, 32°, 84° and 125°, and the form stable at the highest temperature is a cubic modification which melts at 170°. [Shown with ammonium nitrate]. The several polymorphous forms of any particular substance in general differ markedly in ordinary physical properties, such as solubility; thus, when a hot concentrated solution of sodium naphthionate is allowed to cool, the salt crystallises in broad feebly doubly-refracting sheets, which give place at ordinary temperatures to a strongly doubly-refracting form, crystallising in stout rhombs. The latter modification is much less soluble in water than the former, and it will be seen that each small rhomb becomes the centre of a pool of liquid bounded by the more soluble form; the pool and the central rhomb each become rapidly larger as the salt is dissolved away from the sides and is deposited on the rhomb of the more sparingly soluble substance. [Shown with sodium naphthionate].

These few examples have shown some of the characteristic differences between a crystalline solid and a liquid substance. The former possesses a geometrically homogeneous structure as revealed by the regular outline and the double refraction; the latter is amorphous and entirely lacking in regularity of structure, in accordance with the single refraction of the liquid. A large number of substances are known, however, which on melting yield a liquid showing one of the characteristic properties of solid crystalline substances, that, namely, of double refraction. Thus, crystalline *p*-azoxyanisol melts at 116° to an opalescent liquid which is strongly doubly-refracting, the double refraction being about twice as strong as that of calcite; this, as the temperature rises, shows a second transition point at 134°, the liquid becoming transparent and singly-refracting. The process is reversed on cooling and the opalescent doubly-refracting liquid stable between 116° and 134° is less viscid than either water or the clear singly-refracting liquid into which it is converted at 134°. [Shown with *p*-azoxyanisol]. The interference colours of the doubly-refracting liquid *p*-azoxyanisol between crossed Nicol prisms show that, as melted upon a glass microscope slide under a cover slip, no fixed orientation of the principal topical directions is established; on melting the substance in a cleavage cleft produced in a sheet of mica it is seen, however, that the crystalline structure of the latter gives direction to the optical properties of the doubly-refracting liquid. This is analogous to the regular manner in which crystals deposited from solution often arrange themselves upon a plate of crystalline material. [Shown with *p*-azoxyanisol in a mica cleft]. Other substances chemically related to *p*-azoxyanisol show very similar behaviour; thus, the homologue, *p*-azoxyphenetol, melts at 134° to a doubly-refracting liquid, which becomes transparent and singly-refracting at 168°. [Shown with *p*-azoxyphenetol].

Certain of these doubly-refracting liquids retain some element of the homogeneity of crystal structure possessed by the crystalline solid from which they are produced. Thus, crystalline ethyl *p*-azoxybenzoate melts to an agglomerate of double-refracting liquid sheets, and this, when cooled, gives a mass of doubly-refracting crystals each individual in which has approximately the original orientation; the trace of the solid crystal structure is thus conserved during melting and reappears on cooling. It is seen, in fact, that the liquid patches exhibit roughly the outline, between crossed Nicol prisms, of the original solid crystals. [Shown with ethyl *p*-azoxybenzoate.]

When a doubly-refracting liquid is kept suspended in a singly-refracting liquid in which it is partly soluble, it may be made to dissolve or to separate from solution by a change of temperature; in certain cases the doubly-refracting liquid can be caused to separate in globules which, from their interference bands, appear to be rotating rapidly. [Shown with mixtures of *p*-azoxyanisol, *p*-azoxyphenetol, resin and a trace of oleic acid].

Cholesterol and its esters give on melting doubly-refracting liquid phases which exhibit distinct granularity suggesting a certain regularity of structure. [Shown with cholesteryl chloride, acetate and benzoate]. With some of these the change of interference colour with change of temperature indicates a rapid variation of the degree of intensity of the double refraction with change of temperature. [Shown with cholesteryl cinnamate].

It has been seen that a marked analogy exists between the behaviour of solid crystalline substances and of these doubly-refracting liquids; it is interesting to discuss the reason for the similarity in behaviour. Three views have been put forward, and each strongly supported, in explanation of the existence of doubly-refracting liquids. The first suggests that the doubly-refracting liquid phase, which has temperature limits of stability between those of the singly-refracting liquid and the crystalline solid, represents a state of matter in which the kinetic forces, which are so completely subjugated in the solid crystalline state as to lead to the establishment of equilibrium of the particles of the material in one of the 230 point systems, have by the lowering of the temperature become partly subjugated in the doubly-refracting liquid and so give rise to patches of doubly-refracting liquid which have a transient homogeneous arrangement closely imitating the solid crystalline structure. The second view is to the effect that a sort of arrangement of molecules is set up in the doubly-refracting liquid which is not homogeneous in the sense of the definition, but consists in the establishment of a roughly parallel shaking together of long molecular complexes of definite shape. The first view is that the doubly refracting liquid has a homogeneous structure corresponding to a homogeneous point-system as is the case with solid crystals; the second is the basis of the so-called "swarm" theory of Bose, according to which the molecules lie merely banded together in roughly congruent positions. The third view, that of Tamman, is to the effect that the doubly-refracting liquids are two-phase systems somewhat of the nature of emulsions; it has been urged against this view that the supposed emulsions cannot be resolved by electrostatic forces or by centrifuging and that the limits of stability are defined by well-marked transition temperatures.

The recent physical work of Langmuir, Hardy, Adam and others has confirmed the conclusion long since drawn by organic chemists, that the chemical molecule is not spherical, but has different dimensions in different directions. Practically all substances which yield doubly-refracting liquids are of very complex composition and possess molecular constitutions in which the component atoms and radicles are arranged in a long chain, Thus, *p*-methoxycinnamaldazine,

$$p\text{-CH}_3\text{O·C}_6\text{H}_4\text{·CH : CH·CH : N·N : CH·CH·CH· : C}_6\text{H}_4\text{·OCH}_3,$$

and all the derivatives of cholesterol, $C_{27}H_{44}$, which latter almost certainly contains one normal chain of seventeen carbon atoms, form doubly-refracting liquids. [Shown with *p*-methoxycinnamaldazine.] If the molecules are ellipsoidal in shape it is legitimate to imagine that they are distributed without definite arrangement in the singly-refracting liquid phase, much as when a lot of sticks of firewood are thrown together. As the kinetic energy of such a heterogeneous mass of molecules diminishes by a fall in temperature. it is natural to imagine that swarms of molecules in parallel arrangement may be formed and constitute the doubly-refracting liquid. Bose has thrown quite a remarkable light on this question by careful determinations of the heats of transition and the viscosity of anisaldazine.

The change, solid anisaldazine to doubly-refracting liquid, absorbs about 20 calories, which is a quite ordinary magnitude, but the change, doubly- to singly-refracting liquid, absorbs less than one calorie, a minute amount when compared with ordinary heats of liquefaction. The viscosity of the singly-refracting liquid increases normally as the temperature falls to the limit when turbidity sets in, and then diminishes very sharply to a minimum about two degrees below; as the temperature still falls the normal increase of viscosity is again established, but the viscosity never attains anything like the magnitude of that of the singly-refracting liquid. This peculiar behaviour constitutes the so-called "viscosity anomaly" and has been treated kinetically by Bose. If the anisaldazine molecule has the shape of an ellipsoid of rotation, Bose shows that the viscosity ratio of doubly- and singly-refracting liquid can theoretically be as low as 0·67; if the molecule has the shape of a triaxial ellipsoid this ratio may fall even lower. The observed ratio is 0·65 for anisaldazine, and in further support of the swarm theory is the fact that the change, singly- to doubly-refracting liquid, is accompanied by a notable increase in density.

Each swarm of parallel-placed molecules should exhibit the symmetry of a figure of rotation; the wave surface of light in the swarm should be the double ellipsoid of rotation and sphere characteristic of all uniaxial substances. In accordance with this, all doubly-refracting liquids are uniaxial. So long as the dimensions of the swarm are greater than the wave-length of light, the mass should appear turbid; as the swarms diminish in size with rise in temperature, they would become of less magnitude than the wave-length as the liquid becomes singly-refracting. The swarm itself should, of course, be clear and show no turbidity; Bose showed that a layer of doubly-refracting liquid anisaldazine 4 m.m. thick is cleared by the application of a magnetic field of a few thousand Gauss units when viewed along the direction of the lines of force. With most doubly-refracting liquids the optic axis lies normal to the face of the miscroscope slide, but on setting up a transverse magnetic field the optic axis is deflected slowly towards the direction parallel to the lines of force.

One observation appears to be in disaccord with the swarm theory. More than one doubly-refracting liquid phase sometimes exists; thus, cholesteryl caprinate forms three doubly-refracting liquid phases. [Shown with cholesteryl caprinate.]

THE FRENCH METALLURGICAL INDUSTRY

The number of blast furnaces alight has risen from 88 in May to 99 on June 1, whilst 74 are ready to be lit, and 46 are being built or repaired. This greater activity corresponds with the increase in the output of pig-iron from 350,485 metric tons in April to 393,428 t. in May and of steel from 365,791 t. to 399,249 t. during the same period.

It is reported that one difficulty hindering the application of the Basset process for the production of steel directly from the ore has been solved. This difficulty was presented by the lining of the furnace, but it now appears that the use of the rotary furnace has been abandoned, a fixed furnace of the Martin type being used instead.

RECENT RESEARCHES ON THE CAUSATION OF RICKETS

By PROF. J. C. DRUMMOND, D.Sc.

Some few years ago the Medical Research Council, then the Medical Research Committee, decided to initiate an exhaustive investigation into the etiology of rickets, in view of the fact that this previously much neglected disease is responsible for untold damage and loss of child life, particularly in our large cities. At the outset of the series of investigations made with their assistance there were very many theories of the origin of the disease, but, broadly speaking, they could be grouped into three classes, according to whether the causative factor was held to be an infection, unsatisfactory hygienic environment, or some defective dietary condition.

The pioneer researches of Mellanby (Medical Research Council, Special Report No. 61, 1921) demonstrated that a condition closely resembling infantile rickets could be produced experimentally in young dogs by feeding them on ill-balanced diets, in which there was a deficiency of an organic substance showing similar properties and distribution in foodstuffs to the so-called vitamin A. or fat soluble A. His experiments appeared to be well controlled, but his conclusions were vigorously attacked by Findlay, Noël Paton and other workers of the Glasgow School, who strongly supported the view that defective hygienic surroundings, lack of sunlight and exercise, with perhaps an associated specific infection, were responsible for the disease (Findlay and Ferguson, M.R.C., Special Report No. 20, 1918, and later publications). For a time it was difficult to reconcile the statements of the experimentalists of the two schools, but with the discovery by Huldschinsky (*Deut. Med. Woch.*, 1919, **45**, 712) that the short wave length radiations of the mercury vapour lamp would cure bone lesions in rickets in children, and more particularly with the observations of Hess and Unger (*Proc. Soc. Exper. Biol. Med.*, 1921, **18**, 298) that cures of experimental rickets could be similarly brought about by sunlight, it was possible to foresee how the two lines of thought might converge.

Meanwhile, two further important studies of rickets were published under the auspices of the Medical Research Council. One by Korenchevsky (M.R.C., Special Report No. 71, 1922) gave, in addition to an excellent review of previous studies, the results of his own experimental work, mainly on rats, whilst the second, by Mann, (M.R.C., Special Report, No. 68, 1922) was a report of close clinical observation of a large number of cases of rickets in London. Both investigators were led by their observations to support the dietetic theory, and Korenchevsky, in particular, held that the most important factor in the causation of the disease was a deficient supply of an as yet unidentified organic factor present in cod-liver and certain other oils.

Quite recently there has been published a further report which constitutes a most striking contribution to our knowledge of rickets. This is the report by Miss Chick and her colleagues from the Lister Institute, who were sent under the auspices of that Institution and the Medical Research Council to Vienna in 1920, in order to make a close study of rickets, which at that time was ravaging the infant population of Central Europe. (Medical Research Council, Special Report, No. 77, 1923. H.M. Stationery Office. 7s. 6d.). One of the most striking features of this report is the preface written by Professor Clemens Pirquet, Director of the Kinderklinik of the University of Vienna, who provided the facilities for the work and gave valuable assistance. Two quotations from his remarks are given below.

"The results of the first two years' work of our British colleagues showed me no reason for changing my opinion (*i.e.*, that rickets was an infectious disease, to which children were prone as the result of defective hygiene, defective food, etc.). The minute and conscientious observations carried out by them on a large number of individual cases led to no clear conclusion, but the third year of their work shed new light upon the subject."

After reviewing briefly the nature of the crucial experiments made and their results he adds :—

"With this the chain of evidence appears to me to be complete that animal experiments upon rickets are applicable also to man, that rickets is a disease of nutrition, and that deficiency of fat-soluble vitamins in diet is an essential cause of the disease."

Miss Chick and her co-workers have found that the action of sunlight, or other source of short wave length radiation, is apparently not to replace the vitamins, but to enable the animal organisms to economise its supply of that substance. In other words, an animal will require a greater amount of the organic factor or factors present in cod-liver oil to protect it against the onset of rickets if it is maintained under conditions of bad lighting. It is now possible, therefore, to see a reconciliation between the two schools of thought. There can be no doubt that the chief causative factor of rickets is a deficient supply of the vitamins associated with certain oils, but primarily found in most green vegetables. If the supply of these accessory food factors is not optional then the unhygienic surroundings and bad lighting of slum dwellings may operate as a secondary factor just to turn the scale so that the disease appears.

Part 4, sections 3 and 4 of this last report contain an account of some very striking experiments by two of the Lister Institute team, Miss E. M. Hume and Dr. H. Henderson Smith. In attempting to solve the effect which short wave length radiations have in economising or activating the vitamin A, they found that exposure of the animal to the rays was not necessary, but that placing them in jars containing air which had been previously irradiated had the same effect. Apparently the active agent in the irradiated air is not ozone, for exposure to this gas had no beneficial action.

Possibly the authors will turn their attention to certain oxides of nitrogen, which are produced under these conditions, and which Prof. B. Moore held to be the beneficial agents of seaside air so frequently termed "ozone."

All will await with the greatest interest the discovery of the nature of the two chemical substances which play such important parts in the normal calcification of bone ; on the one hand the organic vitamin in cod-liver oil, and on the other the presumably inorganic factor present in irradiated air.

The series of reports outlined in this short review have thrown a clear light on the etiology of that dread disease rickets, and it may well be a source of pride that British workers have played so great a part in solving the problem and rendering it possible for the scourge of the "Englische Krankheit" to be wiped out.

SAFEGUARDING OF INDUSTRIES ACT

FORMALDEHYDE

The following is the decision recently issued by the Referee on the complaint made by the Chemical Merchants' and Users' National Vigilance Committee and opposed by the Board of Trade, May and Baker, Ltd., and Howard and Sons, Ltd. :—

The question in this reference is whether formaldehyde is properly included in the list of articles dutiable under the Act. The case has troubled me a good deal because it raised three distinct questions as to every one of which I was asked to depart from principles I had already laid down for my guidance. I do not say that I regard myself as bound by what I have said before. If I am satisfied in the light of further evidence that what I have said should be modified. I will be quite ready to act on that conviction. But unless and until I am satisfied that the evidence given and accepted by me in earlier cases was wrong, or that I misunderstood it, I propose to adhere to the lines I have laid down.

It is said by the Board of Trade that the inclusion in the list of formaldehyde is justified—1. Because it is an analytical reagent. 2. Because it is a synthetic organic chemical. 3. Because it is a fine chemical.

(1) It is very difficult to say when a chemical which has a use as an analytical reagent is within the Act, but of this I have no doubt,

that unless a chemical compound has a real and substantial use as distinct from a nominal or occasional use as an analytical reagent it ought not to be included as such in the list. I am satisfied that the use of formaldehyde as an analytical reagent is too trifling to justify its inclusion in the list as an analytical reagent.

(2) I think that a good deal of confusion may arise unless one bears in mind that neither chemists nor books speak of synthetic chemicals. The expressions "synthetic perfumes" and "synthetic dyestuff intermediates" are doubtless in common use, but I think that the word "synthetic" is used quite loosely in the former case, and I am told by Sir Arthur Colefax and Mr. Parry that the expression "synthetic intermediates" has a special meaning referring to bodies from which synthetic dyestuffs can be obtained. The use of the word in this connexion, therefore, throws but little light upon its meaning in the Act.

Various writers have defined the word "synthesis." The word describes certain methods of production of chemical compounds. I am asked by the opponents to say that if a chemical can be produced synthetically, that chemical is a synthetic chemical without regard to the question whether in any particular case the substance has been, in fact, so produced. In my opinion, that is not the meaning of the Act. I think that the expression "synthetic organic chemical" means such chemicals as have in fact been produced synthetically. The results of the contrary view, if logically worked out, are so startling that I shrink from its adoption.

In my opinion the question to be determined in each particular case resolves itself into this: Has the substance on the importation of which it is claimed that duty is payable, in fact, been produced synthetically?

It is, of course, common ground that the synthesis of an organic chemical includes its building up (to use Thorpe's expression) or its formation (to use Richter's expression) from its elements. It is equally clear that synthesis includes the "building up" or "the formation" from such carbon derivatives as can be obtained from the elements. But if the carbon derivative actually employed in the latter case as the raw material is one which, although it could be, has not, in fact, been produced synthetically, it is contended, at least, I understand that it is contended, that the resulting compound is synthetically produced without regard to the nature or character of the further building up or formation from that raw material.

I am assisted in the decision of this point by the fact that there is no evidence to support the contention.

Dr. Ormandy and Mr. Parry are at one on the point. To quote the former, "the raw material must be one which could in case of necessity be produced through all the steps from its elements, and the further step must itself be synthetic." I accept that view.

There then remains to be decided the question whether the step taken, *namely*, the oxidation of methyl alcohol in the presence of a catalyst is truly described as synthesis. By this oxidation the methyl alcohol loses two atoms of hydrogen. Does this step partake of the nature of synthesis?

In two earlier cases great stress has been made upon the contention that the essence of synthesis was a building up, or at any rate, a bringing or placing together. The truth of that contention was one of the main issues in the camphor case. I quote the following passage from the opening remarks of Sir Arthur Colefax; "The Board of Trade are actually driven to this incredible position. Synthesis I have always until now understood merely as a matter of definition involving, adding something to or putting something together. But they are driven by the logic of their argument to this truly remarkable position, that synthesis is no longer to be putting two things together, but it is to be actually applied to a case where you take something away. It is a most remarkable use of the word synthesis, and certainly I should have thought that nobody has ever held it." And, later, he put to his main witness the question, "mere oxidation would never be talked of as building up." He also asked the question in argument, "Where is the case that they can point to in which you can find general acceptance of the term "synthesis" where the change does not involve an addition of a carbon atom?" I quote these passages to show how clearly the contention was raised on the one side in that case. On the other side, the Board of Trade submitted that the meaning of a "synthetic organic chemical" was "a chemical produced by controlled processes resulting in molecular changes of any kind." Dr. Forster, called for the Board of Trade, objected to the expression "building up," and argued that the true meaning was "placing together." He agreed that the generally understood meaning of synthesis was the bringing together of the component elements. He agreed that by the vast number of chemists to-day the bringing together of elements or radicles to form a more complicated body was their understanding of the term. On the evidence given in that case and on the arguments of Sir Arthur Colefax I accepted the view that synthesis, as generally understood, involved the bringing together of elements or radicles to form a more complicated body. I definitely rejected the contention that synthesis, as generally understood, included any molecular change so long as it was produced by controlled processes. I thought, and still think, that it is my duty to give to the words their commonly accepted meaning. Doubtless many chemists hold a different view. It is obvious that I cannot decide that the steps necessary for the formation of formaldehyde from methyl alcohol are synthetic without ignoring or reversing the view I took in the camphor case. It is to be noticed that no evidence was called by the Board of Trade or those supporting their view as to the meaning of " synthetic " or as to whether formaldehyde was or was not a synthetic chemical. Dr. Ormandy dealt with it only in cross-examination. He did not take quite the same view as Dr. Forster. He expressed the opinion that an operation was synthetic if it was a controlled reaction and if it gave proper yields—an entirely new suggestion. It is sufficient to say that no evidence has been given which satisfies me that the view I took in the camphor case was wrong. Incidentally, that view is entirely consistent with the evidence given in the calcium-carbide case.

(3) I frankly admit that I should like to be able to decide that formaldehyde is a fine chemical. My difficulty is that I cannot find any ground upon which I can do so consistently with what I believe to be the true principles applicable.

It is quite clear on the evidence that this substance has not been commonly regarded as a fine chemical.

The *Chemist and Druggist* definitely treated it as heavy; it appeared as heavy in Haywith and Hart's advertisements. Several lists were put in, in which formaldehyde was classified as " technical " or " general " as opposed to " fine." This may not amount to very much, but, on the other hand, not a single instance could be given of formaldehyde being called a fine chemical, or being classified as such before the Act of Parliament. An American paper, of 1923, was produced in which it was classified as " fine," and the list of fine British chemicals published in 1922 includes it. Dr. Ormandy was not asked about it. Mr. Allen, called by the opponents, could only say that he did not regard it as a heavy chemical, and that he did not understand the meaning of " fine."

No one was called from any of the big fine-chemical manufacturers. Two or three gentlemen were called who expressed the opinion that it was a fine chemical, but there was not any evidence at all that when this Act was passed formaldehyde had been regarded as a fine chemical in any branch of the trade.

According to my decision in the tartaric-acid case, this finding ought to settle the case; but I think that one is driven to the same conclusion by a consideration of the other circumstances said to be relevant.

This chemical is not a pharmaceutical chemical. The opponents disclaimed any intention of putting it forward as such. It is an industrial chemical produced on a fairly large scale—a scale very large for a fine chemical.

There is no doubt that most of the witnesses that have given evidence before me regard an industrial chemical used on a substantial scale as something very different from a fine chemical. Even representatives of May and Baker and Howards, manufacturers of fine chemicals on a very large scale, take the same view.

A special plant is necessary for its production. It is handled in quantities somewhat big for a fine chemical.

On the other hand, it is said that the formaldehyde on the market is of great purity, and that its manufacture involves continuous scientific control. One has only to re-read the evidence in the earlier cases to see (1) that the degree of purity does not help very much, and (2) that the scientific control there described as necessary to stamp the product as a fine chemical was a control of highly trained chemists as opposed to the skilled control of persons trained *ad hoc*, with the result that the cost of that control was high relatively to the total cost.

I am not at all satisfied that the skill required to produce formaldehyde is anything more than the skill of men taught and trained for the particular purpose, and Mr. Romanes said in his evidence that if you worked out the cost per ton of the scientific supervision you would find it very small.

I do not think that the description of the fine-chemical group, group 6 of the (Association of) British Chemical Manufacturers, covers this substance.

The case is one of those border-line cases upon which opinion will necessarily differ, but dealing with it as best I can in the evidence given, I find that the complainants have made out their case and that I must award that formaldehyde be excluded from the list.

ROCHELLE SALT

The Referee's award (dated August 16) on the complaint relating to Rochelle salt runs as follows :—

In my opinion no case has been made out for taking Rochelle salt out of the list.

The Rochelle salt of commerce is a pharmaceutical chemical. It has also a well-recognised use as an analytical reagent. It has practically no industrial use.

I am inclined to think that the use as an analytical reagent in itself justifies the inclusion of Rochelle salt in the list, but I do not decide the case on that ground. Mr. Kenneth Swan's contentions may possibly require very careful consideration in some future case.

I decide this case on the ground that there is no evidence to justify me in saying that the Board of Trade was wrong in including Rochelle salt in the list as a fine chemical.

The fact that the chemical is used only in pharmacy and as a reagent raises a strong presumption that the trade would regard it as a fine chemical. Mr. Howard said that it was known in the trade as a fine chemical. Mr. Blenkinsop and others gave similar evidence. There was no trade evidence to the contrary.

In my opinion there is no evidence that Rochelle salt is wrongly included in the list, and I award that the complaint fails.

FORTHCOMING EVENTS

Sept. 10–13. The Institute of Metals. Annual Meeting at Manchester. *Second Annual Autumn Lecture.* "The Use of Non-Ferrous Metals in Engineering," by Lieut.-Col. Sir Henry Fowler, K.B.E., at 8 p.m., Sept. 10. "The Cause of Red Stains on Sheet Brass," by E. A. Bolton. "Note on 'Brinell Hardness Numbers,'" by H. W. Brownsdon. "The Behaviour of Metals under Compressive Stresses," by H. I. Coe. "On the Measurement of the Change of Volume in Metals during Solidification," by Hikozo Endo. "The Electrochemical Character of Corrosion," by U. R. Evans. "The Constitution and Age-Hardening of the Quarternary Alloys of Aluminium, Copper, Magnesium and Magnesium Silicide," by Marie Gayler. "Investigation of the Effects of Impurities on Copper (Part I—The Effect of Oxygen on Copper)," by D. Hanson, C. Maryatt, and G. W. Ford. "Experiments with some Copper Wire; Cohesion a Function of both Temperature and Cold-work," by D. H. Ingall. "The Effect of Small Quantities of Nickel upon High-grade Bearing Metal," by A. H. Mundey and C. C. Bissett. "Stereotyping," by A. H. Mundey and J. Cartland. "Hardness Tests on Crystals of Aluminium," by H. M. O'Neill. "A Dilatometric Study of the Transformations and Thermal Treatment of Light Alloys of Aluminium," by A. M. Portevin and P. Chevenard. "Effects of Rate of Cooling on the Density and Composition of Metals and Alloys," by R. C. Reader. "Crystallisation Effect on Galvanised Iron Sheets," by E. L. Rhead and J. D. Hannah. "Equilibrium in the System Gold-Zinc (based on Investigations of Electrical Conductivity at High Temperatures)," by Prof. P. Soldau.

Sept. 12–19. The British Association for the Advancement of Science. Ninety-first Annual Meeting, to be held at Liverpool. The President, Sir E. Rutherford, F.R.S., in his inaugural address, will deal with "The Electrical Structure of Matter."

Sept. 17–18. The Iron and Steel Institute. Autumn Meeting, to be held at Milan, in the Chamber of Commerce, commencing each day at 9.30 a.m. At the conclusion of the meeting visits have been arranged to Florence. Rome. Piombino, Leghorn, Genoa, and Turin.

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS

The Society of Chemical Industry has in each of the past two years held a dinner in London in the month of October, but for the present year arrangements have been made for an Informal Dinner and a Social Gathering of Chemists under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, which members of these, and of any other of the Chemical Societies, with their friends (including ladies) may attend.

This dinner will be held in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on the evening of Wednesday, October 31, at 7 for 7.30. The price of tickets for ladies or gentlemen will be 12s. 6d. each, not including wine.

Further particulars will be issued later, and the Councils hope that Members of the Societies mentioned, who intend to be present, will make early application for tickets, which must be limited to 300. These will be issued in the order in which applications accompanied by payment are received.

Applications should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2.

MANCHESTER SECTION

The programme of the Manchester Section for next Session is almost complete and commences on October 5 with an address from the new chairman of the Section, Dr. H. Levinstein, entitled "Recent Progress in Chemistry"; the meeting on November 2 is the usual joint meeting with the Local Sections of the Institute of Chemistry, Society of Dyers and Colourists and with the Manchester Literary and Philosophical Society. This year it is the turn of the Society of Dyers and Colourists to choose a lecturer, and they have invited Prof. W. D. Treadwell, professor of analytical chemistry at the Eidgenössische Technische Hochschule, Zurich, who will give a paper on "Electrometric Methods in Analytical Chemistry." On December 7, Dr. T. Callan and N. Strafford will read a paper on "The Analysis of Rubber Vulcanising Accelerators", to be followed on the same evening, it is hoped, by a paper from a member of the Institution of Rubber Industry. The January meeting will be held on Friday, the 11th, and two papers will be presented—viz., "Fullers Earth," by A. Brittain, and "Fractional Distillation," by C. Elliott. The fifth meeting on February 1, will be addressed by Dr. Ernest F. Ehrhardt, who has chosen for his subject, "Reminiscences of Dr. Caro." Prof. F. Gowland-Hopkins, F.R.S., of Cambridge, has promised to give an address on

March 7, the provisional title being "Some Chemical Qualities of the Living Cell" (it is possible that this and, indeed, any of the above titles may be changed). The meeting of April 4 will include a paper by Prof. F. L. Pyman, F.R.S., on the "Tautomerism of Amidines." Other papers are promised, and the Session will probably require further dates. There is a likelihood of another joint meeting with the Liverpool Section at a date to be announced and members are asked to book the date, November 23, for the Annual Dinner of the Section, which will be held at the Queen's Hotel, Manchester. L. Guy Radcliffe

BRITISH ENGINEERING STANDARDS ASSOCIATION

The fifth annual meeting was held on July 12 at the Institution of Mechanical Engineers. The Chairman, Sir A. Denny, in reviewing the year's work, stated that the Association was faced with a deficit of some £1700 and hoped that both the Government and Industry would help to put the finances of the Association on a more stable basis. The national character of the work of the Association, devoted to simplification and the promotion of economy in our engineering and allied industries, was too well known to need comment. The Association was not a profit-making body; and it had nothing to gain from, but much to give to, industry. The continually increasing volume of work which the Association had to deal with necessitated more generous financial support than was now given. Neither the Government nor industry as a whole appeared fully to appreciate the value of the work done voluntarily by the 2000 engineers constituting the Association.

On July 3–6, a second unofficial conference of secretaries of the various standardising bodies was held in Zurich, thirteen different countries being represented—viz: Austria, Belgium, Canada, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Norway, Sweden, Switzerland and United States. When the first conference was held in London in 1921, the secretaries of seven standardising organisations were present. Reports were presented on the progress of the standardisation movement in various countries and a general discussion took place on organisation, methods of working, the practical application of the standards, the extent to which international collaboration is now taking place and the possibilities of making it more effective. Considerable progress appears to have been made during the past two years towards closer international collaboration and a number of questions of importance to various branches of industry were discussed. The recommendations made by the conference will be placed before the national organisations.

CORRESPONDENCE

A SUGGESTION

Sir,—Two considerations incite me to send this letter—one is the fear that we may one day have a fearful accident on a tube railway, and another is anxiety about the coming winter, when many more people are likely to lack work. The fear about the tube railways is that in case of fire in a tube there is every condition for a really serious accident, as nearly all the fittings above the frames of the cars consist of inflammable material in a state of dryness calculated to spread fire very rapidly. Then nearly all the woods and many other materials employed in the construction of these carriages are imported, some more or less ready for use.

I should like to suggest that nearly all the parts and fittings of railway carriages (walls, partitions, roof, flooring, seats, doors) might be made of metal. In conjunction with steel this would be a good opportunity to use aluminium and its alloys, rustless iron alloys, etc.

The objection that metals are noisy can easily be overcome. For example, doors, partitions and the like can be constructed with double walls of thin metal and the space between filled with material such as slag wool or asbestos, which are most excellent sound deadeners as well as being non-inflammable and bad conductors of heat. All the materials I have mentioned are produced in this country. Their application in the direction I have roughly indicated would give employment to many artisans, not merely those who only "fetch and carry" or wield the crowbar. I see no reason why the stuffy, microbe-colonised seats in public conveyances should not be replaced by metal wire-gauze arrangements which might, if necessary, be covered with one of the usual covering materials. It needs but little imagination to apply steel where some strength is needed, and aluminium, or the like, in places where no great strain comes. All these metals can be painted or enamelled as cunningly and æsthetically as carriages usually are. Doors can be constructed of a steel frame with aluminium and glass fillings and deadened against the classic bang of the railway official, as well or better than the expensive timber construction now used.

All this would be safe against fire, and *home made*. Some part of what I have said about "carriages" applies to doors, window panes and other fittings in houses. A considerable amount of fitted woodwork is imported ready made from abroad. I see no reason why a house door should not consist of a steel frame with light-metal panels padded or lined or filled, as the case may be, with some substance for the purpose before mentioned. Metal window frames would give us a chance to return to the more sanitary, so-called Tudor windows, which open outwards like a door and let air into the house.—I am, Sir, etc., W. R. Hodgkinson

Eastbourne, August 19, 1923

THE LATIN WORKS OF GEBER

Sir,—I think it will be admitted that Prof. J. R. Partington has adequately proved his point, and that he has shown that the spectre which Prof. Lippmann challenged him to produce has a distinctly material existence. Prof. Partington's promised article on the Latin works of Geber will be awaited with interest, for, as he has already remarked, the identity of Geber is one of the most important problems in the history of chemistry.

As I am responsible for suggesting that the old identification of Geber with Jabir ibn Hayyan has a good deal to be said for it, perhaps I may be allowed to make one or two observations. In the first place, I believe that the Latin works of Geber show unmistakable signs of an Arabic origin, though they may not be literal translations. This view I have expressed previously (*Nature*, February 10, 1923). It was therefore with considerable pleasure that I noted that Prof. Julius Ruska, in a review of Darmstaedter's *Die Alchemie des Geber*, which is to appear in the next number of *Isis* (and of which Dr. Sarton, editor of *Isis*, was good enough to send me an advance proof), expressed the opinion that, whilst the Latin works are not translations from the Arabic, the author "muss arabische Quellen gekannt und direkt oder indirekt benützt haben. Dies erhallt nicht nur aus dem Gesamtinhalt, sondern auch aus der Disposition der Schriften und aus einzelnen Wendungen und Fachausdrücken." One may also note in this connexion that Prof. H. E. Stapleton (Mem. Asiat. Soc. Bengal, 1905) concluded that "the contents of the Summa were derived from previously existing Arabic works on Alchemy."

As to E. Meyer's statement (quoted by Prof. Partington) that "it is just possible that neither Gabir nor Chalid ben Jazid ever lived or wrote," one may remark that all the Arabic authorities agree in assigning Jabir to the eighth century A.D., that Al-Nadim (10th century) used Jabir's own catalogue of his writings in the preparation of his encyclopædia, that some 80 books ascribed to Jabir (most of them mentioned by Al-Nadim) are still extant, and finally that in the *Kitab al-Aghani*, the "Register of the Arabs," compiled by Abu'l-Faraj of Ispahan (died 967 A.D.), five or six pages are devoted to the life of Khalid ibn Yazid, casual mention being made of the fact that "he busied himself with the search for Al-Kimia" (*i.e.*, the philosophers' stone).

The recent discussions have at least conclusively proved that, so far from "Geber's" writings representing European advances in chemistry made in the twelfth or thirteenth centuries, they were merely the means of introducing to many European chemists the chief knowledge of the chemists of Islam. Prof. Ruska himself says: "Man wird erstaunt sein, wie viel von technischen Einrichtungen, die der lateinische Geber beschreibt, schon dort und bei andern im Orient lebenden Vertretern der 'grossen Kunst' vorhanden war."

The whole problem is gradually resolving itself, and in the light of information gained by attacks from both the Latin and Arabic sides we may reasonably hope that a satisfactory solution will be found at no very distant date.—I am, Sir, etc., E. J. Holmyard

Clifton College
August 20, 1923

HAFNIUM OR CELTIUM?

Sir,—I have read Prof. Urbain's article in the current number on the above subject with considerable interest, and mingled feelings of disgust and amusement. Surely to Science the importance lies in the facts, the honour of priority being quite subsidiary. Contemporaries never get their due, and posterity will do as Prof. Urbain recalls was done in the Crookes-Lamy controversy. Perhaps it does not strike the authors that to the public such polemics are childish and hardly likely to increase the appeal now so widely being made. After all, the History of Science is strewn with instances and a hundred, two hundred . . . . years hence what matter whose name is linked with milligrams of material, so long as that is identified correctly?

It can only be regretted that the attitude is foreign to no branch of Science: Mr. Johnstone's plea for a sense of humour in the same number of *Chemistry and Industry* might well be emphasised.—I am, Sir, etc.,

A Hundred-Thousandth of the
Chemical Brigade

August 14, 1923

* * *

In our issue of July 27 we published a review of a book entitled, "Textile Chemistry," by F. J. Cooper, of the Blackburn Technical College, in which Mr. Cooper considers that it is implied that the author had attributed to Mercer the discovery of the lustring of cotton and that he was ignorant of the fact that this was a later development of the process. This implication is untrue. In fact, the author stated as follows:—

"Unfortunately mercerized cotton was not a commercial success in Mercer's lifetime, and in fact made very little progress until another property regarding it was discovered some 30 years later. Since then it has increased enormously in popularity.

"This important characteristic is produced by stretching the cotton during or after immersion in the alkali and keeping it so during the washing process. The fibre is thus prevented from contracting, with the result that an external lustre is produced."

If such an implication as mentioned above was made we regret it and we offer to Mr. Cooper our sincere apologies for its publication.

B

PERSONALIA

Mr. J. A. S. Ritson, senior inspector of mines in the Cardiff district, has been appointed to succeed Prof. Granville Poole (who has accepted a chair at Armstrong College, Newcastle-on-Tyne) as professor of mining in the University of Leeds.

Prof. E. Anderson, of the University, Nebraska, has become head of the chemistry department at the University of Arizona, and J. H. Schmidt has resigned his instructorship in organic chemistry at the University of Wisconsin to become research chemist to the Redmanol Chemical Products Co., Chicago.

Monsieur Binder, vice-president of the Société de Chimie Industrielle, has been appointed Chevalier of the Legion of Honour.

Prof. The Svedberg, who has been lecturing and directing research work on colloid chemistry during the summer session at the University of Wisconsin, has been awarded the degree of D.Sc. *honoris causa* by that University.

Dr. W. Schumann, Director of the Institute for Technical Physics of the University of Jena, has been appointed professor of electrotechnology in the Technical *Hochschule* of Munich.

* * *

From Paris the death is announced of Monsieur E. Agache Kuhlmann, president of the Etablissements Kuhlmann. M. Kuhlmann was responsible not only for the expansion of the firm of chemical manufacturers that bears his name, but also for the development of the textile factories of Agache Fils.

NEWS AND NOTES

SOUTH AFRICA

Reported Discovery of Platinum in the Transvaal

A correspondent writing in *The Times*, of August 16, announces that the discovery of platinum is reported from the Waterberg district of the Transvaal. A reef has been traced for 30 miles, and samples have been obtained which are said to show 46 per cent. of platinum and payable gold.

The Portland Cement Industry

The four portland cement factories in South Africa have a capacity of 4,250,000 bags (1 bag=188 lb.) or 2,125,000 casks per annum, but production during the past year has been reduced by one-half, owing to the poor demand. The industry is stated to be suffering from foreign competition, as ocean freights are low compared with the heavy rail rates in South Africa. Prices of South African cement, however, have been reduced appreciably during the past year, and compare favourably with prevailing foreign rates on a f.o.b. works basis. In 1922 the import of cement was 248,376 casks, chiefly from Great Britain, Belgium, Norway and Denmark.—(*U.S. Com. Rep., June* 25, 1923.)

FRANCE

Société de Chimie Industrielle

The Annual Meeting of the French Society will be held in Paris from October 21 to 27, when papers covering the various fields of applied chemistry will be read and visits paid to various factories, etc. It will be remembered that during the Annual Meeting of the British Society in Cambridge, an invitation was extended by Monsieur Paul Kestner to British delegates to attend the congress in Paris.

AUSTRALIA

Eucalyptus Oil as a Motor Fuel

According to the *Oil and Colour Trades Journal* (August 18), Capt. C. M. Dyer claims that eucalyptus oil can be used as a fuel for petrol engines. Mileage tests gave the following results :—gasoline, 24 miles per gallon ; gasoline 50 per cent., eucalyptus 50 per cent., 28 miles per gall. ; eucalyptus oil alone, 28 miles per gall. It is claimed that the oil acts as a decarbonising agent, but priming is necessary, as a start from cold cannot be obtained. It is reported that the Australian Government may take up the question. Distillation of eucalyptus oil is very simple, the main difficulty being to find labour for picking the leaves. The yield varies up to 35 lb. of oil per 1000 lb. of leaf.

GENERAL

Donation of £15,000 to the Imperial College of Science

The Clothworkers' Company of the City of London has offered an annual contribution of £3000 for the period 1923-27 to the Imperial College of Science and Technology, South Kensington, to be applied towards the maintenance and development of the City and Guilds (Engineering) College, one of the three constituents of the Imperial College of Science. This gift is supplemental to the £85,000 voted some years ago by the Goldsmiths' Company to enable the College to extend its buildings, and is distinct from the annual vote of £5000 from the City and Guilds of London Institute which has been paid to the Imperial College since the Charter was granted some 15 years ago, and applied to the City and Guilds (Engineering) College. The gift is a pleasing indication of the value attached to research and teaching in science as related to industry.

Chilean Nitrate Industry

The Chilean nitrate industry has almost completely recovered from the slump of 1921, for sales effected during the 9 months ending March 31 totalled 2,185,108 metric tons or only 15 per cent. less than the quantity sold in the same period of prosperous war years. The number of plants working increased from 59 in March to 62 in April. Stocks are being steadily reduced throughout the world, and exports from Chile have increased greatly, approximately 50 per cent. of recent shipments going to the United States.—(*U.S. Com. Rep., June* 18 *and* 25, 1923.)

REVIEWS

Industrial Hygiene and Medicine. *By* E. W. Hope, O.B.E., M.D., D.Sc., *in collaboration with* W. Hanna, M.A., M.D., D.P.H. *and* C. O. Stallybrass, M.D., D.P.H. *Pp.* viii+766. *London: Baillière, Tindall and Cox*, 1923. *Price* 25*s.*

The appearance of a volume dealing with the whole scope of industrial hygiene is such a rare event in this country, that not a little interest is aroused by the publication of this volume of over 750 pages under the joint authorship of Dr. E. W. Hope and two of his colleagues on the public health staff of the City and Port of Liverpool. The aim which the authors had in view is stated in the preface, " that British and Colonial, American and Continental experience and progress should again be presented and summarised for the student in a single volume. The book is primarily intended for the medical profession, but it is hoped that others engaged in the various aspects of industrial hygiene and welfare will find it of value."

The book is arranged in eleven chapters, the first three being devoted to general aspects of the history of legislation in industry, vital statistics and the application of the principles of environmental and community hygiene.

Under " Vital Statistics of Occupation " a collection of data is given with the general effect of showing the fallacies in present statistical methods when applied to industrial conditions. The need for definite lines of study and tabulation is indicated, but no very practical suggestions are put forward.

Under industrial poisonings, amongst others, the important subject of lead poisoning is discussed in its various sources and manifestations. The reviewer does not agree that " of all the individual precautions to be adopted, those relating to personal hygiene are by far the most important. Very little trouble is required and the dangers to health and life can easily be avoided." On the contrary, constant vigilance on the part of the employer as to the efficiency of the plant and unremitting care on the part of the worker regarding cleanliness and the avoidance of dust and fume inhalation are necessary to achieve this end. The danger of poisoning from lead fume in oxy-acetylene burning in ship-breaking is important and difficult to deal with, though here it is referred to only in a footnote.

" Dust as a cause of disease " receives extensive treatment in a chapter of 80 pages. The methods of investigating the dust content of air, and the character of the particles in animal, vegetable and mineral dusts are described and an outline of the physiological defences and pathological effects of various kinds of dust is given. The dusts arising in different industrial processes and the appliances devised to remove them are described. No mention is made of Owens' dust-counter amongst the methods of dust collecting; it certainly does not come within the somewhat sweeping statement, applied to the impaction method, that it " apparently fails to catch most of the very fine particles which are especially dangerous." The disease known as " silicosis," has given to it the alternative name, " dust phthisis "—a term which has no specific meaning and certainly does not mean " silicosis." The opening sentence in the paragraph :—" The development of a fibrosis of the lung is due to mineral dust containing silica," requires modification, as fibrosis may be produced by dusts other than silica, and even independently of dust. Speaking of grinding of metal articles, " The use of ' wet methods,' where possible, is advocated "; some of the worst processes to-day are " wet methods." The term " phthisis " is used freely in this chapter and coming from Medical Officers of Health this is to be regretted, as it may stay the abolition of a term which has played havoc with health statistics in the past.

In the chapter on industrial infections a full description is given of the Government Disinfecting Station at Liverpool, as well as a useful description of anthrax as it occurs in industry and extracts from existing Regulations under the Factory and Workshop Acts relating to its occurrence in industry. Other infections are also dealt with, including tuberculosis, other respiratory diseases and some of the less common microbic and parasitic disorders. The importance of the inhalation of silica dust as a predisposing cause of tuberculosis is pointed out in various sections of the book, and attention is rightly called to the possible danger of stone dusting in coal mines in this connexion. The case of the tuberculous worker, handicapped, but able and willing for partial employment is set out in a convincing manner in this chapter.

In the chapter on diseases of the skin, a classification is made on the basis of the agents causing the injury, physical, chemical, irritant or poisonous. The ulcers caused by various chemical agents are described. The most important of these is the chrome ulcer produced by the chromates in the course of manufacture or in their use in the industries; reference is also made to the perforation of the nasal septum commonly seen in workers exposed to dust of chromates. The bichromates are also usually held responsible for skin affections in the dye industry, in French polishing, photo-engraving, etc. The effects on the skin of shale oil, coal tar, coal oils, pitch and soot are described and the serious epitheliomatous, or cancerous, ulceration is fully dealt with. A special section in this chapter deals with cancer and occupation, and data are set out which appear to indicate that arsenic plays an important part as a causative agent. In a table which shows the trades grouped according to the average comparative mortality figures for the two pericensual triennia 1890-1892 and 1900-1902, chimney sweeps reveal the highest mortality figure, 158, followed by gasworks service with 68·5, chemical trades with 68·0, and all occupied males 53·0.

The later portions of the book are devoted to discussions of industrial fatigue and allied conditions; industrial welfare, medical examinations and first-aid provisions in industry; the incidence, causation and prevention of accidents, and the provisions for workmen's compensation.

In three appendices are given references to British legislation affecting industrial hygiene, duties of local authorities under the Factory and Workshop Acts and duties of certifying factory surgeons.

The subject matter of the book is largely a compilation from many sources and a comprehensive bibliography is provided at the end of each chapter, which those desirous of following any of the subjects farther will find useful. It is here, indeed, that we think the chief merit of the work lies, in bringing within the compass of a single volume salient facts and references to authentic literature on a subject which has become so diverse in its application that specialisation is unavoidable where exhaustive treatment of any phase of it is aimed at. The book will fulfil a useful purpose as a work of reference and it is particularly well adapted for the use of Medical Officers of Health, from whose point of view the subject has been treated.

E. L. Middleton

Die Neueren Chemotherapeutischen Präparate aus der Chininreihe (Optochin, im besonderen Eukupin und Vuzin) und aus der Akridinreihe (Trypaflavin, Rivanol). *By* E. Laqueur, *assisted by* A. Grevenstuk, A. Sluyters *and* L. K. Wolff. *Pp.* 90. *Berlin: Julius Springer*, 1923. *Price, paper*, 3*s*.

The author has undertaken the praiseworthy task of sifting critically the mass of publications from pharmacologists and clinicians on the therapeutic value of the substances enumerated in the title. In all, five drugs are dealt with—namely, the quinine derivatives, optochin, eucupin and vuzin (respectively ethyl-, isoamyl-, and isooctyhydrocupreine), and the substituted acridines, flavine (trypaflavin) and rivanol (2 ethoxy-6.9-diaminoacridine). Though writing as a pharmacologist, he has set himself the task, outlined in the preface, of answering in regard to each of these preparations the simple but pertinent therapeutic questions: (1) Does it do the patient any good? (2) If so, what harm does it do him at the same time?

The author and his collaborators are of the opinion that "the opponents of chemotherapeutic research are unfortunately justified in complaining that excessive advertisement and personal enthusiasm ("einseitiger Enthusiasmus") make it very difficult for the most impartial observer to form an unbiassed judgment," and they wish to help those who desire to do so. In this undertaking they will surely earn the gratitude of the less "specialised" medical man, as well as that of the technical chemist or manufacturer who may be hesitating to put a new drug on the market, and to recommend it to the medical profession for use.

It has been frequently pointed out that in Germany the introduction of a new drug is greatly facilitated by the close collaboration of chemists, pharmacologists and clinicians, and that the appearance of a new chemical derivative in the laboratory, possessing potential therapeutic possibilities, is at once followed by a superabundance of pharmacological and clinical research. That this method rapidly brings to light useful drugs is undeniable, but it also leads to great confusion, due largely to the "personal enthusiasm" above referred to. This is by no means necessarily commercial in its origin.

The pamphlet is divided into three parts; in the first and second the quinine and acridine derivatives are respectively dealt with; the third section is devoted to a brief discussion of the question whether and in what degree experiments on antisepsis *in vitro* and *in vivo* can serve as a basis for therapeutics. The references to literature are (as the author admits) by no means complete, but the attempt has evidently been made to collect evidence calculated to throw light on the subject from all sides. For example, a considerable amount of space is given to the discussion of the English publications on Flavine, in particular to the work of Browning and collaborators, and the most interesting part of the book is decidedly that devoted to a critical survey of the practical antiseptic value in surgery of eucupin, vuzin and flavine on the basis of the publications reviewed. In the case of eucupin and vuzin, these are, unfortunately, nearly all German, but they are none the less highly controversial.

The author is loth to pronounce judgment of his own, and with the sole exception of optochin, the value of which as a local pneumococcicide and (if carefully administered) in pneumonia he regards as definitely established, the only result arrived at is "that the substance named can produce good results" if used in the right way.

It is evident, therefore, that the author does not belong to the "enthusiasts." Nevertheless, the conclusions are not discouraging to the chemo-therapeutical research worker, and it would seem that a critical work of this kind may also prove useful to him as a survey of the ground on which he stands, and from which a new line of exploration is to be mapped out.

J. W. Blagden

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Aug.* 16)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Algeria	Building materials, iron and steel sheets, galvanised sheets	205
,,	Sugar, petrol	206
,,	Copper sulphate, sulphur, fertilisers	207
British West Indies	Leather goods	D.O.T. 4254/ E.D. M.C.
do. (Trinidad)	Cement, galvanised iron	183
Bulgaria	Oil, varnish, lead, zinc	191
New Zealand	Cable wire	185
Norway	Pig iron, electrode scrap, paper	195
South Africa	White lead, oils, paints, varnishes	120
United States	Pig iron	213
Switzerland	Metals, machinery	202

TARIFF CUSTOMS EXCISE

Egypt.—Revised valuations have been issued for use in assessing import duties on various classes of iron and steel goods, with effect from November 15, 1923, or until denunciation.

France.—Waste of galvanised iron may be exported, until further notice, without previous authorisation.

Greece.—A decree, dated July 13, modifies the import duties on various goods. The modifications came into effect on July 15, and affect, *inter alia*, asphalt, iron and steel naphthalene, sulphide, sulphate, hyposulphite and hypochloride of soda, chloride of lime, chloride of manganese, celluloid, tinplate, aluminium, zinc, etc.

Italy.—Recent modifications in the "general" customs tariff affect sugar, oilseeds, artificial silk, iron and steel, various metals and their alloys, scientific instruments, ceramic products, glassware, mineral, resinous and tar oils, various chemicals and fertilisers.

SAFEGUARDING OF INDUSTRIES ACT, PART I

The Referee has decided that formaldehyde be excluded from the lists of articles dutiable under Part I of the Act, and the withdrawal will take place from August 20.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

There is not much improvement in the market for chemical products and no great change for the better in the home trade can be anticipated until the holiday season is over. Export inquiries are comparatively good when the state of Europe and the world generally is taken into account. The most important change in price to be reported is a reduction of £2 per ton in manufacturers' prices for caustic soda.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d.—5s. per carboy d/d. Quiet in textile circles.
Acid Nitric 80° Tw.	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.—£8 per ton. General export demand good, particularly from the Continent.
Arsenic (White)	£72—£73 per ton. Not much doing.
Bleaching Powder	Spot £11 7s. 6d. d/d.; Contract £10 7s. 6d. d/d. Quiet.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Copper Sulphate	£25 10s.—£26 per ton.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass Bichromate	5¾d.—6d. per lb. d/d.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.–£5 per ton. Export demand continues good and manufacturers are in many cases fully sold for some time ahead.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.

Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	7½d.—1s. 3d. per lb.
Crimson	1s. 6d.—1s. 8½d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Cheaper at 10½d.—1s. 1d. per lb. Ample supplies now available.
Chromium Oxide	1s. 3d. per lb.
India Rubber Substitutes, White and Dark	5½d.—6¾d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

In sympathy with most trades, this market is now a little easier.

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d.
Grey	£22 per ton d/d.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8—£10 15s. per ton d/d, according to locality of market and type of charcoal. Demand easier.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2s. per gall. 24° Tw.
Red Liquor	1s 3d. „ „ 14/15° Tw.
Wood Creosote	2s. 7d. „ „ Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. „ „ 60% O.P Firm market as to price but demand quiet.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5–£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton d/d.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d. per lb. spot. 1s. 1½d. per lb. for forward delivery
Crude 60's	3s.—3s. 6d. per gall. Market firmer for early delivery.
Acid Cresylic—97/99	2s.—2s. 5d. per gall. Steady demand.
Pale 95%	1s. 11d.—2s. 4d. per gall.
Dark	1s. 10d.—2s. 0d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price, no business.
Anthracene Oil—	
Strained	8¾d —11d. per gall. Supply short. Plenty of inquiries.
Unstrained	8½d.–10d. per gall. Market short.
Benzole—	Market uncertain. Prices doubtful.
Crude 65's	1s. 1d.—1s. 1½d. per gall.
Standard Motor	1s. 4d.—1s. 6½d. per gall. Business slack, abundant supplies.
Pure	1s. 9d.—1s. 11d. per gall.
Toluole—90%	1s. 8d.—1s. 10d. per gall. Not many inquiries. Easier.
Pure	2s. per gall. Not much inquiry.
Xylol	2s. 3d.—3s. 3d. per gall., according to quality.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8d.—9d. per gall. Market steady.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—9d. per gall.
Solvent 90/160	1s. 5d. per gall. Quiet.
Solvent 90/190	1s. 4d.—1s. 7d. per gall. Market quiet.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Very little business passing.
Whizzed or hot pressed	£11—£13 per ton. Quiet.
Naphthalene—	
Crystals	£21 per ton.
Flaked	£17 10s. per ton.
Pitch, medium soft	135s.–145s. per ton. Autumn delivery. No buyers at present.
Pyridine—90/140	18s.—20s. per gall. Demand good.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 8d.-1s. 9d. per lb.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	5s. 2d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.—6½d. per lb. Quiet.
m-Cresol 98/100%	2s 1d.—2s. 3d. per lb. Fair demand.
p-Cresol 32/24° C.	2s. 1d.—2s. 3d. per lb. Fair demand.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
d-Dichlorbenzol	£75 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.

Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£90 per ton d/d.
Dinitrotoluene—48/50	8d.—9d. per lb. naked at works.
66/68	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market remains exceptionally dull and orders continue to be very scarce owing to holidays and disturbed labour conditions.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	2s. 11d.—3s. per lb. for cwt. lots.
Acid, Benzoic	2s. 3d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 5½d.—1s. 6d. per lb., less 5%. Market weaker.
Acid, Gallic	3s. per lb. Down to 2s. 11d. for large quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d. per lb. Limited demand.
Acid, Tannic	3s. per lb. would now be accepted.
Acid, Tartaric	1s. 2d. per lb. less 5%. Market weaker.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 5d. per lb. Market very weak.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz.
Barbitone	18s. per lb. now quoted. Prices for forward delivery considerably easier.
Benzonaphthol	4s. per lb.
Bismuth Salts	Good inquiry being met with. Prices unchanged.
Borax B.P.	£31—£33 per ton, carriage paid buyer's station.
Bromides	Position unchanged. Prices vary according to quantity and source.
Calcium Lactate	2s. 6d. per lb. for best makes. Better inquiry.
Chloral Hydrate	3s. 9d. per lb., duty paid.
Chloroform	2s. 2d. per lb. for cwt. lots. Very firm. Higher prices expected.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	Can now be imported free from duty. Spot supplies very scarce and prices erratic from £100—£110 per ton. Lower prices for forward delivery.
Guiacol Carbonate	8s. 6d. per lb. Spot supplies short.
Hexamine	3s. 9d. per lb. In fair supply on a quiet market.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.
Magnesium Carbonate—Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	65s.—75s. per cwt., according to quality and quantity.
Menthol	38s. per lb. spot, less 2½%. Slightly weaker.
Mercurials	Very much weaker. Reduced 6d. lb. all round. Quicksilver reduced to £8 15s. per bottle.
Methyl Salicylate	2s. 3d. per lb. for carboys.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Metol	8s. 9d. per lb.
Morphine and Salts	Prices advanced about 6d. per oz., due to higher price of opium. Alkaloid: Cryst. 11s. 6d., Precip. 11s. 3d., Acetate 9s., Hydrochlor. 9s., Sulphate 9s. per oz.
Paraformaldehyde	3s. 9d. per lb. Lifeless.
Paraldehyde	1s. 5d. per lb. Very slow.
Phenacetin	6s. per lb. Weaker tendency.
Phenazone	7s. per lb. In better demand, especially for small quantities.
Phenolphthalein	6s. 6d. per lb. Supplies still short.
Potass. Bitartrate—99/100% (Cream of Tartar)	88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s. 3d.—3s. 9d. per lb., according to quantity.
Potass. Iodide	15s. 8d. per lb. Good demand. Steady market.
Potass. Permanganate	9½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	5s. 6d. per lb.
Salol	2s. 8d. per lb. Very quiet. Lower in value.
Silver Proteinate	10s. per lb.
Sod. Benzoate	2s. 3d. per lb. Slow of sale.
Sod. Citrate, B.P.C. 1923	2s. 2d. per lb. for cwt. lots.
Sod. Hyposulphite—Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.

Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—87s. 6d. per cwt. Fairly good demand. Expected to improve with continued warm weather.
Sod. Salicylate	Powder 2s. 6d. per lb., and Crystal at 2s. 7d. per lb. Market still very quiet.
Sod. Sulphite, anhydrous	£27 10s.—£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.—1s. 4d. per lb.
Thymol	15s. per lb. for cwt. lots of natural recryst.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. 9d. ,, ,,
Amyl Butyrate	7s. 6d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	2s. 9d. per lb.
Benzyl Benzoate	3s. 3d. ,, ,,
Cinnamic Aldehyde Natural	18s. 6d. ,, ,,
Coumarin	18s. ,, ,,
Citroneilol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	15s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	35s. ,, ,, Advanced.
Geraniol	5s. 6d.—12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. 6d. per lb.
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	21s. ,, ,,
Methyl Anthranilate	8s. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Xylol	11s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	2s. 1d. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	22s. 3d.—23s. 6d. per lb. Firm with steady demand.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	29s. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4½d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 2d. per lb.
Ceylon	3s. 8d. ,, ,,
Clove Oil	8s. ,, ,,
Eucalyptus Oil 70/75%	2s. 2d. ,, ,,
Lavender Oil, Mont Blanc 38/40%	18s. ,, ,,
Lemon Oil	3s. 1d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	13s. 7d. per lb.
Otto of Rose Oil	30s.—60s. per oz, according to quality.
Palma Rosa Oil	24s. 6d. per lb.
Peppermint Oil—	
English	80s. ,, ,,
Wayne County	13s. ,, ,,
Japanese	7s. 3d. ,, ,,
Petitgrain Oil	7s. 3d. ,, ,,

TRADE NOTES

Trade Information

Where to Buy Everything Chemical.—This useful guide to the principal sources of general and fine chemicals and plant, the July number of which has just been issued (London: S. Davis and Co. Price 2s.) continues to increase in size and scope. An interesting feature is that the entries under the various classified headings are not restricted to firms who advertise in the guide. Sections that have been especially enlarged are those relating to "Colours" and "Dyestuffs," under which many more firms are not listed. The guide should be very useful to all those who utilise chemicals or chemical plant.

Fireclay Goods.—The almost unlimited range of uses of fireclay goods is well illustrated by the productions of the Glenboig Union Fire Clay Co., Ltd., of Glasgow, a firm whose manufactures include firebricks, special bricks for various forms of metallurgical furnaces, gas retorts, sewage pipes, tiles, and many other essential industrial supplies. Chemical analyses of fireclay are liable to be misleading, but this company supplements the physical and chemical tests on its raw materials and products carried out in a well-equipped laboratory by experience gained in manufacturing fireclay goods for nearly ninety years.

Market Notes from France

Turpentine is still quoted at 500—505 fr., and although this price means a loss to most manufacturers, many are compelled to dispose of their output owing to the fairly good demand. *Clear rosins* are quoted at 82—83 fr., and it appears that the demand will continue for lower grades, as colophony is priced at only 83 fr.

PUBLICATIONS RECEIVED

The Manufacture of Pulp and Paper from Australian Woods. *By* L. R. Benjamin. *Commonwealth of Australia. Institute of Science and Industry, Bulletin No.* 25. *Pp.* xvi+92. *Melbourne: A. J. Mullett*, 1923.

Monthly Report of Coal Statistics for Canada. March, 1923. *Dominion Bureau of Statistics, Mining, Metallurgical and Chemical Branch. Vol.* 2. *No.* 3. *Pp.* 12. *Ottawa: F. A. Acland*, 1923.

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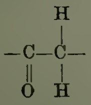
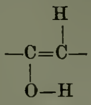
EDITORIAL

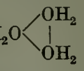
IT is nearly forty years since van Laar introduced into chemistry the conception of tautomerism, an example of which is the reversible change which takes place in certain ketonic esters where the group (*a*) easily changes into the group (*b*) and vice versa.


(*a*)


(*b*)

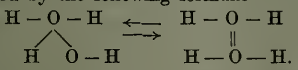
This sort of change is more intelligible since the introduction of the modern conception of molecules, consisting of various positive atomic nuclei held together by a variety of electrically negative electrons. Very slight changes of the conditions lead to a rearrangement of the electrical attractions, and even without a change in the positions of the atoms or nuclei a different method of binding them together may result, forming a distinct chemical compound. Prof. H. E. Armstrong has applied this sort of conception to water, which according to him consists of a mixture of polymers of the type

$H_2O{=}OH_2$ and



$$H_2O<\begin{matrix}OH_2\\ |\\ OH_2\end{matrix}$$

which may readily undergo change of the kind indicated by the following formulæ



With any given degree of purity, temperature and other relevant factors, an equilibrium is set up so far as these polymers are concerned, but in addition the liquid dissolves a quantity of gaseous H — O — H which he calls hydrone. The addition of hydrochloric acid to water forms a much more complicated system, but this will still contain a variety of readily interchangeable compounds which under given conditions will attain a constant relation to each other. Mendeleef, Pickering, Bousfield, Lowry and others gave consideration to this kind of problem in days gone by, but without —so far as we remember—considering in detail the various possibilities of complexity which Armstrong has indicated in a recent note contributed to the *Comptes Rendus.* It is interesting to learn, also from the *Comptes Rendus*, that M. Camille Gillet and Messrs. Kling and Lassieur have independently come to somewhat similar conclusions. That so common a substance as water and so frequent an experiment as the solution of an acid or salt in water should be so complicated is not an occasion for any surprise. Of the metals we are accustomed to, iron and steel are perhaps the most common, and how complex these are! How little is known of the structure of coal which has been chemically treated by an infinite number of methods! Mr. R. H. Atkinson writes to *Nature* to explain how to separate heavy lead from lighter lead by ordinary fractional crystallisation, and yet this process had been practised on the large scale for scores of years before its significance was observed. It is less than thirty years ago that a whole family of gases was detected in the air. Chemists need not be afraid that opportunities of research are getting limited or that they must seek for obscure essential oils extracted from a plant which flourishes where the balmy breezes blow soft o'er Ceylon's isle or for some rare mineral from Patagonia or Spitzbergen. The chemistry of air, water, iron, silica, lead, carbon and plenty of other substances is not yet exhausted. Not that the collection of rare minerals from high altitudes is to be despised; a few days spent at Bode or in the Lyngenfiord reflecting on the vanity of this world and the deceitfulness of chemists is an agreeable preliminary to an essay on a distant prospect of tautomerism. We have not heard that Armstrong has isolated the compound OH_3Cl but we have a vague and perhaps erroneous impression that $OH_2.CH_3.Cl$ and $OH(CH_3)_2Cl$ were prepared some years ago.

THE FOURTH INTERNATIONAL CHEMICAL CONFERENCE

As the official report of the Fourth International Chemical Conference held at Cambridge from June 17 to 20 under the presidency of Sir William J. Pope (*cf. Chem. and Ind.*, p. 612, 1923) has now come to hand, we publish the following extract of portions of interest to our readers :—

The Council agreed unanimously to the admission of Brazil to the Union, and it was announced that the International Research Council no longer allows international unions depending on it to admit new countries to its membership unless they belong to the International Research Council. Countries wishing to join must apply to the International Research Council, and state that they desire to adhere to the International Union of Pure and Applied Chemistry.

The Commission on Inorganic Chemical Nomenclature proposed that in future the work be confided to the editors of the *Journal* of the Chemical Society, of *Chemical Abstracts*, of the *Gazzetta Chimica Italiana*, of the *Helvetica Chimica Acta*, of the *Recueil des Travaux Chimiques des Pays-Bas* and of the *Bulletin de la Société Chimique de France*. Each country will communicate suggestions to these publications, so as to lead to the necessary discussion, and when general agreement appears to have been reached, the suggestions should be carried into effect. The Commission does not wish to decide finally what symbols should be used for Glucinium (Gl) or Beryllium (Be), and Niobium (Nb) or Columbium (Cb), and considers that a decision should be arrived at next year after the different countries have been consulted. The Commission is of the opinion that the formulæ of acids, salts and bases can be written so as to conform to the ordinary pronunciation of the respective names in each country, that is to say in Anglo-Saxon languages HCl, H_2SO_4, $BaCl_2$, etc., will be written, whilst in Latin languages ClH, SO_4H_2, SO_4Na_2, Cl_2Ba, will be written ; in the same language only one form will be adopted, *i.e.*, either $ClNa$ or $NaCl$, but not both. The word hydrate will be reserved for compounds containing H_2O, *e.g.*, Cl_2,nH_2O ; $Na_2SO_4, 10\,H_2O$. The word hydroxide will be reserved for compounds containing OH, *e.g.*, $Al(OH)_3$.

The names of the acids listed in the French Report which agree with those in the list in the Danish and American reports are to be adopted and the following acids are added :— Chromic, molybdic, tungstic, manganic and permanganic acids. Names not found in these lists will be subject to further decisions, *i.e.*, hyposulphite or hydrosulphite, pyrosulphuric acid, heptamolybdic acid, etc. Condensed acids such as pyrosulphuric and heptamolybdic acids will be considered later, but the Spanish suggestion might be adopted to designate such acids by the prefix "anhydro" accompanied by a number and followed by the specific name of the acid preceded also by the proper number, *e.g.*, chromic acid H_2CrO_4 ; potassium dianhydro-trichromate, $K_2Cr_3O_{10}$. For certain acids possessing numerous derivatives one name might be adopted, *e.g.*, heptamolybdic acid to indicate solely the hexacid $H_6Mo_7O_{24}$. Acid salts will be named in accordance with the French proposals, *e.g.*, $CaHPO_4$ calcium acid phosphate ; dihydrogen potassium phosphate KH_2PO_4. The method for suggesting the valency expressed in the French report can be adopted by all countries ; this will close the discussions on the terminations *eux, ique, a, o,* etc. The nomenclature of complex compounds requires consideration.

The Commission on the Reform of Organic Chemical Nomenclature enlarged its Executive Committee to include representatives of the same Journals as the Commission on Inorganic Nomenclature, and passed resolutions relating to the method of working. The following proposals were adopted by the Commission on the Reform of Biochemical Nomenclature :— (1) The name of a compound of known constitution should be formed according to the rules of organic chemical nomenclature. The term "glucides" is to be applied to the group including simple reducing sugars and substances which yield one or more of these sugars on hydrolysis. The term "lipoids" is suppressed, but the term "lipides" is applied to a group of substances including fats and esters possessing analogous properties, *e.g.*, lecithins, phosphatins, etc. By "protides" is meant a group of substances including natural amino acids and substances which on hydrolysis yield one or several of these acids.

It was decided by the Commission of the Bureau of Physico-Chemical Standards to enquire from Directors of Research Laboratories which physico-chemical standards were most urgently needed in order to co-ordinate the work of the Bureau. The Commission considers that the Bureau should be asked to collaborate with certain firms which have specialised in the production of pure products and to submit a scheme for carrying this out. The thanks of the Commission were conveyed to the Secretary of the Bureau, Monsieur Timmermans, for his admirable work, and the wish was expressed that he should continue to publish the critical accounts of the physico-chemical constants of organic bodies, a work of very great importance. It was also suggested that the Bureau should collaborate more closely with the Commission on Research Chemicals.

Resolutions proposed by the Commission on Tables of Constants were as follows :—The following countries have given their adhesion to the International Fund established in 1922, viz., Belgium, Denmark, Spain, United States, Great Britain, France, Italy, Norway, Netherlands, Portugal, Switzerland and Czechoslovakia, and the hope was expressed that other countries, whose adhesion was considered as certain, would actually join without delay. The establishment of the international fund, the necessity for which was recognised by the Union in 1922, is required for the very valuable International Annual Tables, which are indispensable for scientific and technical progress. It was hoped that the numerical documentation for the years 1917 to 1922 would be published as soon as possible so that the International Tables of Constants and Numerical Data could soon appear annually. In consequence it is most desirable that the subscription list under the patronage of scientific and industrial circles of participating countries will allow the Committee for the Annual Tables to realise this wish.

The modifications proposed in physico-chemical symbols are as follows :—

1. The title of the second part of the list of symbols should read "General Constants," instead of "Universal Constants."

2. In the third part, line 9, read "Molar fraction" instead of "Mole Fraction."

3. On page 505, fifth part of the list, line 2, suppress the symbol "n" in the column headed "Alternative Symbols."

4. In part 5, line 8, replace $M[\alpha]$ by $[M]$ as the symbol for "Molecular Rotatory Power."

5. Part 5, last line replace $M[\omega]$ by $[\Omega]$ as symbol of the "Molecular Magnetic Rotation."

6. On page 506, third line from bottom, delete the words "Soschmidts Number."

7. On page 509 in the paragraph headed by "Entropy," line 2, delete the words "on the ground that this symbol was used by Willard Gibbs, and also."

8. On page 511 in accordance with general usage, molecular rotatory power is defined by

$$[M] = \frac{M \times [\alpha]}{100}$$

The use of the symbol $[\omega]$ for specific magnetic rotation and $[\Omega]$ for molecular magnetic rotation, is recommended, magnetic molecular rotation being defined by the formula

$$[\Omega] = \frac{M \times [\omega]}{18}$$

These changes should be noted in the alphabetical list on page 507.

The Commission proposes to appoint a Committee to collect suggestions for additions or changes in the list of symbols. This Committee will be presided over by Prof. E. Cohen (Utrecht), and will include Professors Findlay and Marie, and an American member to be nominated by the United States National Research Council.

The Commission on Scientific and Industrial Patents concluded that, as in the Latin countries —all of which grant patents without previous examination—the unification of the legislation appears more immediately possible, these countries should begin to group themselves so as to form a single group with uniform legislation. Considering that one of the first objects to be realised should be to allow scientific men to protect their discoveries and that in addition they cannot carry out researches in secret, but must publish the results of their work as they are obtained, the Commission declares that it is inadmissible that the applicant for, or the owner of, a patent can be opposed on the ground of his own discoveries during a fixed time after their publication. The Commission also considers that scientific discoveries should be given legal protection, a question which will be studied by the Commission. To co-ordinate efforts the president of the Commission has been delegated to attend the Intellectual Co-operation Commission of the League of Nations and the International Chamber of Commerce to put forward the views of the Commission.

In consequence of the decision to increase the number of vice-presidents of the Union to six, the Council nominated Prof. Cohen (Holland) and Prof. Sakurai (Japan) as the two new vice-presidents.

The Conference decided that the Bureau of the Union should set up a Committee to get in touch with the organisations which control the exchange of students and professors between universities in the various countries, in order to co-operate and to bring about exchanges for those concerned with chemistry.

In conclusion, the Council decided that the Fifth International Conference should be held at Copenhagen.

The Report concludes as follows :—

"The foreign delegates will retain an indelible memory of their stay in the old university city, where they were able to appreciate British hospitality at its proper value. Most of them were housed in the colleges or with the professors and thus were able by this contact with English life to appreciate the preponderating part played in the activities of a nation by a university education stamped with the deep and strong traditions of many centuries. The Fourth International Conference was a real success. On leaving Cambridge the delegates paid a hearty tribute to those who had organised the meeting and particularly to Sir William Pope, the president of the British Federal Council for Pure and Applied Chemistry, to Mr. J. E. G. Harris, secretary of the local committee, and to their colleagues, who neglected nothing to provide the foreign delegations with the warmest hospitality."

ANALYTICAL CONTROL IN THE DYESTUFF INDUSTRY *

By T. CALLAN, M.Sc., Ph.D.

Analytical control in the dyestuff industry may be divided under five headings, as follows :

(*a*) Analytical control of the "raw chemical materials as brought into the factory."

(*b*) Analytical control of the "partly-finished or intermediate products," *i.e.*, material passing from process to process, as for instance, a nitro compound ultimately intended to be reduced to an amino compound, which itself might further be diazotised or coupled.

(*c*) Analytical control of "raw materials, such as engineering supplies," *e.g.*, lead, fuels, water supplies, materials for water softening, etc.

(*d*) Analytical control of "finished products."

(*e*) Analytical control of "waste products," such as flue gases, effluents, etc.

Although such a grouping is applicable to practically all chemical factories, some of the smaller ones may not control their affairs to such an extent as set forth, but in view of the fact that dyestuff factories are generally conceived on a fairly large scale, the control of each section becomes of considerable importance.

ANALYTICAL CONTROL OF RAW CHEMICAL PRODUCTS

The number of different substances used in a modern dyestuff factory as raw chemical products is extraordinarily large and covers a large range of both inorganic and organic products. In addition to the considerable number bought, a further large number is manufactured as so-called "intermediate-products." Below are appended a few of the more important substances used as raw products which have to be analysed regularly :—

Inorganic.—Iron for reduction, in the form of borings, zinc dust, sulphur, caustic soda and potash, lime, oleum, sodium bisulphate, sodium sulphite and sulphate, copper sulphate, potassium sulphate, bromine, bromide and bromates, sodium sulphide, hypochlorites, phosgene, nitric acid, nitrates, thionyl chloride, chlorsulphonic acid, lead and lead salts, tin and tin salts, bichromates, etc.

Organic.—Benzene, toluene, xylene, nitrobenzene, anilines, toluidines, xylidines, acids such as benzoic, phthalic, salicylic, chlorbenzoic, chlorbenzene, nitrochlorbenzenes, dinitrochlorbenzene, toluene sulphonchloride, phenols, cresols and their nitro and amido derivatives, etc.

Analytical control of these substances, if they are bought from outside sources, properly commences in the buying department, and thus prevents the purchase of substances of an inferior quality. It is far more important that the purchase of an impure or unsuitable product should be prevented, rather than it should be discovered when the material actually enters the factory with the subsequent arguments and claims against the seller. A very important part of the analyst's business is to draw up such specifications and this, of course, can only be done provided he knows exactly what the material is intended to be used for. Furthermore, it is important that the specification should not be unduly strict, as otherwise the price of the material might be unnecessarily raised in order that it should pass the specification. For instance, benzoic acid might be required for the manufacture of benzoyl chloride ; in this case it would be necessary to insert a very strict qualification as to moisture content, whereas if required for nitrating to nitrobenzoic acid, the moisture content would not be so important and a cheaper article might quite easily suffice.

There is little to say about inorganic substances as the methods employed for their analysis follow the lines laid down in all text books on inorganic analysis.

Text books on organic analysis, however, are comparatively rare and many students gain the impression that organic analysis consists of only determining carbon, hydrogen and nitrogen together with halogen determinations by the Carius bomb-tube method. Many methods of organic analysis really only deal with such things as titres, total organic matter, physical constants and general analytical data as given by technical organic products. Thus the analysis of an oil would mean the determination of the saponification valus, iodine value, specific gravity, etc., and very rarely indeed the actual determination of oleic, linolic and linolenic acids or the isolation and identification of the unsaponifiable matter ; similarly for the analysis of a soap or a tanning material. The organic substances used in the dyestuff industry, on the other hand, are usually "straight" chemical substances and their determination in many cases is just as straight forward as that of inorganic substances. A very considerable number of organic substances, for example, can be determined by simple volumetric processes. The methods of analyses employed can be divided into two classes, viz.:—(*a*) Physical methods. (*b*) Chemical methods involving the determination of a specific group, *e.g.*, nitro, amido, hydroxy, halogen, etc.

Physical methods.—The chief methods found of value involve determination of melting and solidifying points, specific gravity, refractive index, boiling point or, better, the distillation range and heat of reaction. The impurities to be looked for in many substances used for the manufacture of dyestuffs are in many cases isomeric or homologous with the substances itself, so that actual chemical analysis is of little value. In such cases, physical methods only can be employed; *e.g.*, in the analysis of the three nitrotoluenes—*ortho, meta and para*. The only practical way to distinguish these in the presence of each other is to determine the melting or setting point and compare with known mixtures. In many cases the determination of the setting point or crystallising point is preferable to determination of the melting point, particularly in such cases where this value is the chief criterion of purity, as, for instance, in the case of naphthalene, the naphthols, chloracetic acids, phenols and cresols, dinitrochlorbenzene, etc., as the setting point determinations can be made on large quantities of material, say a few pounds, thus eliminating sampling errors. For the determination of "setting points" the method recently introduced by Bell and Hertz of prolonging the cooling curve after the commencement of solidification on to the original cooling curve has given very good results, particularly for substances where the amount of impurity is fairly large. The determination of distillation range, *i.e.*, the temperature interval between the beginning and end of distillation, is usually more important than the actual boiling point, and many substances, such as aniline, monochlorbenzene, are required to have a very narrow distillation range. In a few cases only, however, such as benzaldehyde and carbon disulphide, is the refractive index of much importance as a means of analysis. An interesting example of the use of physical methods is the determination of small amounts of aniline, monomethyl- and monoethylanilines in dimethyl and diethyl-anilines by determining the rise in temperature when definite amounts of the dialkyamine and acetic anhydride are mixed. In the absence of the above-mentioned impurities there is a small actual fall in temperature, but when they are present the heat of acetylation is very considerable and affords quite a reliable measure of the amount present.

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* Lecture delivered before the Evening Students' Chemical Society, College of Technology, Manchester, on February 27, 1923.

Chemical methods.—The chemical methods of analysis employed generally resolve themselves into the determination of some particular group, such as the amino, hydroxyl, sulphonic and halogen groups, and in a very large number of cases these groups can be determined quite readily by simple volumetric methods, and in comparatively few cases by gravimetric methods. With a few volumetric solutions it is possible to determine a very considerable number of organic radicles. As a very considerable number of substances used in the dyestuff industry are aromatic primary amines capable of being diazotised, they can readily be determined by titrating in acid solution with a standard solution of sodium nitrite, the end point being taken when a trace of uncombined nitrous acid is present, as shown by spotting on to starch iodide paper. This reaction is extremely sensitive, and the method is capable in experienced hands of giving very accurate results for a large number of primary amines and their sulphonic acids. Aniline, however, should not be determined by this method, as the end point is uncertain, but is best determined by titrating with standard potassium bromate solution, as will be mentioned later. It is important to determine for each substance the optimum temperature and concentration at which the titration is to be carried out—some substances, *e.g.*, peri acid (naphthylamine 1·8 disulphonic acid), titrate exceedingly slowly with nitrite unless warmed to 35° C., whilst in other cases, particularly Tobias acid (β-naphthylamine-1-sulphonic acid) and Gamma acid, it is impossible to get an accurate result if the concentration of the amino compound exceeds a certain amount, as otherwise the diazo compounds, which in these cases are insoluble substances, drag out of solution some of the undiazotised amino compound. Failure to recognise this fact has more than once led to disputes between different analysts as to the strength of samples of certain of these substances. Those of little experience who are called on to determine the strength of diazotisable amino compounds by means of standard nitrite should first determine the optimum conditions of concentration and temperature on a pure sample of the substance.

Just as a standard solution of sodium nitrite affords a ready means of titration of amino compounds, a standard solution of a diazotised amino compound affords a method of determining many phenolic compounds used as components in the manufacture of azo dyestuffs, *e.g.*, Neville and Winter's acid, H acid, chromotrope acid, etc. Although the preparation of a standard solution of a diazo compound might seem difficult at first sight, it is really quite simple:—a definite amount of a known amino compound (usually alkaline) *p*-nitraniline, *m*-xylidine, *p*-toluidine or *p*-bromoaniline is diazotised in acid solution by the addition of a slight excess of sodium nitrite and the solution made up to a definite volume with ice water. Thus 25 c.c. N/2 aniline diazotised and made up to 250 c.c. would give a N/20 solution of diazobenzene. Although such diazo solutions are usually unstable they will keep quite well if kept in ice water during the comparatively short time the titration occupies. Diazotised *p*-bromoaniline will, however, keep many hours at ordinary temperature without decomposition. Usually in such titrations the temperature is kept constant, namely, at 0° C., by addition of ice, and the chief factors to be considered are the diazo compounds to be used and the degree of alkalinity of the solutions. It is quite possible by chosing suitable diazo solutions to titrate one phenolic substance in the presence of another, as different diazo solutions differ enormously in their reactivity. Thus diazotised *m*-xylidine couples very readily and is a very unstable substance, whilst diazotised *p*-bromoaniline, which is a very stable substance, only couples very slowly.

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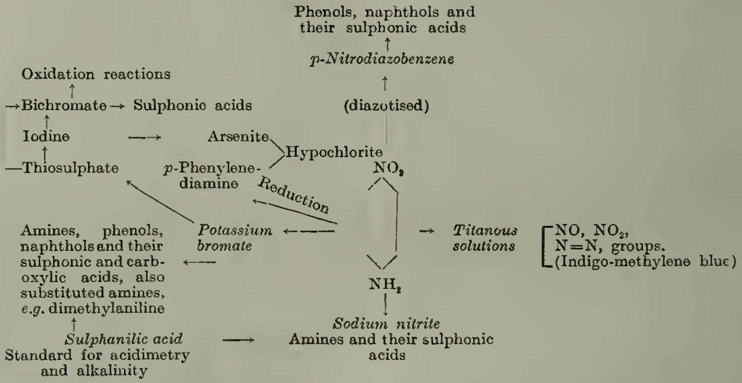
A standard solution of potassium bromate is of particular importance for determining many amines and phenols. When potassium bromate is run into an acid solution of many amines and phenols, the nascent bromine is sufficiently reactive to give immediate and quantitative bromination, and bromate solution can, therefore, be run in until the substance is quantitatively brominated and a slight excess is present as indicated by spotting on to starch-iodide paper. It is important to note that this method affords information as to the orientation of substituting groups, for the bromine always enters the ring in the *ortho* or *para* and never in the *meta* position. Standard potassium bromate affords, therefore, a rapid and accurate method of determining such substances as aniline, toluidines, sulphanilic acid, phenol, resorcinol, etc.


Phenols, naphthols and their sulphonic acids
p-Nitrodiazobenzene
(diazotised)
Oxidation reactions
Bichromate
Sulphonic acids
Iodine
Arsenite
Hypochlorite
Thiosulphate
p-Phenylene-diamine
Reduction
NO₂
Amines, phenols, naphthols and their sulphonic and carboxylic acids, also substituted amines, e.g. dimethylaniline
Potassium bromate
Titanous solutions
NO, NO₂, N=N, groups. (Indigo-methylene blue)
NH₂
Sodium nitrite
Sulphanilic acid
Standard for acidimetry and alkalinity
Amines and their sulphonic acids

Nitro, nitroso and azo groups are usually estimated by Knecht's method of titrating with titanous salts, either the chloride or sulphate. Many nitro compounds which reduce to diazotisable amines can be estimated by reducing with excess of zinc dust in acid solution and subsequently determining the amine so formed by titration with standard sodium nitrite. An interesting method for determining the nitroso group is Clauser's method, in which the nitroso compound dissolved in glacial acetic acid is treated with phenylhydrazine and the solution heated. A rather complicated reaction takes place with the quantitative liberation of gaseous nitrogen, which can be measured in the usual way.

Attention is drawn to the advantages which *p*-nitraniline has as an ultimate standard to which the greater number of the substances previously mentioned can be referred ; it can readily be obtained in a high degree of purity, and affords a most convenient method of standardising various volumetric solutions. The advantages of having a single ultimate standard are obvious. The diagram, which is given above, will show the various substances which can be standardised by its use.

Analytical Control of Engineering Supplies

The analytical control of such materials as lead (which is used very largely in chemical plants), fuels, water supplies and water softening plants, is of considerable importance to the dyestuffs industry. The analyst is also very often called on to advise as to the suitability or otherwise of some "anti-corrosive" metal to be used in chemical plant. This often implies prolonged experiments with the actual liquors which the plant has to handle.

Analytical Control of the Finished Chemical Products

The finished product of a dyestuff factory is, of course, chiefly colour but many colour factories produce certain intermediates in excess of their own requirements and these when sold require the same analytical control as a bought product. In addition certain substances, such as betanapthol, paranitraniline, etc., are sold directly for dyeing purposes, although themselves not dyestuffs. In the case of dyestuffs, chemical analysis is rarely used as a method of standardisation, an actual dye trial being generally preferred, the advantage of this being, of course, that not only strength, but also shade, is determined at the same time. Even for dyestuffs for which exact methods of analysis are available, *e.g.*, methylene blue, indigo, and many azo dyestuffs, chemical standardisation is rarely demanded. Certain dyestuffs, however, are sold primarily for colouring foodstuffs and these are always subjected to very strict analytical control to ensure purity and the absence of such poisonous metals as arsenic and lead. These two substances are invariably present in ordinary commercial dyestuffs, so that colours intended for foodstuffs have consequently to undergo a careful purification treatment and strict analytical control is therefore necessary at every stage.

FORTHCOMING EVENTS

Sept. 10–13. The Institute of Metals. Annual Meeting at Manchester. *Second Annual Autumn Lecture.* "The Use of Non-Ferrous Metals in Engineering," by Lieut.-Col. Sir Henry Fowler, K.B.E., at 8 p.m., Sept. 10. "The Cause of Red Stains on Sheet Brass," by E. A. Bolton. "Note on 'Brinell Hardness Numbers,'" by H. W. Brownsdon. "The Behaviour of Metals under Compressive Stresses," by H. I. Coe. "On the Measurement of the Change of Volume in Metals during Solidification," by Hikozo Endo. "The Electrochemical Character of Corrosion," by U. R. Evans. "The Constitution and Age-Hardening of the Quarternary Alloys of Aluminium, Copper, Magnesium and Magnesium Silicide," by Marie Gayler. "Investigation of the Effects of Impurities on Copper (Part I—The Effect of Oxygen on Copper)," by D. Hanson, C. Maryatt, and G. W. Ford. "Experiments with some Copper Wire; Cohesion a Function of both Temperature and Cold-work," by D. H. Ingall. "The Effect of Small Quantities of Nickel upon High-grade Bearing Metal," by A. H. Mundey and C. C. Bissett. "Stereotyping," by A. H. Mundey and J. Cartland. "Hardness Tests on Crystals of Aluminium," by H. M. O'Neill. "A Dilatometric Study of the Transformations and Thermal Treatment of Light Alloys of Aluminium," by A. M. Portevin and P. Chevenard. "Effects of Rate of Cooling on the Density and Composition of Metals and Alloys," by R. C. Reader. "Crystallisation Effect on Galvanised Iron Sheets," by E. L. Rhead and J. D. Hannah. "Equilibrium in the System Gold-Zinc (based on Investigations of Electrical Conductivity at High Temperatures)," by Prof. P. Soldau. During the meeting the new metallurgical department of Manchester University will be opened by Sir George Beilby.

Sept. 12–19. The British Association for the Advancement of Science. Ninety-first Annual Meeting, to be held at Liverpool. The President, Sir E. Rutherford, F.R.S., in his inaugural address, will deal with "The Electrical Structure of Matter." *Section A.—Mathematics and Physics.* Presidential Address by Prof. J. C. McLennan on "The Origin of Spectra." Discussion with the Chemistry and Engineering Sections on "Cohesion and Molecular Forces." "The Penetrating Radiation from the Upper Air," by Prof. R. A. Millikan; "Energy of the Circulation of the Atmosphere," by Capt. D. Brunt; "Meteorological Effects on Sea Level and Tides," by Dr. A. T. Doodson; "The Production of Triatomic Hydrogen," by G. Stead and Miss B. Trevelyan; "Matter and Radiation," by Sir Oliver Lodge; "Apocoptic Expansions," by T. Smith; "Notes on the Approximate Expansions of Empirical Results," by Prof. H. Levy and H. W. Moore; "Series of Magnetic Disturbances," by Rev. A. L. Cortie; "Some Effects of Alternating Magnetism," by W. M. Morday; "Demonstration of the Frenophone," by S. G. Brown; "The Correspondence Principle," by Prof. N. Bohr; "Remarks on Quantisisation," by Prof. P. Ehrenfest; "The Structure of Atoms and Their Magnetic Properties," by Prof. P. Langevin; "The Effect of Weak Magnetic Fields on the Polarisation of Resonance Radiation," by Prof. R. W. Wood and Dr. A. Ellet; Discussion on 'The Spectra of the Lighter Elements"; "The Magnetic Rotary Dispersion in Certain Paramagnetic Liquids," by R. W. Roberts; "The Angle of Contact: Variation with Relative Motion of Solid and Liquid," by R. Ablett.

Section B.—Chemistry. The following papers are to be read:—(1) "The Formation of Precipitates," by S. Oden; (2) "The Nature and Significance of the Resin of Hevea Rubber," by G. S. Whitby; (3) "The Physical Chemistry of Interfaces," by Prof. F. G. Donnan, F.R.S.; (4) "The Quantum Theory in Chemistry," by Prof. G. N. Lewis; (5) "The Bohr Atom and the Periodic Law," by Dr. N. V. Sidgwick, F.R.S.; (6) "On High Frequency Spectra and the Theory of Atomic Structure," by Dr. D. Coster; (7) "The Activation of Hydrogen in Organic Compounds," by Miss E. H. Usherwood; (8) "Membrane Potentials Considered as Diffusion Potentials," by Dr. E. B. R. Prideaux; (9) "Enzymes," by Dr. E. F. Armstrong, F.R.S.; (10) "The Relation of Certain Enzyme Actions to Tissue Differentiation and Tumour Growth," by Dr. K. G. Falk; (11) "Catalytic Actions in the System Copper, Copper-Oxide, Oxygen, and Gaseous Reducing Agent," by W. G. Palmer; (12) "Alumosilicates," by W. Vernadsky; (13) "The Chemistry of Hafnium," by Dr. G. Hevesy; (14) "The Utilisation of Volcanic Steam," by Senatore Prince Ginori Conti; (15) "The Biochemical Effect of Polarised Light," by Miss E. S. Semmens; (16) "Cotton Wax," by Dr. R. G. Fargher; (17) "The Absorption of Methylene Blue by Cotton," by D. A. Clibbens; (18) The Sulphonation and Nitration of Naphthalene," by Prof. H. E. Fierz.

Sept. 17. The Institution of Rubber Industry, in the Kelvin Room, Engineers' Club, Coventry Street, W., at 8 p.m. "Rubber Floors and Rubber Roadways," by E. J. Edwards.

Sept. 17–18. The Iron and Steel Institute. Autumn Meeting, to be held at Milan, in the Chamber of Commerce, commencing each day at 9.30 a.m. At the conclusion of the meeting visits have been arranged to Florence, Rome, Piombino, Leghorn, Genoa, and Turin.

CORRESPONDENCE

TUBE RAILWAY FIRE RISKS

Sir,—The communication on the above subject, published in *Chemistry and Industry* of August 24, would be amusing were it not for the fact that it levels a serious charge against the "Underground" authorities.

Your correspondent states, referring to the risk of fire in tube railway carriages, that "there is every condition for a serious accident," and in fairness to the authorities I consider this a serious misstatement of the facts.

In the early days of tube railways exhaustive tests were conducted to determine the fire-resisting qualities of the carriages, and in every case it was proved that there was no risk of serious damage by fire. Is your correspondent aware that the materials which he terms "inflammable . . . in a state of dryness calculated to spread fire rapidly" are rendered fire-resisting by chemical treatment? Details of suitable treatment are given in Thorpe's "Dictionary of Applied Chemistry."

In addition to this precaution, fire extinguishers of very effective patterns are placed in conspicuous positions in underground and tube railway carriages ready for immediate use; and the complete absence of fires such as your correspondent fears is sufficient testimony to the efficacy of these precautions.—I am, Sir, etc.,

W. J. Painter

Plaistow, E. 13
August 24, 1923

HAFNIUM OR CELTIUM?

Sir,—You have favoured my remarks with some friendly criticism in your current editorial. Perhaps I may be allowed to amplify slightly, as long correspondences are apt to get tedious.

My chief regret is in seeing the personal element brought so strongly into the sunlight. Prof. Partington and Mr. Holmyard are investigating a question which, along with others, *historians* might well tackle, and one, too, the importance of which is open to a difference of opinion, but it is admitted that different people attach varying degrees of importance and find varying interests in the same subjects: besides theirs is hardly a personal controversy, and at all times an impartial third party review is far more satisfactory and reads infinitely better. Even your own reviewer admits on p. 788 in his last paragraph, "We do not know what decision the International Committee on the Elements will announce, but we think . . .," a decision which will be decided from an International standpoint and by a body to which I take it Messrs. Urbain, Coster, and von Hevesy will acquiesce.

Referring to the announcement in the *Times*, your editorial continues, "but if the proposal . . . leads to the general enforcement of the principle that credit is to be given where credit is due . . ." By all means, but, to put the matter in a nutshell, does it improve the position one jot or tittle to emblazon oneself in diatribe after the results are published, especially as to-day it is possible to obtain access to almost any foreign or home journal with ease and then make use of one's own judgment?—I am, Sir, etc.,

A Hundred-Thousandth of the Chemical Brigade

August 27, 1923

PERSONALIA

It is announced that Prof. A. G. Green, F.R.S., has resigned his position as director of research and chief chemist to the British Dyestuffs Corporation, Ltd., owing, it is stated, "to his dissatisfaction at the lack of technical knowledge on the board of directors, and his belief that the permanent establishment of the dyestuff industry in this country is impossible under these conditions."

The British Research Association for the Woollen and Worsted Trades has awarded research fellowships for 1923-24 to Mr. R. Burgess, B.Sc., to investigate the damage caused by bacteria and fungi to woollen goods and yarns during storage, and to Mr. H. E. Farrar, B.Sc., to investigate the dyeing of wool with acid and mordant colours. Advanced scholarships have been granted to Mr. S. Menza (University of Leeds), Mr. T. N. T. Graham (Scottish Woollen Technical College, Galashiels), and Mr. P. M. Redman and Mr. W. Lee (Bradford Technical College).

Prof. E. Anderson, professor of chemistry in the University of Nebraska has accepted a similar chair in the University of Arizona.

The American Foundrymen's Association has awarded the John A. Penton Gold Medal to Enrique Touceda for his work in the development of the American malleable casting industry, and the John H. Whiting Medal to John H. Hall for his work on special manganese steels.

ACADÉMIE DES SCIENCES

During the meeting held on August 20, Monsieur Lindet communicated a note by Monsieur Piettre describing a process for transforming Cardiff coal into humus. In this process the coal is dissolved in pyridine, then oxidised and reduced, treatment similar to that employed in converting benzene into aniline. Prof. Le Chatelier transmitted a note by Monsieur A. Charrion on the absorption of sodium thiosulphate by photographic paper, showing that the best method of completely eliminating sodium thiosulphate from photographic papers and plates, is to wash with solutions of sodium or ammonium bicarbonate instead of pure water, the action taking place rapidly and completely eliminating all trace of thiosulphate.

NEWS AND NOTES

UNITED STATES

The Dye Industry

The census of dyes and other synthetic organic chemicals prepared by the United States Tariff Commission shows that the domestic production of dyes in 1922 by 87 firms was 64,632,187 lb., an increase of 66 per cent. compared with 1921. The sales for 1922 totalled 69,107,105 lb. valued at $41,463,790. The importance of the industry in 1922 is in sharp contrast with that of 1914, when only seven firms manufactured a total of 6,619,729 lb. valued at $2,470,096. The increase in production in 1922 is largely due to an increase in general business activity. In June the textile and other dye-consuming industries became more active and during the remaining months of the year the demand for dyes steadily increased. One of the conspicuous developments of the year 1922 was the increased production of vat and alizarin dyes. The total production of vat dyes (not including indigo) was 1,075,992 lb. (345,152 lb. in 1921), and that of anthraquinone dyes, including alizarin dyes and a large part of the vat dyes, was 1,234,963 lb. Many important dyes were produced for the first time on a commercial scale, comprising vat dyes, alizarin, developed cotton dyes, mordant and acid dyes. The increased production of these colours, which has resulted only after large expenditures on research and most painstaking investigations, is reflected in a reduction of the corresponding imports.

The United States produces 93·55 per cent. of its requirements in dyes. Imports in 1922 totalled 3,982,631 lb., the output was 64,632,187 lb., and the exports amounted to 6,956,593 lb., so that the consumption was 61,658,225 lb. The output of dyes in 1922 grouped by classes according to their method of application was as follows :—Acid, 9,380,014 lb.; basic, 2,937,585 lb.; direct cotton, 11,931,737 lb.; lake and spirit-soluble, 1,009,512 lb.; mordant and chrome, 3,749,701 lb.; sulphur, 16,913,767 lb.; vat (not including indigo), 1,075,992 lb.; indigo, 15,850,752 lb.; unclassified dyes, 1,283,127 lb. The total output of dyes and other finished coal-tar chemicals by 164 firms was 88,368,131 lb., compared with 51,457,565 lb. by 147 firms in 1921, which represents a 72 per cent. increase of coal-tar products; colour lakes, 10,578,664 lb., were produced by 43 firms; photographic chemicals, 345,798 lb. by 7 firms; synthetic medicinals, 2,946,347 lb.; perfumes, 793,148 lb. by 17 firms; flavours, 1,215,668 lb. by 20 firms; synthetic phenolic resins, 5,944,133 lb. by 5 firms; and synthetic tanning materials, 1,910,519 lb. by 4 firms. There was a large increase in the production of tricresyl phosphate, which is used as a substitute for camphor.

Preliminary figures of the Geological Survey indicate that the production of coal tar and by-products from the by-products coke industry during the year 1922 was the greatest in the history of the industry.

Conspicuous progress has been made within the past few years in the development and manufacture of synthetic organic chemicals not of coal-tar origin. These include many chemicals used in industrial and other processes, and the field holds high promise of further expansion. The production of synthetic organic chemicals, other than those derived from coal tar, was 79,202,155 lb., during 1922 (21,545,186 lb. in 1921).—(*Chem. & Met. Eng., July* 9, 1923.)

New Use for Dyes

In an interesting article in *Industrial and Engineering Chemistry* (August 23), Mr. P. A. Kober describes a reliable method for controlling temperatures in heating processes which consists in applying a liquid dye to the heated product, the disappearance of or change in colour indicating that the part to which the colour has been applied has received a definite amount of heat. Many dyes break down readily on heating, a large proportion of those found suitable belonging to the triphenylmethane group of colours. Amongst possible applications, the method may be used in controlling the annealing of glass or the baking of cements or other mixtures, and to indicate over-heating in parts of electrical instruments. A further development consists in using two dyes to indicate when the heat applied has passed a maximum as well as a minimum temperature limit. The following dyes, in certain proportions, act as good double indicators : Chemco Blue and Chemco Red; C.P. 196 Malachite Green; Malachite Green and Rubine Red; Erythrosin and Neptune Blue.

Casein Output in 1922

During 1922, 74 factories produced 6,907,000 lb. of casein from skimmed milk. During the first quarter of 1923, 92 factories produced 2,037,000 lb. compared with 1,166,000 lb. from 64 factories during the same quarter in 1922. It thus appears that the production, both total and per factory, has increased by nearly 50 per cent.—(*Oil, Paint and Drug Rep., Aug.* 6, 1923).

A New Source of Cantharidin

Recent investigations by officials of the United States Bureau of Chemistry have shown that the blistering principle of *Cantharis vesicatoria* can also be obtained from an American beetle of the species *Macrobasis albida*, which occurs abundantly in Texas, Kansas and the adjoining States. The Spanish beetle yields less than 1 per cent. cantharidin, and the Chinese beetle 1·2 per cent., quantities which are equalled, if not surpassed by the American beetle. It is not yet known, however, whether commercial extraction from the American species is possible.—(*Oil, Paint and Drug Rep., Aug.* 6, 1923).

FRANCE

The Wood Industry

An exhibition illustrating the various technical applications of wood will be held in Lyon from October 6 to 21, and lectures will be delivered showing recent progress in the mechanical working of wood, in the paper industry, and in the chemical industries using wood as a raw material.

Congress for the Fishing Industry

The Eighth Congress for Maritime Industries and Fishing will be held in Boulogne from September 9 to 16, when numerous biological papers will be read and attention will be devoted to the utilisation and preservation of fishery products, methods of cold-storage, the marine chemical industries (*e.g.*, marine salt, iodine, soda, etc.), the utilisation of fishery by-products (fertilisers, fish-meal, oil, glue, etc.), the hydrogenation of marine animal oil, etc.

The Output of Dyestuffs

The progress made by the French dye industry is shown by the following figures indicating the output of the factories included under the Union Syndicale des Fabricants de Matières Colorantes en France during recent years :—1916, 463,344 kg. ; 1917, 961,579 kg. ; 1918, 759,771 kg. ; 1919, 2,316,388 kg. ; 1920, 6,517,401 kg. ; 1921, 5,288,016 kg. ; 1922, 7,481,347 kg. This increase has taken place mainly in the production of the commoner dyestuffs and of a few of the more expensive types, but new dyes are regularly being manufactured and put on the market.

Petroleum

Before commencing the summer vacation the Chamber of Deputies began to discuss the Government Bill for the institution of the "Office national des pétroles," which would be entrusted with the task of encouraging petroleum exploration in France and the Colonies, supervising exploitation and the training of petroleum technologists, and assisting in the formation of a fleet of oil tankers capable of supplying France with 900,000 tons of oil annually. Funds for this would be provided by the import tax of 10 fr. per m.t. of petroleum and from the 100 million fr. accumulated by the consortium of petroleum importers. Actual stocks in France total 100,000 t. of petroleum and 206,000 t. of petrol, so that the importation in 1922 consisted of : Lubricating oil 265,650 t., residues 127,324 t., paraffin 323,145 t., petrol 869,364 t., a total of 1,600,000 t. The Minister of Commerce has allocated 500,000 fr. to assist petroleum exploration in Madagascar. Already a deposit has been discovered that covers 200 sq. kilometres in the Ranobé region, and is estimated to contain a milliard metric tons of sand saturated with oil, each ton of sand yielding roughly 1 hectolitre of crude containing 26·7 per cent. of petrol and 24 per cent. of petroleum.

SOUTH AFRICA

The Sugar Crop of 1922–23

According to the *South African Sugar Journal* (May 20, 1923), the 1922–23 season's sugar crop in South Africa was 158,221 tons, as compared with 155,194 t. for the previous season. Up to the end of February, 1923, 15,831 t. had been imported (mostly from Mozambique), as compared with 16,506 t. for the previous season. Between March 1 and April 30, a further importation was made, levelling up the figures to those of the previous season. In the 1922–23 season, 33,754 t. was exported overseas as against 34,515 t. for 1921–22. No stocks were carried over in the past season, whereas in 1921–22, 6379 t. were carried over. The net consumption is stated to be 144,376 t., an increase of 42,198 t. over the previous year. The new season promises well, and it is anticipated that there will be a record crop of from 180,000 to 200,000 t. of sugar.—(*Ind. Tr. J., July* 26, 1923.)

GERMANY

Prices of Chemicals in 1923

The prices of German chemicals increased during January to February, 1923, by 126·5 per cent. to 7535 times their pre-war figure, thus exceeding the wholesale index figure (5585) and that of the dollar exchange (6650). These increases brought them into line with the prices of raw materials, for which the index figure stood at 7971. According to the dollar exchange chemical prices stood in February at a gold level of 114.

Heating and Ventilation Congress, Berlin, 1923

In connection with the 25th meeting of the "Verband des Zentralheizungsindustrie," to be held in September, 1923, in Berlin, a congress will be held on heating and ventilation. The organisation of this congress is in the hands of Oberr-Rat v. Boehmer, Berlin—Lichterfelde—West, Hans Sachs-Str., 3, and E. Purschian, Berlin W.9, Konigin-Augusta-Str., 7.

Heating in the Glass Industry

The recent report of the "Wärmetechnischen Beratungsstelle der deutschen Glasindustrie" shows that the Institute has devoted its second year to the classification of heating methods in the glass industry. Previous observation had shown that special attention was paid to the Institute's publications which also treated of the costs of labour, methods, etc. Researches by engineers have shown that many plants are run below the maximum efficiency. The equivalent quantities of various fuels used in the production of glass are given. For example, for the production of 1 kg. of table-glass 2·00-2·15 kg. of coal, 2·90-3·15 kg. of lignite briquettes, 4·00-4·30 kg. of peat or wood, and 6·10-6·60 kg. of lignite are required.

The Coal Industry

In Germany, lignite is produced in three regions, each controlled by a syndicate, the Central German, with headquarters at Leipzig, the Rhenish (Cologne), and the Eastern Elbe (Berlin). The output from the three areas amounted in 1922 to 53·5 million tons, 34·8 mill. t., and 33·8 mill. t. respectively, showing increases of 64·16, 55·68, and 43·44 per cent. respectively over the pre-war figures. The following table shows the production of coal in the occupied areas in millions of tons and as percentages of the total output for the whole of Germany within its present boundaries.

	1922			1913	
	Million tons	Per cent.		Million tons	Per cent.
Saar	11·2	8·6	..	13·2	8·6
Rest of originally occupied area ..	6·0	4·6	..	7·0	4·5
Ruhr	92·6	71·1	..	110·4	71·6
Total, occupied areas	109·8	84·3	..	130·6	84·7
Total, German Empire	130·3	—	..	154·1	—

About one-third of the total coal output of the Ruhr is converted into coke. In 1922 78·2 per cent. of the coke made in Germany was produced in this area. The originally occupied zone is an important lignite area, producing 37,346,000 t. in 1922, or 27·3 per cent of the German total. Assuming that lignite has two-ninths of the calorific value of coal and converting the production accordingly, the output of coal in the German Empire, within its present limits, becomes 161 mill. t. for 1922, as against 174 mill. t. in 1913. The following table shows the combined production of coal and lignite in the occupied areas:—

	1922			1913	
	Million tons	Per cent.		Million tons	Per cent.
Saar	11·2	7·0	..	13·2	7·5
Rest of originally occupied area ..	14·3	8·9	..	11·5	6·6
Ruhr	92·6	57·6	..	110·4	63·4
Total	118·1	73·5	..	135·1	77·5

Thus, about three-quarters of the German fuel reserves are in the occupied areas. The coal and coke reparations deliveries, principally derived from the Ruhr district, amounted in 1920 to 15·6 mill. t. in 1921 to 18·2 mill. t., and from Jan.–Nov., 1922, to 17·0 mill. t.

The following table shows Germany's position among European coal-producing countries :—

Country	1913 Million tons		1922 Million tons
German Empire[1]	140·9	..	119·1
Saar	13·2	..	11·2
France[2]	43·8	..	31·2
Belgium	22·8	..	21·3
Poland[3]	40·5	..	36·4
Czechoslovakia	12·7	..	—
Great Britain and Ireland ..	292·0	..	255·9
Rest of Europe	44·1	..	—

[1] Present boundaries, excluding Saar region.
[2] Including Lorraine.
[3] Including Eastern Upper Silesia.

GENERAL

The Fauser Process for Fixing Nitrogen.

As the process of nitrogen fixation devised by G. Fauser has recently been applied on an industrial scale by the Società Elettrochimica Novarese at Novara (Italy), a brief description will be of interest.

Hydrogen required for the synthesis of ammonia is obtained electrolytically, a special device being used to avoid danger of explosion, (*cf.* J., 1923, 601 A.) The electrolytic cells require 6000 amps. and a potential difference of 2·4 volts, the current consumption being 6 kw.-hrs. per cb. metre of hydrogen, which is produced at the rate of 6000 cb.m. per day, and is over 99 per cent. pure. The ammonia-synthesis plant has a capacity of 1800 kg. per day and ranks in type between the Claude, Casale and Haber processes, but most resembles the Haber process. The gases are sent over the catalyst at a pressure of 300 atmospheres (200 in the Haber process), which facilitates partial liquefaction of the ammonia in the anhydrous state. Uncondensed ammonia is absorbed by water used to lubricate the compresser, thus dispensing with the need for high-pressure pumps. The dissolved ammonia is recovered by passing through a heat exchanger warmed by gas coming from the reaction chamber. In addition the condenser column is utilised for the absorption of the ammonia. Attached to the ammonia-synthesis plant is a Frank and Caro apparatus which yields 10 tons of nitric acid (36° Bé) per day. The oxidation apparatus is provided with a means for recovering the residual gases, which contain much nitrogen and a little oxygen and are mixed with a calculated volume of hydrogen and passed over platinised asbestos to remove the oxygen as water, leaving almost pure nitrogen for use in synthesising the ammonia. This method of preparing pure nitrogen without having recourse to liquefaction appears to be very economical. It is reported that the consumption of direct current per kg. of nitrogen produced as ammonia is 17 kw.-hrs., 19 kw.-hrs. being required for the production of 1 kg. of nitrogen in the form of nitric acid.

The World's Output of Salt

According to *Commerce Monthly*, the world's production of salt in 1920 was about 18,700,000 tons, compared with approximately 17,200,000 gross t. before the war. Whereas the output of the United States has increased from 4,300,000 t. in 1913 to 6,107,000 t. in 1920, that of the United Kingdom declined from 2,248,000 to 2,158,000 t. during the same period. The output for other countries was as follows, the figures for 1913 being given in parenthesis :—Russia, 539,000 (1,910,000) ; Germany, 2,887,000 (1,888,000) ; France, 1,230,000 (1,262,000) ; Japan, 580,000 (610,000) ; Austria, 79,000 (Austria-Hungary, 585,000) ; Spain, 974,000 (59,000) India produced 1,764,000 t. in 1919, compared with 1,299,000 t. in 1913.

REVIEWS

THE PHASE RULE AND ITS APPLICATIONS. *By* PROF. A. FINDLAY, M.A., Ph.D. *Fifth edition. Pp. xvi+*298. *London; Longmans, Green & Co.*, 1923. *Price* 10*s.* 6*d.*

The new edition of Prof. Findlay's instructive book contains a considerable amount of new matter. Multi-component systems have received further attention, and the section on iron-carbon alloys has been revised for the second, but not, we suspect, for the last, time. The sections on sulphur and phosphorus have been rewritten, and an interesting study has been included of the conditions of formation of calcium aluminium silicates. These additions undoubtedly increase the value of the book.

The appearance of a fifth edition of a textbook of this nature in itself renders unnecessary the praise of a reviewer, and discounts his criticisms. Yet perhaps a few general remarks may not be out of place, from one who remembers, as a student, reading the first edition with great interest and pleasure.

Professor Findlay's book is a general introduction to the study of heterogeneous chemical equilibria. The phase rule is only one of the guiding principles which can be brought to bear on such problems. It is, itself, a generalisation of commonsense principles which were applied to specific problems long before the phase rule was enunciated. For some reason, difficult to appreciate after the lapse of years, its discoverer succeeded in concealing this simply derivable rule in a forest of mathematics. Its subsequent rescue and adoption by Roozeboom had, therefore, a certain element of romance; and the romance has succeeded in clinging to this day. The phase rule is still "trotted out" as a kind of infant prodigy; we are called upon to admire the variety of its performances, and its strict adherence to the truth; and more books and lectures have been named after it than after any single important theorem in physics or chemistry.

These somewhat flippant remarks are made deliberately, since the average student, much though he may learn from Prof. Findlay's and other books on the subject, is often left a little puzzled in the end as to the real value, and the limitations, of the phase rule in the study of heterogeneous equilibrium. Indeed, in spite of its title, a large portion of Prof. Findlay's book owes little of its value to the application of the phase rule. In the interpretation of experiments on heterogeneous equilibria, the phase rule does not carry one far without the help of other considerations such as Le Chatelier's theorem, which is simply another application of the second law of thermodynamics. Clear writer though Prof. Findlay is, he is not always quite clear on this point. For example, early in the introductory chapter we find these words: "What are the *conditions* under which these two forms (of sulphur) can exist in contact with liquid either singly or together, and under what conditions can the two solid forms exist together without the presence of liquid sulphur? To these questions an answer can also be given with the help of the phase rule." Now, the phase rule allows one to deduce that it is feasible that each of the systems rhombic sulphur-liquid; monoclinic sulphur-liquid; rhombic-monoclinic; can exist in stable equilibrium at a series of temperatures and pressures; and that the system rhombic-monoclinic-liquid may exist in stable equilibrium at one pressure and temperature. The phase rule does not enable us to predict, for example, that rhombic and monoclinic sulphur can in fact exist together in stable equilibrium with the liquid phase; all it says is, that if they so exist, then it is only at one temperature and one pressure. Again, in Chapter XII., where the author summarises the application of the phase rule to systems of two components, it is stated that "The interest and importance of investigations into the conditions of equilibrium between two substances, lie in the determination, not only of the conditions for the stable existence of the participating substances, but also of whether or not chemical action takes place between these two components; and if combination occurs, in the determination of the nature of the compounds formed, and the range of their existence. In all such investigations the phase rule becomes of conspicuous value on account of the fact that its principles afford, as it were, a touchstone by which the character of the system can be determined, and that from the form of the equilibrium curves obtained, conclusions can be drawn as to the nature of the interaction between the substances." Now, is not this somewhat misleading to the student? Take the case of two components, A and B, which form a discontinuous series of mixed crystals so that all liquid mixtures of A into B have freezing points higher than A, and the freezing-point curve shows a definite discontinuity at one point (Fig. 56). What does the phase rule teach in this case as to the nature of the interaction between A and B? Surely nothing at all. It would be quite consistent with the phase rule by itself to say that such a curve should represent the normal freezing point curve of two components which form neither a compound nor mixed crystals. Other principles show that in such a case the freezing point of each component must be lowered by the addition of the other, and, therefore, that the temperature at which the two can exist in stable equilibrium with a liquid phase must be lower than the freezing points of either pure component (Fig. 67, I). None of the typical curves given in Chapter XII. can be interpreted in the light of the phase rule alone; on the other hand, they can all be interpreted with the help of other principles, the phase rule supplying a useful check on the accuracy of the interpretations.

As one further example of some ambiguity in the application of the phase rule may be chosen the much-discussed equilibrium between hydrogen and palladium (p. 141). The discussion on the interpretation of the curves obtained by Roozeboom and Hörtzema has to a large extent centred round the theories (1) that a definite compound is formed, (2) that two solid solutions are formed. Now, if the curves represent true equilibrium, the phase rule leads to only one conclusion—namely, that under the experimental conditions two solid phases are never present together. The formation of two solid phases must, therefore, be ruled out altogether. Whether the results are consistent with the formation of a compound which forms a completely homogeneous mixture with the remaining solid phase, rests on other considerations. Why, then, is "the assumption of the formation of two solid solutions more satisfactory than that of the formation of a compound" though "it does not entirely explain the facts"? The phase rule categorically denies the former, but not the latter.

In view of the importance of the application of other considerations based on the second law of thermodynamics in the interpretation and prediction of heterogeneous equilibria, it would seem advisable, even in an introductory textbook, to lay more stress on the quantitative nature of the phenomena observed. Prof. Findlay avoids this, presumably because it is liable to introduce mathematics; but is it reasonable to assume that the modern student of physical chemistry knows no mathematics? Something may be gained with little recourse to mathematics. For instance, if two components tend to form a compound—*i.e.*, if the molecular attraction between A and B is greater than that between individual A molecules, then the vapour pressures of the mixtures at constant temperature will tend to be lower than in the "ideal" state, whilst the effect of B in lowering the freezing point of A will be greater. If the two components tend to separate, the reverse relations hold. Two figures (70 and 72) given in the book afford an example of this. Toluidine forms a compound with phenol, but none with *o*-nitrophenol; consequently, we find that the influence of phenol in lowering the melting point of toluidine is greater than that of an equal molecular proportion of *o*-nitrophenol, as may be seen by superposing the curves. The intimate relation between vapour pressure and freezing curves of mixtures is very instructive, but is seldom brought out. It is a useful and simple exercise for a student to measure the effect of the addition of alcohol and of alcohol containing a little water, on the freezing point of benzene down to say 0° C., and to deduce what he can from the results as to the general behaviour of mixtures of benzene and aqueous alcohol (*a*) in the light of the phase rule, (*b*) in the light of other considerations. Such an exercise would serve to illustrate the above remarks, and has a further merit of being of some technical importance.

The views expressed above have been called forth by re-reading Prof. Findlay's book. They must not, of course, be taken as a general criticism of the book. On the contrary the book has been and will continue to be of the greatest value in the teaching of the subject. The fifth edition is even more interesting than the previous editions, and the author has evidently devoted much care in bringing it up to date.

H. T. Tizard

Mémoires et Rapports sur les Matières Grasses. Congress de la Production Coloniale de l'Exposition Coloniale de Marseille, 1922. *Vol. I. Pp.* 476. *Vol. II. Pp.* 211. *Marseille: Institut Colonial,* 1922.

The struggle for an adequate and continuous supply of raw materials is a feature of modern commerce, and the insistent demands of the rapidly multiplying population of most civilised countries have led to an increasing scarcity of many commodities, not the least important of which are oils and fats. The encroachment of the manufacturer of fatty foods upon supplies formerly available as soap fats and paint oils has not been checked nor has increased demand been overcome by extended production. The greatest consumption of oil and fat products is amongst the crowded industrial populations of the temperate zones, whilst the chief source of these materials is the sparsely populated forest regions bordering on the Equator.

Most of these tropical supplies are of purely native production, which is notoriously wasteful both of labour and material. Many efforts have been made to improve these conditions, and quite considerable sums, both of public and private moneys, have been spent for the purpose of increasing output and improving quality. It cannot be said yet that success has attended these efforts, but sufficient has been learned to indicate that such success can be attained, and that the problems which have to be faced in arriving at these ends are not incapable of solution. It is also true that even the slight progress that has been made has been hindered by lack of knowledge of work that already has been done, and much duplication of labour and vain experimenting would have been saved if some form of record, which necessarily if it were to be complete would be almost international in character, had been adopted. A number of monographs have been published in English, French and German dealing with the cultivation of the West African oil palm and the preparation of oil from its fruits, and to a lesser extent this has also been done for the coconut palm. Such publications, however, only serve to show how meagre is our information and how much yet remains to be done before we can be said to have arrived at even a reasonable approximation to an economic ideal. This absence of assembled records has been very considerably ameliorated by the publication of the above "Mémoires et Rapports," and the Colonial Institute of Marseilles is to be congratulated on the publication of two volumes which are quite unique in their character and full of just such assembled information as has been so greatly lacking before. The matter contained in these volumes was delivered to the Oils and Fats section of the Congress of Colonial Production held at Marseilles last year, and presents authoritative statements as to the present position and future prospects of the oil-seed and oil industry throughout the whole of the French Colonies.

The earlier portion of Vol. I is taken up with a statement of the French Government proposal to establish a large experimental station at M'Bambey, in Senegal, to investigate the cultivation of arachis nuts; and two similar stations, one in the Ivory Coast and the other in Dahomey, to study the cultivation of the oil palm and the manufacture of oil from its fruit. It has been proposed by the French Government to use for the establishment of these stations the profits, amounting to over 8,500,000 fr., which accrued during the war to the Oils and Fats Consortium. The plans for these stations, which are both extensive and elaborate, have been set out in considerable detail, both as to land, equipment, and personnel. The Colonial Institute of Marseilles, through the person of its secretary, Monsieur Baillaud, offers the serious criticism of these plans that they are too extensive for the purpose in view, especially at the beginning of the research, and that the elaborate nature of the station equipment, besides absorbing a large proportion of the Consortium profits, practically reduces the experimental work to a trial of mechanical appliances, forgetting the fact that most of the oil-bearing seeds must necessarily be produced by the cheap labour of natives on their own farms. It is pointed out that in the French Colonies large estate production, financed by home capital and carried out under white management, is developed to a much less extent than in British or Dutch Colonies, although even there such methods of production are only in their infancy, if exception be made of copra production in Ceylon and Malaya, and of the rapid extension of plantations for the production of the West African oil palm in Eastern Sumatra. It is suggested, and with justification, that a much better system would be to copy as far as possible the methods so satisfactorily adopted in Java for similar purposes, in which the planters are associated with the Government in supporting stations for research work carried out on a comparatively small scale, improvements being afterwards translated to the estates under the joint supervision of the station experts and the estate owners.

It is impossible to enter into a detailed criticism of the remainder of the contents of these two volumes, which consist largely of statistics of production and present-day methods of cultivating such oil-bearing fruits and seeds as the olive, linseed, coconut, arachis, sesame, castor, soya, etc. The diseases to which the plants are subject are fully detailed, as also the various forms of insect attack and the best methods of countering them. In certain cases methods of oil manufacture are also described, and even the working up of waste products is in many cases discussed. These statements are evidently made by men familiar with the conditions of the country about whose productions they write and are the more authoritative in consequence.

Not the least valuable portion of the work is the very complete bibliography of recent publications on the production of oil-bearing materials and their products. This bibliography is not confined to French Colonial products only, but its sixty pages form a complete record of the most notable publications on the world's production of these valuable articles of commerce.

The volumes under review constitute one of the most valuable additions to literature of this kind which have been made of recent years.

John Allan

Monographien aus dem Gebiete der Fett Chemie. *Vol. II.*, Glue and Gelatin. *By* Dr. R. Kissling-Bremen. *Pp.* 214. *Stuttgart: Wissenschaftliche Verlagsgesellschaft m.b.H.*, 1923. *Price* 6*s*. 5*d*.

The first things that one notices about this book are the poor quality of the paper used and the apology for binding. More than half of the pages are loose, and it is difficult to read the book without losing some of them. After this, having heard so often that German writers only give references to the work of German chemists, one is curious to see whether it is so in this case. One finds that here, at any rate, chemists of other nationalities are referred to fairly.

The book contains 207 pages and an index. It deals with glue and gelatin under the following headings :—(1) Their chemistry and properties. (2) Raw materials and their preliminary treatment. (3) The preparation of glue and gelatin. (4) Applications of glue and gelatin. (5) The valuation of glue, gelatin, by products and raw materials.

Only 18 pages are devoted to the chemistry and physics of collagen, glutin, gelatin and glue. Of the remainder, 107 are devoted to the manufacture of glue and gelatin, 39 to their application, and the remainder to analytical methods. It will be seen, therefore, that the book forms a strong contrast to those of Bogue and Alexander ; in fact, it may be said that it forms an excellent supplement to them. The details of manufacture are dealt with very ably. The principles of washing are fully described, and the author emphasises their great importance. Thus, in describing the preliminary treatment of skins, he insists upon the necessity of cutting them into small pieces to ensure proper penetration of the liquors. This is generally omitted by English manufacturers on account of the extra cost with the result that clarification becomes difficult owing to residual mucins and lime. Later, in speaking of clarification, the author again emphasises the point that goods treated properly in the preliminary processes require very little clarification. If liquors are difficult to clarify, it is really an admission of faulty methods. The degreasing process is dealt with fully, and the choice of solvents discussed. Three different types of German extractors are described and clear diagrams are given.

Twenty pages are devoted to the extraction of bones and skins. The effects of temperature and pressure are discussed from a common-sense point of view. A full account of the method of working of a battery of extractors is given, again illustrated by good diagrams. Lenz is quoted as an authority for the statement that bone-glue liquors can be heated to a temperature of 130° C. without hydrolysis, though later on the author states the contrary, but regards it rather as a dilemma, for if one wants the best separation of fat one must use a high temperature and risk the danger to the glutin, whilst if a lower temperature is employed the gelatin is better, but the separation of the fat incomplete ; but this does not, of course, refer to degreased bones. Several types of evaporators, including Kestner's, are described, and ten pages are devoted to drying.

In the section devoted to the applications of glue and gelatin a large collection of formulæ, mostly patented, is given. The numerous references to patent processes is a feature of the book. But, in dealing with these, not only does the author give details but explains, in many cases, the chemistry of the principles involved. In others he condemns the chemistry as unsound, and sometimes makes sarcastic criticisms which are quite pertinent. Thus in dealing with one patent where the description is particularly obscure he interjects : "Herr! dunkel ist der Rede Sinn." The last part of the book dealing with analytical process is rather deficient in detail. It is not much more than a survey of the various processes which have been proposed and many of the more modern methods are omitted, but a good description of a German method of determining the breaking strength of glued joints is given.

The book reminds one of Davidowsky's rewritten and brought up to date. It will appeal chiefly to a different type of reader from those of Bogue and Alexander, but to him it will be more useful.

S. R. Trotman

Monographien aus dem Gebiete der Fett-Chemie. *By* Dr. K. H. Bauer. *Vol. III.* Die Oele und Fette in der Textilindustrie. *By* Prof. Herbig. *Pp.* 302. *Stuttgart : Wissenschaftliche Verlagsgesellschaft m.b.H.*, 1923. *Price* 6*s*. 5*d*.

The volume under review represents a great advance on similar books dealing with oils, fats and their products for textile purposes. Chapter A deals with fats, oils and waxes. The text gives briefly the constants for analytical purposes, and in most cases the components that have been recognised in the different oils. This is followed by methods of extraction, commercial classification, application, adulteration and examination. In the methods of extraction, the use of solvents other than carbon disulphide is not mentioned, and in future editions it would be an advantage to the textile chemist if the harmful adulterants were indicated a little more prominently. Tea-seed oil, which has been largely used in the textile industry, is not referred to, nor is any reference made to olive oil substitute which has been produced by partial hydrogenation of certain vegetable and marine oils. In the section dealing with waxes, paraffin wax is only mentioned as an adulterant in spite of the fact that it is very largely used in this branch of industry. Chapter B deals very well indeed with the analytical examination of oils and fats. Chapters C and D give a brief description of the production of textile soaps and washing agents and their laboratory examination. This chapter, although brief, contains valuable information for the textile technologist. The recipes given are probably used in Germany, but it is doubtful whether they would be accepted by the majority of users in this country. Most probably this is due to the different methods of working in the two countries.

Chapter E is divided into two parts : A dealing with oils for woollens and worsteds and the analysis of oil emulsions ; B with the preparation, properties, constitution and application of sulphated oils. Chapter F deals with the laboratory examination of sulphated oils and similar products. The book is well supplied with references to original communications or to abstracts of these, and gives a comparatively up-to-date account of most work that is of interest to the textile chemist. The book can be thoroughly recommended to the student and the textile technologist.

L. L. Lloyd

Errata.—On page 812 of the issue for August 24, col. 1, 7 lines from the bottom, read " optimal " for " optional," and on p. 818. under " Eucalyptus oil as a motor fuel," for " eucalyptus oil alone, 28 miles per gall." read " eucalyptus oil alone, 36 miles per gall."

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Aug.* 23)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Brass goods	235
Belgium	Shellac, chemical products	220
Brazil	Tyres, heavy chemicals	236
"	Drugs, chemicals	237
British India	Steel	*
British West Indies	Paint, varnish	216
Canada	Cast iron pipe	217
"	" " (tender)	11942 & 11961 /E.D./E.C.
Greece	Sugar	221
Italy	Metals and alloys, phosphorbronze	222
Netherlands	Artificial leather, leather cloth	225
Sweden	Leather	229
United States	Copper cable	233

* Director General, India Store Dept., Branch No. 10, Belvedere Road, London, S.E. 1.

TARIFF CUSTOMS EXCISE

Australia.—Imports of caustic soda from Great Britain and of calcium carbide from Jugoslavia are liable to dumping duty, whilst steel from Czechoslovakia and electric immersion heaters from Germany are exempt.

French West Indies.—The duty on heavy oils, residues of petroleum and other mineral oils has been reduced to 10 centimes per 100 kg.

Gold Coast.—Perfumed spirits will be admitted under the rating for duty at 15s. per imperial gallon.

Italy.—An export licence will be required for cinders of zinc, scrap tin and cinders of tin, and for sugar.

Norway.—A stamp tax has been levied on sugar goods.

SAFEGUARDING OF INDUSTRIES ACT, PART I

The Referee has concluded that there is no evidence that Rochelle salt has been wrongly included in the list of articles dutiable under Part 1 of the Act, and therefore decides that the complaint which has recently been heard fails.

COMPANY NEWS

B. Laporte, Ltd.

The report for the year ended June 30 shows a net profit of £20,714, as compared with £17,586 for the preceding year, £3975 being brought forward. It is proposed to write £441 off goodwill account, to transfer £2000 (against £1000) to bad debts reserve, and to pay a dividend at the rate of 11 per cent. (10 per cent.) per annum on the ordinary shares, less tax. A balance of £10,038 was brought forward, £5847, recovered in respect of E.P.D., was placed to taxes suspense account, which, after deducting payments for income tax and corporation profits tax, shows a balance of £10,547. Altogether £17,933 was spent during the year on additional plant and buildings.

United Indigo and Chemical Co., Ltd.

It is proposed to pay dividends of 5 per cent. per annum for the six months ended June 30 on the ordinary shares, less income tax (at 4s. 9d. in the pound); a further dividend of 10 per cent., less income tax (at 4s. 10½d. in the pound), on the ordinary shares, which makes 15 per cent. for the year ended June 30. A further dividend of 10 per cent., less income tax at 4s. 10½d. in the pound, is to be paid on the preference shares, making 15 per cent. for the year, the dividends being payable on September 1. On both classes of capital 12½ per cent. was paid for each of the two preceding years.

Calico Printers' Association, Ltd.

The amount standing to the credit of the profit and loss account of this company is £1,037,579, the net profit for the year ended June 30 being £800,208 and the sum of £237,371 being brought forward. It is proposed to pay a dividend of 10 per cent. per annum on the ordinary shares, with the addition of a bonus of 2½ per cent.; £150,000 has been carried to general reserve, and a similar sum to the fund for equalising dividends, whilst £100,000 has been added to the employees' benefit fund, the carry-forward being £235,432.

NEW WATER-RESISTING GLUE

The formula for casein-silicate glue developed by the Forest Products Laboratory at Madison, Wis., during the war, has recently been improved by the addition of copper salts, thereby giving better strength, water resistance and working properties. The United States Patent Office has granted a patent for this glue for dedication to the people of the United States for free use.—(*Chem. & Met. Eng., July* 16, 1923.)

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Although the demand continues on the dull side there has been a slightly better tone of late. The Home trade position shows little signs of recovery and all business transacted is very much of a hand-to-mouth order. Manufacturers have reduced their prices of Bleaching Powder by 2s. 6d. per ton, otherwise prices are steady.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d.—5s. per carboy d/d. Quiet in textile circles.
Acid Nitric 80° Tw.	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.—£8 per ton. General export demand good, particularly from the Continent.
Arsenic (White)	£72—£73 per ton. Not much doing.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£27 per ton.
Powder	£28 per ton. (Packed in 2-cwt. bags, carriage paid buyer's station.)
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Copper Sulphate	£25 10s.—£26 per ton.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass Bichromate	5¾d.—6d. per lb. d/d.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.–£5 per ton. Export demand continues good and manufacturers are in many cases fully sold for some time ahead.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Carload lots 9¼d. per lb. Less quantities 10½d. per lb. ex wharf London. Ample supplies.
Chromium Oxide	1s. 3d, per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Trade generally is on the quiet side, due to holidays and the Continental situation.

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8—£10 per ton according to grade. Market quieter.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2s. per gall. 24° Tw.
Red Liquor	10d.—1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 6d. ,, ,, 60% O.P Fairly regular demand.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5–£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 4d. per lb.
Crude 60's	3s. 3d.—3s. 4d. per gall. Steady demand for early delivery.
Acid Cresylic—97/99	2s.—2s. 5d. per gall. Steady demand.
Pale 95%	1s. 11d.—2s. 4¾d. per gall.
Dark	1s. 10d.—2s 0½d per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price.
Anthracene Oil—	
Strained	8¾d.—10d. per gall. Supply short. Fair enquiry.
Unstrained	8½d.–10d. per gall. Market short.

Benzole—	Fair enquiry.
Crude 65's	11¾d.—1s. 1½d. per gall.
Standard Motor	1s. 6½d. per gall.
Pure	1s. 9d.—2s. per gall. Fair demand.
Toluole—90%	1s. 8d.—1s. 9½d. per gall. Not much demand.
Pure	2s. per gall.
Xylol	2s. 3d.—3s. 3d. per gall., according to quality.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8d.—9d. per gall. Market steady.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 2d.—1s. 5d. per gall. Quiet.
Solvent 90/190	1s. 4d.—1s. 7d. per gall. More enquiry.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Very little business.
Whizzed or hot pressed	£11—£12 per ton. Quiet.
Naphthalene—	
Crystals	£21 per ton.
Flaked	£17 10s. per ton.
Pitch, medium soft	135s.—150s. per ton. No buyers at present.
Pyridine—90/140	19s.—20s. per gall. Market firm for near delivery.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 8d.-1s. 9d. per lb.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d. per lb. naked at works. Good demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	5s. 2d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.—6½d. per lb. Quiet.
m-Cresol 98/100%	2s 1d.—2s. 3d. per lb. Fair demand.
p-Cresol 32/24° C.	2s. 1d.—2s. 3d. per lb. Fair demand.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
d-Dichlorbenzol	£75 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£90 per ton d/d.
Dinitrotoluene—48/50	8d.—9d. per lb. naked at works.
66/68	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The market remains dull generally, although for one or two commodities there seems to be an increasing demand.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	2s. 11d.—3s. 2d. per lb. A fair demand exists.
Acid, Benzoic	2s. 3d. per lb. Neglected.
Acid, Boric B.P.	Cryst. £56 per ton, Powder £60 per ton.
Acid, Citric	1s. 5½d.—1s. 7d. per lb., less 5%.
Acid, Gallic	3s. per lb.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicylic	2s. 1d.—2s. 2d. per lb. Market firm with upward tendency.
Acid, Tannic	3s. per lb.
Acid, Tartaric	1s. 2d. per lb. less 5%. Market continues weak.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 5d. per lb. Market very quiet.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz.
Barbitone	18s. per lb. Reduced prices have not resulted in much more business.
Benzonaphthol	4s. per lb.
Bismuth Salts	A steady market.
Borax B.P.	£31—£33 per ton, carriage paid buyer's station.
Bromides	There are still heavy stocks here to be realised, so that higher prices are not likely at present.
Calcium Lactate	2s. 6d. per lb. for best makes, Better inquiry.
Chloral Hydrate	3s. 9d. per lb.
Chloroform	2s. 2d. per lb. for cwt. lots. Demand is poor.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	Can now be imported free from duty. Spot supplies very scarce and prices erratic from £100—£110 per ton. Lower prices for forward delivery.
Guiacol Carbonate	8s. 6d. per lb.
Hexamine	3s. 9d. per lb. With lower prices for forward delivery.

Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.
Magnesium Carbonate—	
Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	65s.—75s. per cwt., according to quality and quantity.
Menthol	40s. per lb., less 2½%. Slightly firmer.
Mercurials	Very much weaker. Reduced 6d. lb. all round. Quicksilver reduced to £8 15s. per bottle.
Methyl Salicylate	2s. 3d. per lb. for carboys.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Metol	8s. 9d. per lb.
Morphine and Salts	Prices advanced about 6d. per oz., due to higher price of opium. Alkaloid: Cryst. 11s. 6d., Precip. 11s. 3d., Acetate 9s., Hydrochlor. 9s., Sulphate 9s. per oz.
Paraformaldehyde	3s. 9d. per lb. Lifeless.
Paraldehyde	1s. 4d. per lb. Weaker.
Phenacetin	6s. per lb. Quiet.
Phenazone	7s. per lb.
Phenolphthalein	6s. 6d. per lb. Better supply.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s. 0d.—3s. 6d. per lb., according to quantity.
Potass. Iodide	15s. 8d. per lb. Good demand. Steady market.
Potass. Permanganate	9½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz. in bulk packages. Good steady demand.
Resorcin	5s. 6d. per lb.
Salol	2s. 8d. per lb. Very quiet. Lower in value.
Silver Proteinate	10s. per lb. A weaker market.
Sod. Benzoate	2s. 3d. per lb. Slow of sale.
Sod. Citrate, B.P.C. 1923	2s. 2d. per lb. for cwt. lots.
Sod. Hyposulphite—	
Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—87s. 6d. per cwt. Fairly good demand. Expected to improve with continued warm weather.
Sod. Salicylate	Powder 2s. 5d.—2s. 7d. per lb., and Crystal at 2s. 6d. —2s. 9d. per lb. Shorter supply.
Sod. Sulphite, anhydrous	£27 10s.—£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25-£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.—1s. 4d. per lb.
Thymol	14s. per lb. for best white crystal.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. 9d. ,, ,,
Amyl Butyrate	7s. 6d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	2s. 9d. per lb.
Benzyl Benzoate	3s. 3d. ,, ,,
Cinnamic Aldehyde Natural	18s. 6d. ,, ,,
Coumarin	18s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	15s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	35s. ,, ,, Advanced.
Geraniol	5s. 6d.—12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. 6d. per lb.
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	21s. ,, ,,
Methyl Anthranilate	8s. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Xylol	11s. ,, ,,
Phenyl Ethyl Acetate	20s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	2s. 1d. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	22s. 3d.—23s. 6d. per lb. Firm with steady demand.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	29s. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4¾d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 2d. per lb.
Ceylon	3s. 9d. ,, ,,
Clove Oil	8s. ,, ,,
Eucalyptus Oil 70/75%	2s. 4d. ,, ,,
Lavender Oil, Mont Blanc 38/40%	Very scarce
Lemon Oil	2s. 10d. per lb.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	13s. 7d. per lb.
Otto of Rose Oil	Bulgarian, 35s. per oz.
Palma Rosa Oil	24s. 6d. per lb.
Peppermint Oil—	
English	80s. ,, ,,
Wayne County	13s. ,, ,,
Japanese	7s. 3d. ,, ,,
Petitgrain Oil	7s. 3d. ,, ,,

TRADE NOTES

Rubber Consumption in the United States

The Rubber Growers' Association has forwarded the following statistics (supplied by the Rubber Growers' Association of America) relating to the rubber industry in the United States for the second quarter of 1923:—*Consumption* of crude rubber 80,098 tons; this figure is believed to represent 90 per cent. of the total consumption. *Inventory* stocks on hand at June 30, 1923, 100,885 tons (including 93,169 tons of plantation rubber). This figure is said to represent 95 per cent. of the stocks. In addition to the above figures 27,990 tons of rubber is afloat for U.S. ports and 15,017 tons of reclaimed rubber has been produced.

Dyestuffs from the Occupied Areas

The Union Syndicale des Fabricants de Matières Colorantes en France and the Belgian Minister of Finance are putting on sale on behalf of their representative Governments a part of the stock of dyestuffs seized in May in the works of the Badische Anilin und Soda Fabrik (Ludwigshafen), of Meister, Lucius, und Bruning, of Kalle, and of Weiler Ter Meer. The stocks total 6100 metric tons and include chiefly indigo (paste, powder and reduced), alizarin, etc. After deducting the amount required for the French and Belgium consumers of dyes, who have been deprived of supplies since January by the cessation of German reparation deliveries, roughly 3000 tons of dyes will be sold for export.

French Company News

As the shares of the Société de Pechelbronn are now officially quoted, some details about this company will be of interest. Founded in 1921 with a capital of 45,000,000 francs, the company exploits a concession extending over 44,000 hectares to the north of Strasburg. Production from wells and borings amounted to 700,110 metric tons in 1922 as against 55,575 tons in 1921. The company possesses modern refineries which treated 73,860 tons of crude petroleum in 1922. Recent exploration has revealed the presence of new oil-bearing zones. The company possesses a special department which can undertake exploration in any part of the world.

British Trade Marks in Japan

H.M. Commercial Counsellor, Tokio, wishes to draw the attention of United Kingdom firms trading or contemplating trading with Japan to the fact that cases frequently occur of the infringement by Japanese firms of United Kingdom trade marks. He therefore wishes to impress on British firms the advisability of registering their trade marks in Japan, as by so doing they will not only protect their own interests, but will enable the Japanese Patent Office to have a proper record for reference purposes and to cite the marks so registered against any subsequent applications for registration of similar marks in Japan.—(*Official.*)

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EDITORIAL

We have heard some of the older chemists argue that the modern chemist is too restricted in his conception of the science and that he concentrates all his attention on one small branch of it, thereby losing a sense of proportion and becoming unable to bring a sound judgment to bear on the new discoveries made even in that branch with which he is most familiar. Very likely there is a great deal of truth in the complaint, but it becomes more and more difficult to keep in touch with even the important discoveries and developments of our science. Such fundamental questions as the nature of water and the structure of benzene now require some acquaintance with electrical phenomena, the laws of electrical attraction, thermodynamics, vapour tension and solid geometry, as well as a considerable knowledge of chemistry, and how few of us have both the time and the inclination to pursue these topics to the necessary degree. One might expect that a physicist, in dealing with chemical questions, would take a very broad outlook on the subject, and we confess that we were puzzled by a statement by Sir J. J. Thomson, which seemed to be one of the texts upon which he delivered a lecture in America this spring. His statement is as follows: "The atomic theory had little effect on the progress of chemistry as long as nothing was known about the structure of the atom." We do not profess to a very exact knowledge of the subject; like an early writer we are "rather dimly impressed with some glimmering notions from old poetic associations than strongly fortified with any speculations reducible to calculation on the subject." Perhaps some of our readers who are better acquainted with the history of chemistry can tell us whether we are justly perplexed by Sir J. J. Thomson's statement or whether it is merely another proof that our mind is somewhat out of focus.

* * *

There is much in the Shipping and Engineering Exhibition at Olympia of interest to chemists, not only mechanical devices and plant required by chemical manufacturers, and new developments in the use of chemicals, but some few exhibits of which raise important questions in connexion with pure chemistry. Of these, Professor Hele-Shaw's Stream-Line Filter is the most impressive. What its commercial significance may be is difficult to forecast, but it provides a means of experimenting on the size of particles which may throw great light on theoretical conceptions of molecules. The filter appears to a casual observer to separate from a liquid all or almost all the particles which exceed a very minute size; whether this is a five-hundred-thousandth of an inch, or what the size is we do not know. We gather that dyestuffs are removed from solution or suspension and even, incredible as it may seem, that a proportion of salt may be filtered out from sea-water. One result seemed to us to be singular, that a solution of copper sulphate may be filtered so that the liquid comes out a light green and not blue colour. Now, whether copper sulphate in solution exists in the form of large aggregates of copper sulphate and water or in the form of small ions less in size than even a molecule of copper sulphate is much debated. It may be that the stream line filter will throw some light even on the problem of solution. We should dearly love to have the time and knowledge to play with one of these filters for a few months, but it will surely be difficult to obtain very exact measurements of the infinitely small channels through which the fluid escapes.

OBITUARY

DR. E. K. MUSPRATT

We regret to announce the death, on Saturday, the 1st inst., of Dr. E. K. Muspratt, Honorary President of the United Alkali Company, Ltd., and for several years Pro-Chancellor of the University of Liverpool.

Dr. Muspratt died at Seaforth House, not far from Liverpool, which was built by his father about eighty years ago, and where Dr. Muspratt lived the greater part of his life, which extended over the great span of ninety years.

Edmund Knowles Muspratt was the youngest son of James Muspratt, the founder, a hundred years ago, of the alkali industry in Lancashire. He was born in the year 1833 at Linacre, near Bootle, and sent to school at Worksop. In 1850 he was sent to Germany to study chemistry under von Liebig, at Giessen, where his two elder brothers had already studied; he became an intimate friend of the family, and when von Liebig became professor at Munich, Muspratt followed him there and studied medicine and anatomy. About the year 1856 he entered his father's business and took an important part in the management of the works. In the year 1890 the businesses of James Muspratt and Sons, of Muspratt and Huntley, Sullivan and Co., Ltd., the Globe Alkali Co., Ltd., Charles Tennant and Co., and many other firms, were amalgamated in the United Alkali Company, Ltd., of which Dr. E. K. Muspratt was a director and afterwards Honorary President. He was also for a time chairman of the British Insulated and Helsby Cables, Ltd.

Dr. E. K. Muspratt

From his youth he was keenly interested in politics, and met many interesting men, Cobden, Garibaldi and many others who took an active part in connexion with Free Trade, Home Rule and other questions. He was a thorough Radical in politics, and unsuccessfully contested the Widnes Division as a parliamentary candidate in 1885. In his delightful book, *My Life and Work*, he gives a brief account of how Dr. Ludwig Mond, Dr. Campbell Brown and he, discussed the possibilities of a society to bring scientific chemists in touch with manufacturers, and how, with Prof. Roscoe's help, the Society of Chemical Industry was formed in the year 1881. At the first meeting of the Society he read a paper on the legislation required to deal with noxious gases; a Vice-president of the Society from its inception, he became President during the year 1885—1886, succeeding Sir W. H. Perkin and preceding Mr. David Howard in that office.

He travelled a good deal in various parts of Europe and in America, always meeting interesting people, and studying the pictures and archæology of the many places he visited. He was fond of music and the theatre, and was very helpful in organising the Repertory Theatre in Liverpool about the year 1910. Although trained as a chemist and intending to take up chemistry as a profession the requirements of the great business, in which he and other members of his family were concerned, made so great an inroad on his time that he had to abandon any idea of confining his attention to the scientific side of it. Indeed, his great devotion to politics and public affairs marked him out as a man unsuited to constant attendance in a laboratory.

He took considerable interest in local politics, and was a member of the Liverpool Town Council, and the Lancashire County Council; he was chairman of the Liverpool Chamber of Commerce, and president of the Liverpool Financial Reform Association. He was energetic, public-spirited, accomplished and generous. It is not, therefore, surprising that he took an active part in founding University College, Liverpool, in 1881, and in assisting the College in the year 1903 to become the University of Liverpool.

Dr. Muspratt married in 1861 Miss Frances Baines, a daughter of a former proprietor of the *Liverpool Times*. His son, Sir Max Muspratt, Bart., is well known as chairman of the United Alkali Company, and as one who in many ways has followed his father's example in scientific, political and educational zeal.

CHELATE CO-ORDINATION

By J. D. MAIN SMITH, D.Sc.

Werner's co-ordination theory, now over thirty years old, has been relegated by most British chemists, Prof. Lowry, I think, among them, until recently to the limbo of lost causes. Now that Werner is dead there is almost a fashion for co-ordination. It is a subject for regret that he did not live to see his theory so widely accepted and abundantly confirmed in the recent electron theories of atomic structure and by the results of the new X-ray analysis.

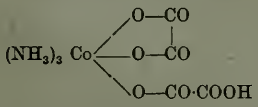
The whole of Werner's theory has a purely practical chemical foundation, and its problems have been attacked and almost invariably successfully solved by the ordinary practical methods of organic and inorganic chemistry and the application of the commonly accepted hypotheses and conclusions of general chemistry. It owes less than nothing to electrical and other physical theories of matter and energy, and little enough to physical chemistry. It is less a theory than a law, a generalisation of the facts of ascertained composition and demonstrated constitution of thousands of complex compounds.

Any extension of the co-ordination theory must be tried by the touchstone of experiment, and the evidence for it examined in the light of existing chemical experience. No attempt, however, may justifiably be made to alter the basis of the theory or to graft on to it any theory of atomic electrical polarity or electron structure of atoms. It is permissible to show its concordance or otherwise with any other theory; but Werner is dead, and his co-ordination theory should remain as he propounded it, built it, defended it, and left it—a chemical theory of the structure of *molecules*.

Prof. Lowry doubts whether ethylenediamine should be included in Prof. Morgan's classification of "chelate groups," in view of "the fact that this diamine is able to form stable co-ordination complexes only with metals of the extended transition series—*e.g.*, from V to Ga, most of which form precisely similar compounds with ammonia. In such cases the crab appears to be dead." Prof. Lowry's doubts are based on a misconception. The term "chelate" was introduced by Prof. Morgan as a convenient description of any and every group whatsoever that can contribute two associating units to a co-ordination number. It is not limited, however, merely to co-ordination complexes of addition, as it is equally applicable to carbon compounds in which the co-ordination number is equal to the valency. Like its representatives, it is all-embracing, and merely a *trivial* name summarising a number of related facts. It is independent of any theory of the mechanism as to how the union of co-ordinated atoms is attained or maintained—the crab may be alive or dead, have hooks in its jaws or muscles in its claws, and still be chelate. The only stipulation is that a chelate group must be claw-like, *i.e.*, capable of simultaneous application at two positions round an atomic sphere.

A precise definition, covering Prof. Morgan's idea, is that "a chelate group is a linked system of atoms which, in combination with another atom, completes a cyclic system." It is merely playing with words to say that a chelate group is non-centric because it is cyclic. Moreover, the terms are not mutually exclusive, for all cyclic groups have centric atoms at their reacting ends. If Prof. Lowry wishes to convey any further idea, some word other than chelate should be his vehicle.

That ethylenediamine may in some complexes contribute only one to a co-ordination number is beside the point. I am uncertain if any such cases have been proved to exist, but they are obviously theoretically possible in compounds having an odd number of groups more active in co-ordination than ethylenediamine. Oxalic acid furnishes examples of a chelate group co-ordinated by one limb and by both limbs in one and the same compound, triammino-cobaltic trioxalate, discovered by Sörensen in 1899, and demonstrated by Werner in 1912 to have the constitution :—



The purpureo-cobalt salts of dibasic acids in general furnish numerous cases of chelate groups co-ordinated by only one limb. The fact that this type of compound has been the subject of much controversy and that Werner's simple idea alone has survived is testimony of its truth.

It will be time enough to modify the term chelate group when Prof. Lowry has demonstrated that "fundamentally differing types of co-ordination" exist. All that his criticism does is to direct attention afresh to a point repeatedly insisted on by Werner—that differences in stability of co-ordination compounds are due to differences in *intensity*, not in type of co-ordination. Ethylenediamine and chelate groups in general enter into complexes of immensely greater stability than do ammonia and other unit groups, as is evident from the ease of resolution of chelate compounds into optically active forms. Co, Cr, and Rh were, in fact, all first resolved through the medium of their ethylenediamine compounds. Ammines, on the other hand, are usually racemised progressively with resolution. Thomas's neat demonstration this year of the *cis*-structure of an ammine, Erdmann's salt, was possible only after the replacement of two of the nitrite groups by the oxalato-chelate group, but even so, resolution was obtained only in solution, the solid enantiomorphs racemising in the act of crystallisation.

The experimental evidence is thus definitely against Prof. Lowry's views, and ethylenediamine must be regarded not only as a chelate group but as one of maximum activity. The co-ordination theory recognises only three classes of chelate groups according to the valency involved. These classes must be regarded only as convenient sub-divisions of a general type, differentiable merely in respect of valency. They are: bivalent chelates, such as oxalic and salicylic acids, univalent chelates, such as glycine and acetylacetone, and non-valent chelates, such as ethylenediamine and $\alpha\alpha$-dipyridyl.

I think Prof. Lowry has been led astray in proposing his two "fundamentally differing types of co-ordination" partly through zeal for the electrical theory and the difficulty of reconciling it with the facts of organic and co-ordination chemistry, and partly to oversight, attributable perhaps to a too recent conversion to the co-ordination theory. The following considerations of a steric, mechanical, physical, and chemical nature appear to have been overlooked :—

(I) The reduction in area open to attack by reagents, owing to the filling of the space round the reactive atom by the inert atoms of the chelate chain, the three hydrocarbon chains of tri-ethylene-diammines, for example, resulting in very complete enclosure, thus affording steric protection and conferring great inertness ;

(II) the mathematically slight probability of the simultaneous detachment of both reacting end-atoms of a chelate group, such as ethylenediamine, in collisions with other molecules in solutions or by thermal agitation, as compared with the probability of the detachment of a unit group, such as ammonia, under the same circumstances ;

(III) the enhancement of the tendency of any group of atoms subject to gaseous or osmotic pressure to assume the configuration having the minimum volume, a chelate group, in virtue of the spatial disposition of the valences of the successive atoms in the chain, occupying a minimum volume owing to this natural cyclic configuration ;

(IV) the lesser volatility of chelate groups as against similar unit groups—ethylenediamine, for example, as against ammonia, and organic dioximes and quinone-oximes as against nitrous acid ;

(V) the variation in the intensity of union of the reacting end-atoms of chelate groups, due to the intrinsic difference in co-ordinative properties of different atoms, and to acquired difference in the case of similar end-atoms, owing to the modifying nature of the intervening dissimilar atoms of the chain by space-filling factors and inherently different chemical properties.

In view of these considerations, it is impossible for chelate groups to be other than different, but only in degree or intensity of reactivity, not type of reactivity. It certainly is not necessary to create, as Prof. Lowry has done, a new type of co-ordination. His argument is truly as much as to say that silver florins are not coins, because some coins are gold and the commonest are copper.

The true mechanism of chemical combination may conceivably be of as many fundamentally differing types as there are compounds, but, it is logically improper, in the absence of clear evidence, to hypothecate more than one cause for very similar happenings. In chemistry, as in every other science, theories are admissible in proportion to their *necessity*, *simplicity*, and capacity to furnish a maximum of explanation with a minimum of assumption. Chemistry is ultimately founded on the hypothesis that chemical combination is of one general type, having as a criterion a common factor called valency, which is numerically measurable positively by the number of halogen atoms combined or combinable, and negatively by the number of hydrogen atoms or their equivalent combined or combinable. The co-ordination theory accepts this hypothesis broadly, but amplifies it by the further assumption that valency is the central force field of an atom in combination, which may or may not be equilibrated by enclosure by valently reacting atoms, and that such equilibration is statically attained only when the valently reacting atoms completely enclose the central force field ; in other cases equilibration is attained only by further non-valent reaction with other atoms having similarly incompletely enclosed force fields. The total number of atoms necessary for complete enclosure of an atomic central force field is termed the co-ordination number, which is, by inference, a function of the central atomic surface and the volumes of the enclosing atoms. This number is, therefore, a constant for atoms having the same atomic volume. It is convenient to refer to that portion of a central force field not enclosed by valently reacting atoms as "residual affinity" or "supplementary valency." Residual affinity is to be reckoned as accidentally but inevitably a part and parcel of ordinary or principal valency, and it is to it that all addition compounds and solution in solvents is considered due in the co-ordination theory.

Whether the foregoing central force fields have their origin in or are identical with gravitation or electricity, or both, or neither, is the province not of chemistry but of physics, and, consequently, no theory of the ultimate origin of valency or of atomic structure can be directly applied to an independent theory of pure chemistry such as co-ordination.

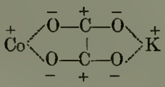
Scarcely anything in chemistry is more certain than that all co-ordination compounds are of the same type, *i.e.*, "centric," to use Prof. Lowry's unnecessary term. His "cyclic" type is already adequately provided for by existing ideas, and, as a fundamentally different type of co-ordination, is justified neither by experimental facts nor theoretical considerations. Not thus lightly can the accumulated evidence of the seventy-two years since Genth discovered purpureo-cobalt chloride and the immense and fruitful labours of Werner for over thirty years be set aside.

It may be Prof. Lowry's opinion that " the size of a ring is an important factor in determining the stability of the co-ordinated complex, but it is mainly a negative factor, since ring-formation does not decisively promote co-ordination." This statement, however, does not relate to matters of opinion but to matters of fact, and in reality the facts are otherwise than stated. It is not always possible readily to obtain decisive experimental evidence for or against any isolated point in chemistry, but in this case the evidence is at hand in one of Werner's classical examples, cited unluckily by Prof. Lowry—the ferrous *aa*-dipyridyl complex. The iron atom, though undoubtedly one of the transition elements and, therefore, of Prof. Lowry's *centric* type, is almost devoid of his centric co-ordination properties, the difficulty-obtainable ammines being instantly decomposed by water. Nevertheless, ferrous salts readily form stable compounds with *aa*-dipyridyl, which were resolved into optically-active forms, thus proving their octohedral structure and constitution as tri-*cyclic* systems with a common *spiro*-iron atom. Ferrous salts form similar cyclic compounds with ortho-phenanthroline, and the cyclic ferric double oxalates are well known. No clearer disproof could be obtained of the statement that " ring formation does not decisively promote co-ordination."

Prof. Lowry's general conclusion that " the maximum of stability should be reached in a six-atom ring containing three pairs of conjugated atoms " is also not borne out by the facts. No compound of iron is known, containing a six-atom ring, of stability at all comparable with the *aa*-dipyridyl and ortho-phenanthroline complexes, neither of which contain the metal in a six-membered or conjugated ring. The stability of these complexes is, however, stated to be due to concordant conjugation in the rest of the molecule—*i.e.*, the pyridine rings. Nevertheless, *aa*-diquinolyl and *aa*-pyridylquinoline, with yet more extensive concordant conjugation, form no compounds with iron, despite a precise resemblance to *aa*-dipyridyl in their theoretical chelate groups. The fact that no compounds, stable or unstable, are formed is proof positive that conjugation, external to a chelate group, is not even a minor factor in co-ordination.

It was early very obvious in the electrical polarity theory of atomic chains, that the existence of rings with an odd number and chelate groups with an even number of chain atoms was inexplicable by the simple form of the theory. A " difficulty dodge " was clearly necessary, of the type of " heads I win, tails you lose," so that the theory could be applied to both odd and even cases, for between odd and even as between heads and tails only one choice can be right. This was found in a verbal spell for enchanting critics, the particular " abracadabra " used being " crossed polarity." It is remarkable that, so far, polarities have been " crossed " only positively, but, as new difficulties arise, it can be prophesied with confidence that " negative crossed polarity " will become a vital necessity.

However, in case the crossed polarity medicine be ineffective, Prof. Lowry proposes a further cure for the odd-ring disease, which is even more drastic. This consists in co-ordinating alkali-metals with the other atoms external to chelate groups, potassium, for example in potassium cobaltioxalate, entering into an eight-membered bridged ring, thus :—



As a minor point, it must be remarked that this formulation does not show the true valency of the atoms, carbon, for example, is shown as tervalent instead of quadrivalent, oxygen as univalent instead of bivalent, and potassium and cobalt as non-valent instead of univalent and tervalent respectively, and the dotted bonds have not the meaning usual in co-ordination formulæ. Such bonds cannot mean half a valence, for even in the electrical theory, a valence is a unit, an electron displaced, and therefore indivisible. The co-ordination dotted bond does not affect the valency, but is merely a qualitative indication that part of the *force* due to valency is binding non-valent atoms or groups. The important point, however, is the co-ordination of an alkali metal, other than lithium, for which there is no experimental justification. The same type of formulation has previously been used by Prof. Lowry for the cobaltinitrites. In neither case does he adduce any evidence, for in fact none exists. Where such compounds are soluble, they are as completely ionised, so far as the alkali-metal is concerned, as ordinary common salt of the same atomic concentration, and the alkali-metal may be replaced in the ordinary ionic double-decompositions by other metals or basic groups, and the latter may be totally devoid of co-ordinative properties, without any loss of stability in the resulting compounds. The ammonium radicle is devoid of co-ordinative properties, yet ammonium cobaltioxalate, ferrioxalate, diamminocobaltinitrite, and cobaltinitrite are known to be stable. The hexammino-cobaltic complex (luteo-cobalt) is also, on any view of its constitution, devoid of co-ordinative properties as a whole, yet luteo-cobalt cobaltioxalate, ferrioxalate, diamminocobaltinitrite and cobaltinitrite, are extremely stable and, moreover, insoluble bodies. The last two were discovered and their stability demonstrated by Gibbs over fifty years ago. As these compounds cannot be co-ordinated in Prof. Lowry's way and yet are all very stable, his argument in favour of co-ordinated alkali-metals falls to the ground. In fact the only valent elements that appear to be devoid of co-ordination properties are potassium, rubidium, caesium, and univalent thallium, the existence of their numerous perhalides notwithstanding; the latter are practically certainly due to co-ordinated positive halogen, as is evident from the existence of similar compounds of all strong bases, such as the metal-ammines, the ammoniums and the higher alkaloids.* The lack of co-ordination in the alkali-metals has been further illustrated by Prof. Morgan and myself in the preparation of the luteo-cobalt salt of nitroso-β-naphthol, one of the most powerful chelate groups known to chemistry, this salt having the same general properties and strange green colour as the corresponding alkali-metal salts. It may be definitely stated, in view of ascertained experimental facts, that any theory of chemistry which requires more than the very feeblest co-ordinative properties in the alkali-metals, other than lithium, is built on sand and can command no credence.

Prof. Lowry's division of co-ordination into two types is, however, not justified on the grounds he cites, for the metals of the extended transition-series occasionally have no "centric" properties, and other metals often have "centric" properties as highly developed as the metals of the extended transition-series. That iron, a typical transition metal, definitely requires a chelate group for stability, has been clearly shown above. On the other hand, glucinum, boron, aluminium, silicon, nitrogen, oxygen, and fluorine, just to mention a few elements not in the transition series, do not need chelate groups to stabilise their co-ordination compounds. Sodium glucinifluoride, borofluoric acid and the borofluorides, amminoborontrimethyl, amminoboron fluoride, sodium aluminifluoride (cryolite), silicofluoric acid and the silicofluorides, all co-ordinated oxy-acids, ammonium salts, alkyl- and aryl- ammonium salts, and the many thousands of ammines of metals, are frequently extremely stable co-ordination compounds, which do not contain any chelate ("cyclic") groups. It thus occurs that nitrogen, oxygen, and fluorine, not being transition elements, must be classed as possessing only "cyclic" co-ordination. Yet they are Prof. Lowry's criterion of "centric" co-ordination. The perfect "reductio ad absurdum"! The futility of this classification is evident, when "cyclic" and "centric" types of co-ordination can be at once different and identical.

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Aug, 8, 1923

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*This has now been directly proved for KI_3, CsI_3, $CsIBr_2$, and $CsICl_2$, by X-ray analysis. See Clarke, *Proc. Nat. Acad. Sci.*, 1923, **9**, 117.

THE PRACTICE AND CONTROL OF BENZOL RECOVERY FROM GAS

THE USE OF SOLID ABSORBENTS

By **REX FURNESS**

The general acceptance of benzol as a motor fuel, either alone or in admixture with petrol, alcohol, etc., warrants the statement that the supply of benzol will not exceed the demand in this country, as the consumption of internal-combustion engine fuel runs into hundreds of millions of gallons per annum. Therefore, whatever developments may occur in the adoption of low-temperature carbonisation of coal—a process which yields a relatively large amount of light oils—it is safe to say that producers of metallurgical coke in recovery ovens will continue to strip their gas of benzol. Present-day coke is of a small or medium celled structure, hard, dense, compact and porous, and is well graphitised, so that, although it may be surpassed in combustibility, it is unlikely that a blast furnace carbonaceous material of equal or superior qualities will appear in industry in the near future. Benzol recovery from coke-oven gas is a problem, then, of present and future importance, and the newer methods of absorbing the hydrocarbon from the gas stream merit consideration.

At the present time, benzol is universally recovered by absorption in a washing oil, from which it is subsequently removed by distillation. The employment of a dry absorbent, active charcoal, silica gel, base exchange silicates, etc., offers so many advantages that its adoption should be carefully considered in all cases of plant extension. Capital sunk in the expensive stripping and recovery apparatus already in existence cannot be sacrificed light-heartedly; but here again it is a matter demanding bold examination whether the savings that can be attained by operating dry absorption plant, together with the greater yield of benzol won from the gas, are not sufficiently large to bear not only their own interest and depreciation charges, but those thrown upon the dry absorption process by the scrapping of existing plant well before its time.

ABSORPTION IN OIL

It is unnecessary to describe present-day plant in any detail, for in effect it consists merely of an oil scrubber packed uniformly with suitable material, allowing intimate contact between gas and washing oil, which pass in counter current. Preheaters for the oil containing benzol and stills for the removal of the latter and regeneration of the former vary in design and efficiency, but present problems outside the scope of this article. It is important to note, however, that the maintenance of benzol recovery at 90 per cent. efficiency demands a care and attention upon the part of operator and manager which admits of no relaxation of effort. Many factors affect the extent of benzol solution in the washing oil, namely, a sufficiency of scrubber space—together with a sufficiently prolonged time of contact between oil and gas — quality and quantity of absorbing oil, temperatures of oil and gas, state of saturation of washing oil and the amount of benzol in the gas.

Assuming that attention is paid to the mechanical details of the process of benzene absorption in oil, the most important single factor in ensuring a good stripping is perhaps the nature of the oil used. Many varieties find successful application, including coal-tar oils, blast-furnace tar oils, petroleum distillates, gas oils, and so forth. In general, however, the oil should have as low a molecular weight as is consistent with a sufficiently high boiling point, to prevent any carry-forward past the scrubbers, or contamination of the benzol in the subsequent distillation. The higher the molecular weight of the absorbing oil, *ceteris paribus*, the lower is its capacity for retaining benzol, assuming Raoult's law to hold exactly.

In this connexion reference must be made to an important paper by Wilson and Wild (*J. Ind. Eng. Chem.*, Aug., 1923, p. 801), in which the vapour pressures of benzene and other hydrocarbons in many oils are studied. Briefly, it may be said that the several types of mineral oils employed in benzol stripping are of approximately equal value, the differences in molecular weight for a given viscosity being almost exactly compensated by the divergencies from Raoult's law.

It is important, however, that the circulating oil, whatever its nature, be kept clean and finely divided solid impurities removed. It is probable that the molecular weight of the stripping oil does not sensibly increase during use by reason of polymerisation, as has been assumed as an explanation of decreasing efficiencies of benzol recovery as the stripping oil becomes older.

The temperature of absorption should be maintained as low as possible, for greater efficiencies result at low temperatures. Here, again, reference only must be given to a somewhat overlooked paper due to Cantelo (*Canadian Chem. Met.*, 1922, pp. 177 and 196) which, although relating primarily to the recovery of gasoline from natural gas, contains much of value to the by-product coke-oven manager. In this paper is given a method for calculating the amount of oil required at any temperature, to remove completely gasoline (or, in this case, benzol) from gas. Theoretically, of course, it should be possible to remove benzol completely from coal or coke-oven gas at any temperature by scrubbing with such an amount of oil as to bring the vapour pressure of the solution at the chosen temperature equal to the partial pressure of benzol vapour in the gas. The paper of Cantelo, read in conjunction with the later work of Wilson and Wild upon the deviations of benzol-oil solutions from Raoult's law, provides much valuable information regarding the practice of benzol stripping.

A factor which will demand consideration in the ensuing comparison between oil washing and absorption in a porous solid is the capacity of the scrubbers. A definite figure cannot be given, for the amount of scrubber capacity depends upon the amount of benzol in the gas, and therefore upon the type of coal carbonised; the temperature of scrubbing, the velocity of gas passage, and the efficiency of recovery demanded or the state of saturation of the washing oil attained. On an average, however, a figure can be taken of from 12 to 18 cb. ft. of scrubber capacity per ton of coal distilled per day, and it can be assumed that 10,000 cb. ft. of gas is produced per ton of coal treated. Again, figuring three gallons of benzol recovered per ton of coal, three per cent. oil-benzol solution, and a twenty-four hour cycle of washing oil, the amount of oil required in the stripping plant must be placed at 100 gallons per ton of coal treated per day. These figures will be used in subsequent discussions and comparisons.

BENZOL ABSORPTION IN CHARCOAL, SILICA GEL, ETC.

The development of decolorising and gas-absorption carbons or charcoals during the last decade, particularly during the later years of the world war, has been paralleled only by the development of highly absorptive inorganic "gels," such as silica gel, the base-exchanging silicates, and other compounds such as ferric hydroxide gel. The high efficiency naturally demanded when active charcoal had to be used as a protection against toxic gases in the field has been equalled and even surpassed by that of silica gel and other inorganic absorbents, so that these compounds present to-day a valuable material for peace-time industry. In particular, benzol can be recovered very successfully from coke-oven gas by absorption in such a compound.

It is unnecessary to indicate the methods by which active vegetable charcoals are manufactured—and the processes claimed are legion—but it will suffice to say that the original carbonaceous matter is destructively distilled, in the presence or absence of addition agents such as zinc chloride, calcium chloride, or phosphoric acid, and the original carbon complex is subsequently activated by a mild oxidation by means of steam, carbon dioxide, oxygen-nitrogen mixtures, etc. Prices ruling for highly absorptive qualities are, however, high, so that products made by relatively simple processes from sodium silicate are likely to outbid the charcoals in popularity. Silica gel, for instance, is easily made by acidifying sodium silicate solution at a definite temperature and concentration, washing out the sodium chloride formed and drying the gel at a relatively low temperature to a hard, glassy mass. This hard " gel " is highly porous by reason of innumerable minute capillaries, probably measuring in diameter not more than the equivalent of several molecular diameters. Base exchanging silicates of high absorptive value are likewise readily prepared by reaction between specific concentrations of solutions of sodium silicate and sodium aluminate. These highly efficient substances, in common with silica gel, are protected by patent rights, of course. In view of the fact that the inorganic absorbents are much cheaper, equally efficient at least, and possess a much greater density than the active charcoals, so that a much greater " space-time " absorption can be effected, or in other words, for a given duty, a smaller apparatus charged with silica gel will suffice, charcoal will be left out of discussion, since, too, the phenomena of absorption are identical in all cases from a practical point of view.

ABSORPTION APPARATUS

A good absorbent gel will hold about 25 per cent. of its own weight of coke oven benzol at 25° C., and will render up this amount on the passage of slightly superheated steam at, say, 250° C., or lower. Moreover, the gel will abstract the benzol from a relatively dilute air-benzol or gas-benzol mixture, although the " break point " and final saturation value depend, *inter alia*, upon the partial pressure of benzol in the gas. (The " break point " has been defined as that point at which the absorbent ceases to remove *all* the benzol from the gas.)

The " break point " varies, of course, with the nature of the absorbent, concentration of benzol in the gas, and temperature, but under normal operating conditions a substantial percentage of the total weight of benzol absorbed at saturation of gel is completely removed from the gas by the latter. In other words, until a certain concentration of the benzol-absorbent complex is reached, the hydrocarbons are completely stripped from the gas. In practice, therefore, three absorption units in the form and arrangement of gas purifier boxes—the ordinary iron-oxide box purifiers of the gas works—may be charged with a suitable absorbent, say, silica gel or base exchange silicates ranging in size from 8—14 mesh. Gas, freed from naphthalene, tar suspensions and, if economically possible, sulphur, is passed through two boxes in series. The benzol is removed for a considerable time by the first box, but towards the end of, say, an eight-hour cycle, benzol commences to come through box No. 1, but is easily retained by the fresh gel in box No. 2. A change over is effected after an eight-hour run, box No. 2 becoming the first box to receive the gas stream, whilst box No. 3 acts as the safety box. In the meantime box No. 1 is undergoing a steaming treatment for the recovery of the benzol, and as this process can be carried through much more quickly than the absorption, the box can be standing cooling for several hours after steaming before it is required to take its place in the absorption cycle once more. In any case, cooling tubes are fitted within the boxes, so that the heat of absorption may be prevented from raising the temperature of the gel during benzol stripping, and a stream of water is circulated through these water tubes in case the box is required at the earliest possible moment after removal of its contained benzol.

A general filter with a final section containing gel should be placed in advance of the absorption boxes. Deterioration of the absorbing gel by the deposition of tarry impurities can be almost indefinitely postponed, but although it is desirable to remove hydrogen sulphide if this is part of normal practice, it is difficult to see that this gas can interfere greatly with benzol absorption. In the absence of air, charcoal, silica gel, etc., do not effect the catalytic decomposition of hydrogen sulphide, and deposition of free sulphur upon the absorbent will not occur. In any case, it is interesting to note that the Bayer Co. claim a patent for an absorbent of greatly enhanced value, obtained by the intentional pre-deposition of sulphur up to 50 per cent. in amount.

ADVANTAGES OF SOLID ABSORBENTS

The practice of benzol stripping is simplified by the use of solid absorption agents. Little attention is demanded, constant supervision and testing are dispensed with, large volumes of circulating oil are not required, and the general operating and maintenance costs are less than in the case of absorption in a washing oil. The size of plant required is considerably reduced. Assuming, for instance, that the absorbent in box No. 1 has retained only 16 per cent. of its weight when it comes off in its turn for steaming and assuming that 100 tons of coal are carbonised per day, yielding 2520 lb. of benzol—approximately three gallons per ton, as assumed in the case of oil scrubbing—it is clear that each of the three absorption boxes must contain 5040 lb. of absorbent, say, silica gel. The total cubic capacity of the three boxes would therefore amount to 345 cb. ft., assuming that silica gel weighs 44 lb. per cb. ft. and allowing nothing for packing, spacing, hurdles, steam and cooling pipes and free space at top of box, etc. Nevertheless, the wide difference between this figure and that for the capacity of oil scrubbers—1200 to 1800 cb. ft. per 100 tons of coal treated per day—is noteworthy.

The above size of plant is quite an outside and entirely safe—perhaps excessively safe—estimate, for gas would pass through this plant at the rate of only about 2 cb. ft. per cb. ft. of gel (over all), or in the cycle suggested about 6 cb. ft. per cb. ft. of gel per minute. Now water has been successfully removed from air passing over gel at the rate of about 30 cb. ft. per minute per cb. ft. of gel, and gasoline, occurring in about the same concentration in natural gas as does benzol in coke-oven gas, has been absorbed in charcoal, the "wet" gas flowing over and through the latter at a rate of 10 cb. ft. per minute per cb. ft. of charcoal. It must be remembered that silica gel, base exchange silicates, etc., are available with an absorptive capacity at least equal to that of activated charcoal. (For a description of the process of gasoline recovery from natural gas by means of activated charcoal, see Burrell, Oberfell and Voress, *Chem & Met. Eng.*, 1921, Jan. 26, p. 156.)

The initial outlay for plant construction is much less than in the case of oil-scrubbing equipment, for from one-fourth to one-fifth of the absorption space is required, and that of very plain construction—viz., of the purifier box type, as contrasted with packed towers or complex mechanical devices for insuring intimate contact between gas and washing oil. In the 100 ton per day plant assumed in the foregoing, about 7 tons of silica gel or an equivalent absorbent would be required, and little allowance made for renewal or replacement. With oil scrubbing, 10,000 gallons of a good washing oil would be required, with constant renewal to a greater or less degree. It is probable that Engelhardt's estimate that the maintenance charges in respect of charcoal absorption of benzene from coal gas amount to one-tenth those for oil scrubbing can be safely applied to inorganic absorption. Charcoal is more costly, is more easily disintegrated in use, and it cannot be freed from adventitious impurities so easily as an inorganic gel. Finally, power charges are likely to be much less than in the case of benzol recovery in oil scrubbers, for no circulation of absorbing material obtains.

The outstanding factor in the whole comparison has already been indicated—namely, the recovery of almost the whole of the benzol from the gas stream with comparatively little attention. The apparatus is essentially "fool and low yield" proof, and returns higher benzol figures per ton of coal carbonised than does oil absorption—at any rate in general operation. In town's gas manufacture the question is not so serious—even if benzol stripping were generally in evidence—for any benzol left in the gas is paid for by the consumer, often at a higher proportionate rate than is obtained by the producing company for the extracted benzol. In coke-oven practice, however, the conditions are, in most cases, different, and it is advantageous to obtain as great a benzol recovery as is possible. Dry absorbents should therefore receive a very careful consideration, and small scale plant trials should be carried out to supplement and define the specific conditions and the estimates of gel requirements made in the foregoing account.

SOLID ABSORBENTS IN PRACTICE

It has been shown that there is no reason to fear deterioration of the absorptive qualities of silica gel if tarry matters or impurities that "smear" the active absorptive surface be excluded from the gases under treatment. Repeated absorption and recovery of the absorbed material by means of steaming the gel have no apparent ill effect upon the latter.

Charcoal has been used in the recovery of gasoline from natural gas, as noted above. The authors of the paper referred to state that installation charges upon the process are small, running expenses are light, and a higher yield of a better gasoline is obtained in comparison with that recovered by absorption in oil. Thus, the charcoal plant operating on the same gas as an oil absorption system gave a yield of 203 gallons of better gasoline per million cb. ft. of gas treated, compared with only 125 gallons for the oil system.

Englehardt reports large-scale experiments which he carried out in the Cologne gas works: 64,000 cb. ft. per day of ordinary coal gas were stripped of benzol by passage through active charcoal, contained in two boxes in series. The rate of gas passage was apparently relatively small, for the capacity of the absorption boxes was about 30 cb. ft. Each box yielded about 80 lb. of benzol on steaming, but if both were used in series as much as 112 lb. could be recovered from a box. The gravity of the benzol was 0·885, as contrasted with 0·90—0·93 for benzol obtained by oil scrubbing in comparative trials. The former benzol, too, gave only 2 per cent. distilling over 145° C., whilst the latter yielded 29 per cent. above 180° C.

Silica gel has been used for drying air, and very successful results are shown in large-scale units. The process is claimed to be cheap enough to be used to dry the air supplied to blast furnaces. Many other applications of the inorganic gels as solid absorbents are contemplated—concentration of sulphur dioxide from dilute mixtures in air, solvent recovery, absorbing lead chamber exit gases in the manufacture of sulphuric acid, etc.—but reference only must suffice here.

CONTROL OF BENZOL RECOVERY

The solid absorbents can be effectively used in the control testing of an oil absorption plant, and experience in the laboratory may well be the basis of subsequent large-scale developments. The simplicity of the test in comparison with the oil washing methods almost universally practised is at once apparent, and the efficiency is convincingly demonstrated.

Many types of apparatus have been suggested from time to time for using activated charcoal as absorbent for the benzol, but the concentric tube system is simple and effective. The absorbent is contained in the inner tube, and the gas is passed at a rate of about 10 cb. ft. per hour over approximately 500 g. of charcoal or gel. Superheated steam is then admitted round the tube, passing thence through the absorbent and carrying away the benzol to a condenser. The calculations required are obvious. The absorbent is allowed to cool and is capable of repeated use. A more accurate method, involving slightly more attention, is described by Davis (*J. Ind. Eng. Chem.*, 1923, July, p. 689) as follows:—Two tubes, 12 in. by 1·5 in., are charged with 300 c.c. of charcoal each and fitted together in a simple manner, suitable gas connexions, etc., being also fitted conveniently. Gas is passed at about 10—15 cb. ft. per hour until a quantity of benzol assumed to be roughly 40 c.c. has been absorbed. (This is known from the known approximate benzol content of the gas.) The charcoal is now placed in a flask, covered with cresol and heated to 180° C. The distillate is washed with caustic soda solution and its volume read. A similar procedure is carried through upon the charcoal in the second absorption tube. The use of this type of test simplifies the determination of benzol in gas, but its chief value is in its influence upon the mind of the operator. The simplicity, convenience and efficiency of solid absorbents is convincingly demonstrated, and the way is paved for an estimated cost survey in the particular circumstances obtaining and for experimental large-scale plant installation.

RUSSIAN METALLURGY IN 1923

In March, 1923, 28 blast furnaces were alight in Russia compared with 212 in 1914, and 37 open-hearth furnaces and 116 rolling mills were in operation compared with 243 and 178, respectively, in 1914. These figures, however, represent considerable improvements on those recorded in 1922 and previous years. The production comprised 141,400 long tons of pig iron, 228,560 t. of open-hearth steel, and 176,850 t. of rolled material, compared with the respective production of 4,151,600 t., 4,182,300 t., and 3,454,800 t. in 1913. The production of iron and steel shows an important decline compared with the figures for the same period in 1921–22. There was a large increase in the output of ore, and stocks also increased, with the exception of those of pyrites, which were not mined during the previous half-year.—(*U.S. Comm. Rep., Aug.* 6, 1923.)

FORTHCOMING EVENTS

Sept. 10–13. The Institute of Metals. Annual Meeting at Manchester. *Second Annual Autumn Lecture.* "The Use of Non-Ferrous Metals in Engineering," by Lieut.-Col. Sir Henry Fowler, K.B.E., at 8 p.m., Sept. 10. "The Cause of Red Stains on Sheet Brass," by E. A. Bolton. "Note on 'Brinell Hardness Numbers,'" by H. W. Brownsdon. "The Behaviour of Metals under Compressive Stresses," by H. I. Coe. "On the Measurement of the Change of Volume in Metals during Solidification," by Hikozo Endo. "The Electrochemical Character of Corrosion," by U. R. Evans. "The Constitution and Age-Hardening of the Quarternary Alloys of Aluminium, Copper, Magnesium and Magnesium Silicide," by Marie Gayler. "Investigation of the Effects of Impurities on Copper (Part I—The Effect of Oxygen on Copper)," by D. Hanson, C. Maryatt, and G. W. Ford. "Experiments with some Copper Wire; Cohesion a Function of both Temperature and Cold-work," by D. H. Ingall. "The Effect of Small Quantities of Nickel upon High-grade Bearing Metal," by A. H. Mundey and C. C. Bissett. "Stereotyping," by A. H. Mundey and J. Cartland. "Hardness Tests on Crystals of Aluminium," by H. M. O'Neill. "A Dilatometric Study of the Transformations and Thermal Treatment of Light Alloys of Aluminium," by A. M. Portevin and P. Chevenard. "Effects of Rate of Cooling on the Density and Composition of Metals and Alloys," by R. C. Reader. "Crystallisation Effect on Galvanised Iron Sheets," by E. L. Rhead and J. D. Hannah. "Equilibrium in the System Gold-Zinc (based on Investigations of Electrical Conductivity at High Temperatures)," by Prof. P. Soldau. During the meeting the new metallurgical department of Manchester University will be opened by Sir George Beilby.

Sept. 12–19. The British Association for the Advancement of Science. Ninety-first Annual Meeting, to be held at Liverpool. The President, Sir E. Rutherford, F.R.S., in his inaugural address, will deal with "The Electrical Structure of Matter." *Section A.—Mathematics and Physics.* Presidential Address by Prof. J. C. McLennan on "The Origin of Spectra." Discussion with the Chemistry and Engineering Sections on "Cohesion and Molecular Forces." "The Penetrating Radiation from the Upper Air," by Prof. R. A. Millikan; "Energy of the Circulation of the Atmosphere," by Capt. D. Brunt; "Meteorological Effects on Sea Level and Tides," by Dr. A. T. Doodson; "The Production of Triatomic Hydrogen," by G. Stead and Miss B. Trevelyan; "Matter and Radiation," by Sir Oliver Lodge; "Apocoptic Expansions," by T. Smith; "Notes on the Approximate Expansions of Empirical

Results," by Prof. H. Levy and H. W. Moore; "Series of Magnetic Disturbances," by Rev. A. L. Cortie; "Some Effects of Alternating Magnetism," by W. M. Morday; "Demonstration of the Frenophone," by S. G. Brown; "The Correspondence Principle," by Prof. N. Bohr; "Remarks on Quantisisation," by Prof. P. Ehrenfest; "The Structure of Atoms and Their Magnetic Properties," by Prof. P. Langevin; "The Effect of Weak Magnetic Fields on the Polarisation of Resonance Radiation," by Prof. R. W. Wood and Dr. A. Ellet; Discussion on 'The Spectra of the Lighter Elements"; "The Magnetic Rotary Dispersion in Certain Paramagnetic Liquids," by R. W. Roberts; "The Angle of Contact: Variation with Relative Motion of Solid and Liquid," by R. Ablett.

Section B.—Chemistry. The following papers are to be read:—(1) "The Formation of Precipitates," by S. Oden; (2) "The Nature and Significance of the Resin of Hevea Rubber," by G. S. Whitby; (3) "The Physical Chemistry of Interfaces," by Prof. F. G. Donnan, F.R.S.; (4) "The Quantum Theory in Chemistry," by Prof. G. N. Lewis; (5) "The Bohr Atom and the Periodic Law," by Dr. N. V. Sidgwick, F.R.S.; (6) "On High Frequency Spectra and the Theory of Atomic Structure," by Dr. D. Coster; (7) "The Activation of Hydrogen in Organic Compounds," by Miss E. H. Usherwood; (8) "Membrane Potentials Considered as Diffusion Potentials," by Dr. E. B. R. Prideaux; (9) "Enzymes," by Dr. E. F. Armstrong, F.R.S.; (10) "The Relation of Certain Enzyme Actions to Tissue Differentiation and Tumour Growth," by Dr. K. G. Falk; (11) "Catalytic Actions in the System Copper, Copper-Oxide, Oxygen, and Gaseous Reducing Agent," by W. G. Palmer; (12) "Alumosilicates," by W. Vernadsky; (13) "The Chemistry of Hafnium," by Dr. G. Hevesy; (14) "The Utilisation of Volcanic Steam," by Senatore Prince Ginori Conti; (15) "The Biochemical Effect of Polarised Light," by Miss E. S. Semmens; (16) "Cotton Wax," by Dr. R. G. Fargher; (17) "The Absorption of Methylene Blue by Cotton," by D. A. Clibbens; (18) The Sulphonation and Nitration of Naphthalene," by Prof. H. E. Fierz.

Sept. 17. THE INSTITUTION OF RUBBER INDUSTRY, in the Kelvin Room, Engineers' Club, Coventry Street, W., at 8 p.m. "Rubber Floors and Rubber Roadways," by E. J. Edwards.

Sept. 17–18. THE IRON AND STEEL INSTITUTE. Autumn Meeting, to be held at Milan, in the Chamber of Commerce, commencing each day at 9.30 a.m. At the conclusion of the meeting visits have been arranged to Florence, Rome, Piombino, Leghorn, Genoa, and Turin.

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS

The Society of Chemical Industry has in each of the past two years held a dinner in London in the month of October, but for the present year arrangements have been made for an Informal Dinner and a Social Gathering of Chemists under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, which members of these, and of any other of the Chemical Societies, with their friends (including ladies) may attend.

This dinner will be held in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on the evening of Wednesday, October 31, at 7 for 7.30. The price of tickets for ladies or gentlemen will be 12s. 6d. each, not including wine.

Further particulars will be issued later, and the Councils hope that Members of the Societies mentioned, who intend to be present, will make early application for tickets, which must be limited to 300. These will be issued in the order in which applications accompanied by payment are received.

Applications should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2.

BRISTOL SECTION

The Bristol Section has issued a useful pamphlet containing a list of names of its officers and members, the rules of the Section and the programme of meetings for the 1923–24 session, from which we extract the following details:—

On October 4 J. F. Reid will read a paper entitled "An Outline of Rubber Manufacture," and on November 1, A. H. Bridges will speak on "Some Aspects of the Paint Trade, Fine-colour and Lake-making." The meeting on December 6 will be held jointly with the Institute of Chemistry, and a paper entitled, "Some Reminiscences of an Alkali Inspector," will be contributed by R. D. Littlefield.

In 1924 the first meeting will be held on January 3, when O. Jones will read a paper on "The Chemical Technology of Canned Foods." On February 7, the meeting will be held under the scheme for co-operation with the Chemical Society, and Profs. F. Francis and J. W. McBain will give an account of "Current Chemical Research at Bristol University." On March 6 there will be the general meeting and election of officers, and the following papers will be read:—"Combustion Control in Boiler Houses," by H. T. Ringrose, and "Fuel Economy Questions," by H. Womersley. It is proposed to hold the annual dinner jointly with the local section of the Institute of Chemistry in February. The meetings are held at 7.30 p.m., in the Chemical Department of the University, Woodland Road.

CORRESPONDENCE

THE ARTIFICIAL SEASONING OF WOOD

Sir,—In an article on the "Artificial Seasoning of Wood by the Ozone Process," which appeared in the December 30 number of your *Journal*, there is described in some detail a theory on the drying of wood which is used as casually as though it had been known and accepted for years, but it appears to be entirely new, and, so far as we know, it has no foundation in fact.

This theory is briefly as follows :—

The proper seasoning of wood consists in oxidising certain organic sap constituents.

If these constituents are not oxidised the wood will shrink during their subsequent oxidation and also absorb water on account of their hygroscopicity.

If these constituents are removed by steaming or boiling, the wood is satisfactory as far as shrinking and absorbing moisture are concerned, but it is brittle and lifeless, since the cells are left empty.

If, however, these constituents are oxidised and the oxidised products are left in the wood, no absorption of moisture, shrinking or swelling will ever take place and the wood retains its resiliency.

In startling contrast to this the facts are as follows :—

The proper seasoning of wood can be obtained by simply drying it with the least possible injury due to too rapid or irregular drying.

Such "organic sap constituents" are wholly mythical, and the absorption of moisture and the drying of wood (accompanied by the corresponding swelling and shrinking, respectively) are properties of the wood fibre itself.

There is an equilibrium between the moisture content of wood and the humidity of the air with which it is in contact, and this is all the theory that is required for the drying of wood.

No [seasoning process can transform wood so that it will not change its moisture content (and its volume) to correspond to the humidity of the air, although the equilibrium curve may be shifted slightly by certain conditions of drying.

The information available on the chemical composition of wood does not show the possibility of such substances being present in wood in sufficient quantity to affect the "life" or brittleness, and, in fact, there is no basis for deciding whether their *presence* or their *absence* would be more likely to make the wood brittle.

Most of these facts on the drying of wood have been known and used for a long time and have been available in the literature (see Tiemann's "The Kiln Drying of Wood"), so that it is astonishing to find such a different and fantastic theory announced without any mention of commonly accepted facts on the subject.

Aside from the general theory there are also many inaccuracies. The term "sap" should be limited to the circulating liquid in the sapwood only, but it is evidently applied to all moisture occurring in wood, since otherwise the theory of drying would apply only to sapwood. The classification of the sap constituents into "amylaceous substances" and "resinifiable substances" is questionable. The decomposition and disappearance of starch at 60° C. is remarkable. There are no usually employed mechanical, chemical, or microscopical methods for distinguishing between air-dried and kiln-dried wood. There are at present in operation commercial kiln-drying processes which produce seasoned wood fully as good as air-seasoned wood.

If we had seen statements of this kind made in a trade journal, in patent specifications or in the newspapers, we would not have taken the trouble to point out the mistakes, but articles appearing in publications like the *Journal* of the Society of Chemical Industry are supposed to be authoritative, and it would be a mistake to allow such inaccuracies to remain unnoticed. —I am, Sir, etc., L. F. Hawley,

In Charge Section of Derived Products

United States Department of Agriculture,
Madison, Wisconsin

"THE REFEREEING OF SCIENTIFIC PAPERS"

Sir,—Improvements in the editing of scientific papers valuable to authors were advocated in the article published under the above title in *Chemistry and Industry* of July 11 ; readers also could benefit from changes within the scope of editorial authority.

Editorial insistence on an explicit usage of terms would aid the ordinary reader. A change or growth of connotation not officially sanctioned and recorded is most apt to lead to a mistaken interpretation. The worst confusion arises when individual writers put new meanings into old terms, which thus may acquire contradictory meanings.

Chlorine is said to be a "mixture" of chemically identical elements with diverse masses. According to the original significance of the word "mixture," chlorine should be separable by diffusion at a predictable rate. Experimentally the separation of the chlorine isotopes is, if accomplished, certainly much slower than for a "mixture" separated by any physical process ; it is assumed to be impossible chemically. As the main implication of the term originally was separability, this use to include the almost or quite inseparable is infelicitous. A "syndicate" of isotopes is a possible alternative ; the derivation implies unity of action, the common connotation is an undisclosed method of action and measure of cohesion.

Editorial rules for the term "electron" also are very desirable. Amongst the varieties discussed are valency, inner, cementing (colloidal) and shared electrons. Although neither matter nor the electron can be defined completely, the properties or attributes used in an investigation can be stated. If the attributes in different researches are incompatible, then the varying brands of electrons should be distinguished clearly. As originally conceived the electron had position, inertia and an invariable electric charge, the electric field being symmetrical and uniform in grade. In this field every electron would act on or "share" every other; the concept of a partial or restricted "sharing" is contradictory to that of a symmetrical field. A special term, *e.g.*, "amberon," derived like electron from amber, for an electron with a polarised field would make for clarity. For the "cementing" electron, an undeveloped concept, "amberguiton," suggests itself.—I am, Sir, etc.,

Manchester E. F. MORRIS
August 27, 1923

THE FIRST USE OF SYMBOLS

SIR,—I shall be greatly obliged if some of your readers will explain when chemical symbols and formulæ came into use. I find them sparingly used by Graham in 1833, and a list of the symbols of the then known elements is given by Berzelius (my edition is dated 1835), but many chemists in much later times seem to have made no use of them.—I am, Sir, etc.,

August 31, 1923 ANALYST

PERSONALIA

Mr. W. A. Davidson, formerly assistant chemist in the laboratory of the Dominion Public Health Department, Winnipeg, has been appointed director of the Dominion Health Laboratory for British Columbia.

The Canadian parliament has voted a life annuity of $7,500 to Dr. F. G. Banting, the discoverer of insulin, to enable him to devote himself entirely to research work.

Dr. V. L. Bohnson has resigned his post as Assistant Professor of Chemistry, in the University of Wisconsin, to join the staff of the Oldbury Electro-Chemical Co., Niagara Falls, N.Y.

* * *

With great regret we announce the death of Dr. E. K. Muspratt, in his ninetieth year. An obituary notice appears on another page.

We regret to announce the death of Mrs. H. Ayrton, whose name will be remembered in connexion with researches on the chemical arc.

The death is announced of Dr. M. P. C. Potvliet, chemist of the Dominion Sugar Co., and the author of papers on sugar refining, etc.

NEWS AND NOTES

UNITED STATES

The Absorption of Carbon Dioxide

In the course of work on the absorption of gases, the U.S. Bureau of Standards has obtained some interesting data on the absorption of oxygen in water and of carbon dioxide in solutions of sodium carbonate. It was found unexpectedly that carbon dioxide dissolved less rapidly in normal carbonate solutions than in pure water, despite the possibility of the formation of bicarbonates. To determine the effect of the viscosity of the absorbent solution on this phenomenon, determinations were made with aqueous solutions of sugar having the same viscosity as the sodium carbonate solutions, but the decreased absorption in carbonate solution still remained.—(*Chem. & Met. Eng., July* 30, 1923.)

Chromite in 1921

The U.S. Geological Survey reports that the total sale of domestic ore in 1921 was 282 long tons, equivalent to 245 long t. of 50 per cent. ore. Although this quantity is trifling as compared with that sold during the war, it is close to the average annual production from 1900 to 1913, inclusive, which was 232 t. Of the total quantity sold in 1921, 68 t. came from California and 214 long t. from Oregon. In spite of the large imports in 1920 and the large reserve accumulated, imports in 1921 were remarkably high, amounting to 81,836 long t., the result doubtless of the low prices, the average price, $8, being even less than the average of $9·56 in 1913. It is thought that a large reserve supply is available, perhaps enough for more than a year's consumption. The imports, were derived chiefly from British South Africa, 23,318 t.; Canada, 7554 t.; French Oceania, 35,108 t.; Greece, 8104 t.; and Turkey in Asia, 5822 t. The imports of chromium compounds were small as compared with the consumption. The apparent consumption of chromite during 1921 was 82,118 long t., which compares with 152,777 long t. in 1920. Sales of ferrochrome in 1919 and 1920, the only years for which figures are yet available were estimated at 15,763 long t. in 1919, and 16,606 t. in 1920. The quantity of 50 per cent. chromite required to yield this amount of ferrochrome, on the arbitrary assumption of no loss of chromium in slag, would be 31,700 long t. for 1919 and 33,400 long t. for 1920. The world's output of chromite in 1920 is estimated to have been 190,000 metric tons.

FRANCE

The Third Congress of Industrial Chemistry

Further details are to hand of the Congress which, as we have previously announced (*Chem. & Ind., p.* 818, 1923), is to be held by the Société de Chimie Industrielle from October

21-27. The Organising Committee has decided that the moment is opportune to treat important questions relating to agriculture, and has accordingly invited experts of various nationalities to deal with these questions in three conferences. Sir John Russell will speak on "The Relation between Soil Organisms and Soil Fertility," and Prof. Menozzi, director of the Higher School of Agriculture, Milan, will read a paper on "The Development of Agriculture" on October 22. On October 24, Prof. Lindet will describe the reconstruction of the sugar factories, distilleries and breweries. The task still awaits geologists and biologists of modernising and industrialising the methods of agriculture, and this aspect of the question will, it is hoped, be particularly emphasised at the meeting. As in former years all branches of chemistry will be represented at the meetings of the fifteen technical and economic groups of the Congress, of which the general recorder is, as at previous meetings, Monsieur Maurice Deschiens. Apart from national representation, scientists representing many foreign societies will take an active part in the work of the Congress. The Congress will be initiated on October 21 with a reception of the foreign delegates, followed by an artistic and musical evening. On October 22 and 23 the time will be devoted to the important conferences mentioned above and to the meetings of the technical groups, and on October 24 the closing meeting will be followed by a banquet under the presidency of Monsieur Chéron, Minister of Agriculture. Visits will be paid on October 25 to the food products factory of F. Potin and to the Ménier chocolate works, where Monsieur Ménier will offer a lunch to those attending. The excursion to Rheims on October 26 will include a reception at the Cathedral and a dinner offered by the Champagne producers, followed by a visit to the wine-cellars.

Members of this Society should be reminded that the French Society has offered, through the medium of its President, Monsieur Paul Kestner, a most hearty invitation to them to attend the meeting in Paris.

Standardisation

The *Journal Officiel* of July 8, contains a list of standards to be applied, within six months, to sheets, plates, tubes, bars and sections of light, strong alloys; to platinum and platinum alloys; to industrial zinc; and to various iron and steel products used in shipbuilding.

GENERAL

Low Temperature Carbonisation

The Fuel Research Board has recently issued a report (Technical Paper No. 7, H.M. Stationery Office, 9d.) entitled, "Preliminary Experiments into Low Temperature Carbonisation of Coal in Vertical Retorts," and containing an account of work carried out at H.M. Fuel Research Station, East Greenwich, with a set of four vertical retorts. These retorts were originally designed for high-temperature carbonisation, but it was considered that the experience gained by experiments with these retorts would help in designing retorts better adapted to low-temperature carbonisation. The new retorts have been completed, but trials have not yet begun and some time must elapse before any results can be published. This report has thus been issued as it was thought that an account of the preliminary work would be of value, especially the results relating to the distribution of temperature in the retort under various conditions of steaming.

Ramsay Memorial Department of Chemical Engineering at University College, London

The work of the Ramsay Memorial Department of Chemical Engineering at University College, London, will begin in October, 1923. This department has been instituted with the object of enabling young graduates in chemistry and engineering, who have already obtained a good training in the fundamental sciences of chemistry, physics and mathematics, to direct their studies and investigations towards the application of the principles of physical chemistry to the scientific design and operation of the apparatus and processes of chemical industry in general.

Mr. E. C. Williams, M.Sc. Vict., has been appointed Professor in charge of the department, and the University College Committee will shortly appoint an Assistant Lecturer, who must have had an engineering training. The commencing salary will be either £350 or £400, according to the previous training and experience of the man appointed.

British Standardised Steel Samples

The Iron and Steel Institute and the National Physical Laboratory issue the following standards:—No. 1, Sulphur ($S=0{\cdot}027\%$); No. 2, Sulphur ($S=0{\cdot}071\%$); No. 3, Phosphorus ($P=0{\cdot}029\%$); No. 5, Carbon ($C=0{\cdot}65\%$) Acid O-H Steel; No. 6, Carbon ($C=0{\cdot}10\%$) Basic O-H Steel. These samples are supplied, post free, at 21s. per bottle of 50 grammes, together with a certificate of standardisation. The samples can be obtained from The National Physical Laboratory, Teddington; or from Prof. C. H. Desch, Sheffield University; Dr. C. A. Edwards, University College, Swansea; Col. E. L. Johnson, Cleveland Technical Institute, Middlesbrough; or Mr. D. A. MacCallum, West of Scotland Iron and Steel Institute, 93, Hope Street, Glasgow.

Metallurgy in Luxemburg

Although the situation of metallurgy in Luxemburg had improved considerably during recent months, it is now greatly hampered by a shortage of coke. At Esh only 5 out 6 blast-furnaces are working, at Dudelange 4 out of 6, at Dommeldange 1 out of 3, at Beral 4 out of 6. The works at Esh are closed down, as are those of the Hadir coal at Rummelange. Altogether, out of 47 blast-furnaces only 26 are alight.

Blast-furnace Slag as Track-metal

After thorough investigation in the German materials-testing station at Dahlem the use of blast furnace slag as a track metal has been approved. Only such slags may be used as have been obtained in the form of blocks or bars. Special rules have been made regarding the production and use of such slags, in respect of their size, resistance to shock, permeability, and so on. (*Cf.* "Die Bautechnik," No. 9, 1923). The regulations supply a need, since not only are they a basis for the application of the metal to railway purposes, but the stipulated tests also provide a means of judging the suitability of slags as "metal" for other purposes.

REPORT

REPORT ON THE COMMERCIAL AND INDUSTRIAL SITUATION IN HUNGARY, DATED MARCH, 1923. *By* R. J. E. HUMPHREYS. *H.M. Commercial Secretary, Budapest. Department of Overseas Trade. Pp.* 38. *H.M. Stationery Office,* 1923. *Price* 1*s.* 6*d.*

The year was an exceedingly difficult one, and though an apparent improvement was to be seen (*cf.* J., 1922, 335 R), the actual daily life of the population did not improve. After an interval of industrial peace, extensive strikes occurred and at the date of the report 70,000 people were out of work.

Agriculture is the chief industry, the exports of agricultural products being an important source of income, and the preserved meat and vegetable canning trades are becoming important. Developments have occurred, however, in the engineering industry. The coal industry was eminently satisfactory in 1922; 741,000 tons of bituminous coal was produced, 605,000 t. being imported and 271,000 t. exported. Of lignite 5,615,760 t. was produced, 49,823 t. imported and 31,788 t. exported; 133,236 t. of coke was imported and 4767 t. exported.

The statistics show that during 1922, Hungary imported 3½ million t. of goods, valued at £25,540,000, compared with exports amounting to 1½ mill. t., valued at £14,000,000. In 1921 the figures were £23,257,000 and £12,050,000 respectively. The chief imports were textiles; coal formed 7 per cent. of the total imports in 1922, chemicals 2 per cent., iron and ironware 2 per cent., and mineral oils 1·7 per cent. The chief exports were wheat and rye flour 20·0 per cent., machinery and electrical materials 12 per cent., and iron and ironware 3·1 per cent. Most of the trade is done with Austria, Czechoslovakia and Rumania. It is anticipated that trading conditions will improve when Hungary is sufficiently stable to enter into commercial agreements with all countries; some are already in force.

REVIEWS

THE PHASE RULE AND THE STUDY OF HETEROGENEOUS EQUILIBRIA: AN INTRODUCTORY STUDY. *By* A. C. D. RIVETT, M.A., B.Sc. *Pp.* 204. *Oxford: The Clarendon Press,* 1923. *Price* 10*s.* 6*d.*

In this little book the author endeavours to provide the student with an introduction to the study of heterogeneous equilibrium which is based on a stricter application of the principles of the phase rule than is usual in most introductory text-books. The author's presentation of the subject is logical, and evidently the product of much thought and care. It should prove a valuable book for the student to read alongside Prof. Findlay's book on the same subject. It does not attempt to cover the same ground as is covered in Prof. Findlay's book by the description of the results of experimental studies of a number of important cases of heterogeneous equilibrium; but it has the compensating advantage that it includes clear explanations of complete space-diagrams which should help the student to obtain a broader view of the whole problem. A short but well-written chapter on "Some Thermodynamical Considerations" is one of the chief features of the book.

There are 118 figures in the book, which help very materially in understanding the subject matter. Only one small mistake has been noticed, namely in Figure 16, in which presumably the whole of the curve P_A P_B, should appear above the dotted horizontal line.

H. T. TIZARD

THEORETICAL CHEMISTRY FROM THE STANDPOINT OF AVOGADRO'S RULE AND THERMODYNAMICS. *By* PROF. W. NERNST. *Fifth edition, revised in accordance with the eighthtenth German edition by* L. W. CODD, M.A. *Pp. xx*+922. *London: Macmillan and Co., Ltd.,* 1923. *Price* 28*s.*

Since the fourth English edition of this work was published in 1916, very important advances have been made in that province which forms the common meeting ground of chemists and physicists, and these have necessitated an unusually thorough revision of the text of various sections as well as the addition of a considerable amount of new matter.

The general character of the book is so well known that a reference to the changes which have been introduced will amply suffice for the purpose of this review. For the most part, the new material has been selected with care, and having regard to the limitations of space, it may be said that a very considerable measure of success has been achieved in the presentation of the more recent discoveries.

The chapters on radioactivity, pp. 480-490, and on the molecular theory of the solid state, pp. 269-292, have been largely re-written, and significant additions have been made to the sections dealing with the structure of atoms, the applications of X-ray spectroscopy and the determination of molecular magnitudes. Attention may also be directed to the very clear exposition of the quantum theory, the applications of which are discussed in relation to the problem of the specific heats of solids, the determination of the Avogadro number and the interpretation of the energetics of photochemical change. As might be expected, the sections devoted to the Nernst heat theorem and its applications are admirable in their lucidity.

In the preface to the German original, the author claims that the theories which have been selected for discussion in the earlier editions have in nearly all cases justified their inclusion in the light of subsequent developments. It may be doubted whether such a claim can be put forward in the future. The theory of electrolytes propounded by Ghosh affords a case in point. This theory has been very favourably considered by Nernst, who describes it as affording the solution of a problem which has occupied the attention of investigators for a period of thirty years. Recent criticisms of the theory give an entirely different impression of the status of the Ghosh hypothesis, and the translator has found it necessary to add a footnote to the effect that the theory must be accepted with considerable reserve in the absence of further confirmation.

In the chapter on the kinetic theory, attention is directed to the equation of state propounded by Wohl, which is described as surpassing all previous formulæ in the accuracy with which it reproduces experimental results over a wide range. As an empirical formula, the equation of Wohl has undoubted merits, but in view of the more recent scrutiny to which the equation has been submitted, it appears very doubtful whether it can be regarded as having any satisfactory theoretical basis.

The doctrine of the equipartition of energy, inappropriately referred to as the theory of degrees of freedom, is subjected to severe condemnation. The author states that he has never been able to understand "that investigators of the first rank, like Maxwell, Boltzmann and W. Gibbs, . . . should have shut their eyes to the fact that the consequences of the theory were in many ways absolutely contradictory to experience, and that therefore the fundamental principles of the theory needed modification." So long as there is any vestige of doubt as to the way in which this principle should be applied to particular types of statistical systems, the dogmatic attitude implied in the above statement seems scarcely appropriate in a text-book of this type. There are undoubtedly differences of opinion on the matter.

Sundry circumstances serve to remind readers that the present translation is based on a German revision completed in 1920. The absence of any account of the important developments which are associated with the Lewis-Langmuir theory of atomic and molecular structure and the nature of chemical combination, and also of recent work on the kinetics of reactions in heterogeneous systems, may be cited as affording an indication of the gap between the present state of our knowledge in certain directions and that of the year of revision.

As a general text-book, the work of Nernst has, nevertheless, many unique and valuable features. Although it can no longer be said to deal adequately with all the branches of physical chemistry with which the advanced student is supposed to have some degree of familiarity, yet its qualities entitle it to be placed in the front rank as one of the sound and philosophic expositions of the outlines of general theoretical chemistry. The translator has produced a very readable version of the German original, and in this the particular merits of the author's mode of treatment of the subject matter have not been allowed to suffer in any way.

H. M. Dawson

Aluminium and its Alloys: Their Properties, Thermal Treatment, and Industrial Application. *By Lieut.-Col.* C. Grard. *Pp.* xxiii+184. *London: Constable and Co., Ltd.*, 1921. *Price* 17*s*. 6*d*.

In reviewing a translation the reviewer undertakes a double task, for he is called upon to appraise both the original book, and the work of the translator or translators. In the present case it is pleasant to be able to say at the outset that if Colonel Grard's book had to be translated the work could not have been better done than Messrs. C. M. and H. W. L. Phillips have done it. Serious errors in translation are singularly few, although one or two have crept in. One such error, which consists, apparently, in the rendering of the French word "soudure" as "soldering," instead of as "welding," which was almost certainly intended, has completely vitiated the sense of Chapter VI, Book I, Part II, which deals with the welding of aluminium. The text, however, runs remarkably smoothly for a translation, although, in the present writer's opinion, the first person plural, so beloved of French scientists and English first-year students, is ill adapted to the purpose it is here called upon to serve. That, however, is merely a matter of taste. Generally speaking, the translation is an excellent piece of work.

The book itself is extremely disappointing. It is not, as its title would imply, a text book on aluminium and its alloys, but an account of some researches carried out by the author, or by several French public testing laboratories on his behalf. The whole is divided into two books, to which are added six appendices, giving the analytical methods used in the course of the research, details of the mechanical tests carried out by the public laboratories referred to above, and a reprint of a paper by the author on the "Thermal Treatment of Duralumin."

Book I is devoted to pure aluminium, and is so full of mis-statements and inaccuracies as to be of no value at all. Two or three examples will suffice to justify this condemnation. Thus, for instance, Chapter I purports to give the physical properties of aluminium. It occupies a short page and gives values for six properties of which five are wrong according to recent determinations. Turning to the chemical behaviour of the metal, the following remarkable sentence is found :—"The explanation of this change (under the influence of chemical, physical or mechanical agencies) refers partly to indisputable phenomena and partly to hypotheses which probably have the advantage of lying very near the truth." This is followed by the statement that "air and ordinary water, acting alternately, have less effect than water alone." As it has been abundantly proved that oxygen is essential to the corrosion of aluminium, the foregoing statement might be said by the uncharitable to lie very near the truth.

In the sections devoted to the mechanical properties of the metal, the elastic limit of work-hardened sheet with a tensile strength of 11·43 tons is given as 11·11 tons per square inch, a figure which is likely to lead any engineer who relies upon it into serious difficulties. In the same section the author describes investigations, the object of which was to determine the time necessary to complete the process of annealing at various temperatures. He finds that at temperatures from 100° C.—300° C. an exposure of five minutes suffices, and this though he was aware of the work of Carpenter and Taverner (cited on a subsequent page), who have shown conclusively that at some of the temperatures within this range (*e.g.* 200° C.), exposure for many years is required before annealing is complete!

The reader who has met statements of this kind in Book I, is not likely to commence the reading of Book II with much confidence. Should he do so, he will be met near the outset by a statement that an alloy containing 3·1 per cent. of copper and 11·60 per cent. of zinc, has a tensile strength of 6·98 tons per square inch. Now the composition of the alloy in question is almost exactly that of the most popular English casting alloy, L5, for which the British Engineering Standards Association specification demands a minimum of 11 tons. A little later he will find the statement that the results produced by quenching the series of alloys of which duralumin is the best known, are "due to the presence of the magnesium or of the magnesium and zinc." This statement ignores altogether the important rôle assigned by recent investigators to the silicon and copper, which are regular constituents of these remarkable alloys.

However, enough has probably been said to indicate that this is no book to place in the hands of students, whilst the advanced worker is little likely to derive any benefit from its perusal.

RICHARD SELIGMAN

RAYS OF POSITIVE ELECTRICITY AND THEIR APPLICATION TO CHEMICAL ANALYSES. *By* SIR J. J. THOMSON, O.M., F.R.S. *Second edition. Pp. x+237. London : Longmans, Green and Co.*, 1921. *Price* 16*s*.

This is a new edition (the second) of Sir J. J. Thomson's well-known book, and gives a very full account of all the new work that has appeared since the date of the first edition (1913). This applies especially to the work of Aston and Dempster, and to the author's own recent work. The application of positive rays to chemical analysis and the bearing of investigations by this method on the nature and structure of atoms and molecules are fully discussed. The book is not only of fascinating interest for every student of science, but also of the utmost importance for chemists. Probably the time is very near when every chemical laboratory will *possess* a positive ray outfit. Already one can say that every University Chemical Laboratory *requires* (even though it does not possess) one, and the same statement applies with equal force to important industrial research laboratories.

F. G. DONNAN

DICTIONARY (ENGLISH-CHINESE) OF THE COMMON ELEMENTS AND THEIR CHIEF COMPOUNDS. *By* PROF. J. L. HOWE, M.A., *and* P. P. PAN. *Pp. iv+60. Shanghai, China : Commercial Press, Ltd.*, 1923.

In view of the increasing output of scientific literature written in Chinese or Japanese characters, a need has arisen for some form of technical dictionary. An attempt to meet this need has been made in the pamphlet under review, which gives, both in English and in Chinese, the names, occurrence (*i.e.*, whether a commercial or laboratory product, or an ore), formula, molecular weight, crystalline form and solubility in common reagents of the commoner elements and their compounds in tabular form. The list of atomic weights needs revision (that of antimony appears as 102·2 instead of 120·2), and although spelling such as "iodin," "sulfid," "sulfate," etc., is doubtless accepted in the United States, the propriety of phrases such as "Antimony Sulphide-tri" or "Chromium Chlorid (ic)" is questionable. The pamphlet, though very limited in scope, should prove useful to those who desire to ascertain the Chinese ideographs for common chemicals, as well as to Chinese students, for whom it is primarily intended.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Aug.* 30)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Algeria ..	Metals, sugar	258, 259
Brazil ..	Drugs, chemicals ..	267
British India	Lubricating oil, electric cable (tender) ..	*
Canada ..	China clay	245
,, ..	Fire bricks	11947/E.D./M.C./2
Chile ..	Oil, iron (tender) ..	8589/F.L./G.C./2
,, ...	Manganese steel (tender)..	8588/F.L./E.C./2
Cyprus ..	Leather	247
Far East ..	Metal, iron and steel bars	261
Morocco ..	Steel (tender) ..	11352/F.E./E.C.
Norway ..	Raw hides, salt, soda	252
Poland ..	Chemicals	254
Rumania ..	Lead tubes (tender) ..	11368/F.E./E.C./2
Switzerland	Drugs	256
United States	Ferro-alloys, china clay, fuller's earth ..	264
,, ,,	Portland cement, ammonium sulphate, fish oils	265
,, ,,	Galvanised sheets, tinplate	20293/1/F.W.

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* Director-General, India Store Dept., Branch No. 10, Belvedere Road, S.E. 1.

TARIFF CUSTOMS EXCISE

British India.—The Indigo Cess (Repealing) Act, now passed, repeals the Acts providing for the levy of a cess on exports of indigo.

New Caledonia (*French*).—A modification of import duties has been applied to oils, resin, spirits of turpentine, calcium carbide, hydrogen peroxide, sulphuric acid, rubber belts and packing.

San Salvador.—Perfumery is now dutiable at the old rate of 40 centavos (gold) per kg.

South Africa.—Imported patent and proprietary medicines of undisclosed composition and for general sale are dutiable.

Southern Rhodesia.—A rebate of the duties has been granted on methylated spirits, medicinal preparations, acetic acid, and perfumed spirits.

COMPANY NEWS

MINERALS SEPARATION, LTD.

At the 18th annual general meeting held on August 29, the chairman, Mr. F. L. Gibbs, said that although progress was slow, the company was steadily gaining a worldwide position of great strength in the coal and metalliferous industries that would amply repay them in future. The department for dealing with the cleaning and briquetting of coal would probably be the first to produce income on a large scale. Last year it was intended to construct a large briquetting works on a site acquired by the Powell Duffryn Steam-coal Co., Ltd., and Minerals Separation, Ltd., at Newport, but as the French Powell Duffryn Co. had decided to erect a large plant at Nantes, it was decided to await the completion and operation of this plant before erecting that at Newport. The working of the Nantes plant had proved their estimates of costs to be right, and arrangements for the erection of the plant at Newport could now be made. The hardness of the briquettes made by the new wet-briquetting system satisfied the standard demanded by the French State Railways, and in addition this fuel was purer than other patent fuel, for it was cleaned of all free ash, a factor which, in combination with the physical structure, was probably responsible for the large calorific power of these briquettes. It was anticipated that in 1925 plants utilising the company's processes for briquetting coal would be producing over 10,000 tons or even more per day. Not only would returns be received in royalties from these processes, but the company would be part owners of many of the works utilising them. Several collieries in this country and in Spain were utilising these processes for cleaning coal for coking, plants were being erected in France, Belgium and Germany, and the use of the processes was being considered in India.

A plant to test the ore-reduction process for the treatment of oxidised silicate and carbonate copper ores had been erected in Australia and another was being erected in the United States. If the plant erected by the Bwana M'Kubwa Copper Mining Co., Ltd., in Northern Rhodesia, gave successful results, the company had in conjunction with others the right to underwrite an issue of further capital by the Bwana Company to be used, in part, for the erection of a large plant. The Bwana Mine contained already over 8,000,000 t. of good grade copper ore, and the success of the process should make the company extremely profitable. With the resumption of active operations at the end of the Broken Hill Strike, there was every prospect that the company's Australian business would be profitable for many years. He hoped that later in the year he would be able to announce that their new metals processes, especially those applied to copper, had been as successful as the processes used for treating coal.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Trade generally continues very flat with no sign of any upward movement. Home trade enquiries are common but there is no volume of business. Export trade in heavy chemicals continues comparatively good. Manufacturers have reduced the price of Borax Commercial by £2 per ton.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d.—5s. per carboy d/d. Quiet in textile circles.
Acid Nitric 80° Tw.	£23 per ton.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton.
Ammonia Alkali	£7 12s. 6d.—£8 per ton. General export demand good, particularly from the Continent.
Arsenic (White)	£72—£73 per ton. Not much doing.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Copper Sulphate	£25 10s.—£26 per ton.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	5¾d.—6d. per lb. d/d.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s.—£5 per ton. Export demand continues good and manufacturers are in many cases fully sold for some time ahead.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Carload lots 9¼d. per lb. Less quantities 10½d. per lb. ex wharf London. Ample supplies.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8—£10 per ton, according to grade. Market quieter.
Iron Liquor	1s. 7d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d.—6s. 4d. per gall. 60% P.O. Fairly regular demand.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5—£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 1½d.—1s. 2d. per lb. Market well maintained and a better enquiry for spot parcels is experienced.
Crude 60's	3s. 3d.—3s. 4d. per gall.
Acid Cresylic—97/99	2s.—2s. 5¼d. per gall. Fair business.
Pale 95%	1s. 11d.—2s. 4¾d. per gall.
Dark	1s. 10d.—2s. 0½d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price.
Anthracene Oil—	
Strained	8¾d.—10d. per gall. Supply short.
Unstrained	8½d. per gall.
Benzole—	Fair enquiry.
Crude 65's	1s. 1½d. per gall.
Standard Motor	1s. 6½d. per gall. delivered buyer's works.
Pure	2s. per gall. delivered buyer's works.

Toluole—90%	1s. 8d.—1s. 10d. per gall. Market quiet.
Pure	2s. per gall.
Xylol	3s. 3d. per gall., according to quality.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8¼d.—9¾d. per gall. Fair enquiry.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 4d.—1s. 6d. per gall.
Solvent 90/190	1s. 4d.—1s. 7d. per gall. Fair enquiry.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Supply short.
Whizzed or hot pressed	£11—£12 per ton. Quiet.
Naphthalene—	
Crystals	£21 per ton.
Flaked	£17 10s. per ton.
Pitch, medium soft	132s. 6d.—145s. per ton. Market quiet.
Pyridine—90/140	19s.—20s. per gall. Market very strong.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	5s. per lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic. tech.	1s. 8d.—1s. 9d. per lb.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works. Price hardening. Large export demand.
Aniline Salts	9½d. per lb.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	5s. 2d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.—6½d. per lb. Prices firm with a good steady demand.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/24° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
d-Dichlorbenzol	£75 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£90 per ton d/d.
Dinitrotoluene—48/50	8d.—9d. per lb. naked at works.
66/68	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	5s. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	2s. 11d.—3s. per lb. Market rather firmer.
Acid, Benzoic	2s. 3d. per lb. Supplies more plentiful, but price maintained.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Citric	1s. 5½d.—1s. 6½d. per lb., less 5%. Supplies in excess of demand.
Acid, Gallic	3s. per lb. for good white with slight reduction for quantity.
Acid, Pyrogallic, Cryst.	5s. 9d. per lb. For large orders 5s. 6d. is accepted.
Acid, Salicyclic	2s.—2s. 4d. per lb. Market firm and prices well maintained.
Acid, Tannic	3s. per lb.
Acid, Tartaric	1s. 2d. per lb. less 5%. Market continues weak.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 5d. per lb. Market very quiet.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz.
Barbitone	18s. per lb. Inclination for price to fall.
Benzonaphthol	5s. per lb.
Bismuth Salts	A steady market.
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides	There are still heavy stocks here to be realised, so that higher prices are not likely at present.
Calcium Lactate	2s. 6d. per lb. for best makes. Better enquiry.
Chloral Hydrate	3s. 9d. per lb. for duty paid. Improved demand.
Chloroform	2s. 2d. per lb. for cwt. lots. Demand is poor.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	Can now be imported free from duty. Spot supplies very scarce and prices erratic from £100—£110 per ton. Lower prices for forward delivery.
Guiacol Carbonate	8s. 6d. per lb.
Hexamine	3s. 6d. per lb. Prices easier, sales slow.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.

Magnesium Carbonate—	
Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	65s.—75s. per cwt., according to quality & quantity.
Menthol	45s. per lb., less 2½%. Market rising owing to speculation.
Mercurials	Very much weaker. Reduced 6d. lb. all round. Quicksilver reduced to £8 15s. per bottle.
Methyl Salicylate	2s. 3d.—2s. 6d. per lb. according to containers.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Metol	8s. 9d. per lb.
Morphine and Salts	Prices advanced about 6d. per oz., due to higher price of opium. Alkaloid: Cryst. 11s. 6d., Precip. 11s. 3d., Acetate 9d., Hydrochlor. 9s., Sulphate 9s. per oz.
Paraformaldehyde	3s. 6d. per lb.
Paraldehyde	1s. 4d. per lb. for quantity.
Phenacetin	6s. per lb. Sales steady.
Phenazone	7s. per lb.
Phenolphthalein	6s. 6d. per lb. Temporarily in short supply.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s.—3s. 6d. per lb., according to quantity.
Potass. Iodide	15s. 8d. per lb. Good demand. Steady market.
Potass. Metabisulphite	5d. per lb. Spot value somewhat lower.
Potass. Permanganate	9½d. per lb. for large quantities.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz. in bulk packages. Steady demand.
Resorcin	5s. 6d. per lb.
Salol	3s. per lb. Demand small, price firm.
Silver Proteinate	10s. per lb. A weaker market.
Sod. Benzoate	2s. 3d. per lb. Continental prices are being maintained.
Sod. Citrate, B.P.C. 1923	2s. 3d. per lb.
Sod. Hyposulphite—	
Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—87s. 6d. per cwt. Fairly good demand.
Sod. Salicylate	Powder 2s. 5d.—2s. 7d. per lb., and Crystal at 2s. 7d.—2s. 9d. per lb. Prices firmer and likely to advance.
Sod. Sulphite, anhydrous	£27 10s.—£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25—£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.—1s. 4d. per lb.
Thymol	14s. per lb. for best white crystal.

PERFUMERY CHEMICALS

Acetophenone	10s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. 9d. ,, ,,
Amyl Butyrate	7s. 6d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	4s. 3d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	2s. 9d. ,, ,,
Benzyl Benzoate	3s. 3d. ,, ,,
Cinnamic Aldehyde Natural	18s. 6d. ,, ,,
Coumarin	18s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	15s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	35s. ,, ,, Advanced.
Geraniol	5s. 6d.—12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. 6d. per lb.
Linalol ex Bois de Rose	21s. ,, ,,
Linalyl Acetate	21s. ,, ,,
Methyl Anthranilate	8s. ,, ,,
Methyl Benzoate	8s. 6d. ,, ,,
Musk Xylol	11s. ,, ,,
Phenyl Ethyl Acetate	20s. ,, ,,
Phenyl Ethyl Alcohol	17s. 6d. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	2s. 1d. ,, ,,
Terpineol	3s. 1d. ,, ,,
Vanillin	22s. 3d.—23s. 6d. per lb. Firm with steady demand.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	29s. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4¾d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 2d. ,, ,,
Ceylon	3s. 9d. ,, ,,
Clove Oil	8s. ,, ,,
Eucalyptus Oil 70/75%	2s. 4d. ,, ,,
Lemon Oil	2s. 10d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	12s. per lb.
Otto of Rose Oil—	
Bulgarian	33s. 6d. per oz.
Anatolian	24s. per oz.
Palma Rosa Oil	20s. per lb.
Peppermint Oil—	
English	80s. ,, ,,
Wayne Country	13s. ,, ,,
Japanese	9s. ,, ,, Market rising owing to speculation.
Petitgrain Oil	7s. 3d. per lb.

TRADE NOTES

Trade Information

Technical Advertising.—Lavoisier once pointed out that facts, to be properly understood, must be properly expressed. In an interesting and well-produced booklet, the Technical Advertising Service, of 44, Bedford Row, London, W.C. 1, utilises Lavoisier's words to show the value of technical advice to the advertisers of technical products. As the difference between general and technical advertising is perhaps not sufficiently understood, this pamphlet should prove of value to those who have to market chemical and allied products, a field in which the "Service" has specialised.

Photography for Commercial Purposes.—We have received a copy of *The Professional Photographer*, which contains a suggestive account of the use made of photography by W. and T. Avery, Ltd., Birmingham, in advertising their weighing, testing and counting machines. As photographs are being increasingly used for propaganda for a wide range of products and other advertising work, it will be of interest to state that copies of the article can be obtained by applying to the Wratten Division of Kodak, Ltd., Kingsway, W.C. 2.

The French Chemical Market

The heavy chemical market in France was fairly quiet during August, and no great fluctuations were noted in prices of the chief products. The market is, however, active and certain factories are finding difficulty in keeping up regular deliveries. The following prices are quoted:—Sulphuric acid (53° Bé), 16·50–17 fr., 66° 27–28 fr.; nitric acid (30°), 130—132 fr.; hydrochloric acid (20—21°), 12—16 fr.; ammonia (22°), 110—115 fr.; caustic soda (76—77°), packed, 110 ft. For secondary chemical products, orders arrive regularly and prices vary very little. Despite the calm relatively usual to the glass industry in summer, orders are being received. Shortage of supplies of bichromates and sodium sulphide is felt in the tanning industry. There is a firm demand for many dye wares, and importation from England and Switzerland is taking place. Orders for dyes are scarce, and certain indispensable raw materials have reached high prices owing to their scarcity. Prices of products for the bleaching industry remain unchanged. There is a poor demand for glues and gelatins.

PUBLICATIONS RECEIVED

Industrial Filtration. *By* A. Wright, M.E. *Vol. I. The Modern Library of Chemical Engineering. Pp.* 336. *New York: The Chemical Catalog Co., Inc.*, 1923. *Price* $5.

The Bulletin of the British Association of Chemists. *Vol. I. No.* 5. *July*, 1923. *Pp.* 16. *London: Bedford House, Baker Street*, 1923.

Report on the Commercial, Industrial and Financial Situation in Japan, 1922, and up to June 30, 1923. *By* Sir E. T. F. Crowe *and* H. A. F. Horne. *Department of Overseas Trade. Pp.* 64. *London: H.M. Stationery Office*, 1923. *Price* 2s.

The Viscosity of Cellulose. *R. D. Report, No.* 22 (*Part III*). *Research Department, Woolwich. H.M. Stationery Office*, 1923. *Price* 1s. 9d.

Dictionary of the Common Elements and their Chief Compounds. *By* Prof. J. L. Howe, Jr., *and* P. P. Pan. *Pp.* 60. *Shanghai, China: Commercial Press, Ltd.*, 1923.

Proceedings of the Engineers' Society of Western Pennsylvania, July, 1923. *Vol.* 39. *No.* 6. *Pp.* 38. *Pittsburgh*, 1923. *Price* 50 *cents.*

Chemistry as a Career. A Synopsis of Lectures given by the Registrar before College Chemical Societies during 1921—1923. *Institute of Chemistry of Great Britain and Ireland. Pp.* 26. *Cambridge: W. Heffer and Sons, Ltd.*, 1923.

Silica in Canada; Its Occurrence, Exploitation and Uses. *By* L. Heber Cole. *Part I.—Eastern Canada. Canada Department of Mines. Pp. v*+126. *Ottawa: Government Printing Bureau*, 1923.

German Research on the Manuring of Forests.—The utility of manuring forests by means of mineral manures is still an open question, possibly because the matter has been tested from the wrong standpoint. In general the soil is chiefly deficient in nitrogen, so that the addition of potash and phosphates would be useless, whereas as soon as nitrogen is provided in an assimilable form astounding results are obtained. Comparison of pine trees grown for twenty years with and without nitrogenous fertilisation showed the growth of the manured trees to be on the average nearly three times that which had not been manured. The manuring was effected either by lupin plants or by surrounding the trunk with brushwood of broom or pine. The question of stimulating the growth of trees deserves attention in consideration of the present timber shortage.

Dr. W. A. Dyes, editor and author of the International Handbook on the Chemical and Allied Industries of the World, informs us that he is now endeavouring to complete the second volume of the "Handbook," in which he hopes to include a limited number of illustrations of works, etc., characteristic of each country. Those who wish to take advantage of this offer should send photographs or blocks of the size 4 by 3½ or 7 by 4 inches to Dr. W. A. Dyes, Berlin-Wilmersdorf, Landhausstr 9.

Erratum.—On p. 829, col. ii., of the issue of August 31, second paragraph, line 12, for "compound (usually alkaline)," read "compound, usually aniline."

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EDITORIAL

THE publication of a book on Ink by Mr. Ainsworth Mitchell reminds us that probably some little injustice has been done to him in this periodical. Some time ago we received an article on pencil marks and the history of the use of the pencil which in due course we published. Mr. Mitchell wrote stating that this article was very largely a paraphrase of his own work and that the source should have been suitably acknowledged. This letter was duly published and as our contributor has not replied the presumption is that Mr. Mitchell has a genuine ground of complaint. The editors of weekly—and we suppose daily—papers have in many cases neither the necessary knowledge to identify the sources of information of the numerous articles on many different branches of human knowledge, nor the time to hunt these up or to submit them to those who are reputed to be experts. They are, to this extent, at the mercy of their contributors and sometimes become their victims. We have received, and printed, communications from some who appeared to put forward unorthodox views, from others who seemed to combine elementary science with a vivid imagination, and from some even whom we suspected to be endeavouring to perpetrate mild hoaxes. Such matters cause us neither anxiety nor regret. But when the work of one person is made use of, even when put into different language, it is usual to indicate the source of it, and it is far more important to do what is usual than to do what each one considers to be suitable. For this reason, and probably no other, we wear collars, we shave in our youth and go bald in the prime of life. We ourselves are studiously conventional and though our own editorial conscience is untroubled we feel that Mr. Mitchell may reasonably be dissatisfied. As our contributor has, whether by reason of holidays or any other reason, given us no explanation we feel justified on his behalf in stating that if by some mischance the usual courtesy has not been observed the omission is much regretted; we trust that he and all others will in future remember this point.

We print in this issue an important article by Professor G. T. Morgan on the dyestuff industry in this country. The state of this industry presents an acute and difficult problem for the consideration of those who control our national well-being. The interest of the consumer is to have cheap dyes from the cheapest source where they can be satisfactorily made. The interest of the manufacturer is to have a reasonable profit on the manufacture, regard being had to our depressed trade, to high prices, high rates of wages and high rates and taxes. The interest of the State is to encourage employment both in the case of the consumer and the manufacturer and also to encourage the development of a successful chemical industry in this country. The reconciliation of these conflicting interests is no easy task. Everyone engaged in business knows that the inflation of foreign currencies, if continued for a considerable time, tends to national insolvency, but that while the inflation is continuing the foreign manufacturer is able to export at a price which is impossible for a country which conducts its finances more prudently. The Germans, the Italians and some other manufacturers can at the present time undersell us in very many commodities. The present condition of the world is wholly exceptional and remedies are suggested and tried, which are appalling to those whose political articles of faith were firmly implanted a score of years ago. But we think we are hardly overstating the case if we say that no country can in the future be a great industrial one and reasonably secure from the horrors of invasion unless it has a flourishing chemical industry. Chemistry will play a more and more important part in manufacture, not only the simple chemistry of the heavy trade, and the more complex chemistry of the fine variety, but also chemistry complicated to an extent hitherto undreamed of. British chemistry as a whole requires a flourishing dyestuff industry here, and if we as a nation really believe this we shall get it. Noteworthy as the progress has been, scientific research alone is insufficient protection.

THE NEW DYESTUFFS INDUSTRY OF GREAT BRITAIN

By Prof. GILBERT T. MORGAN, D.Sc., F.R.S.

The development of the synthetic colour industry has rightly been regarded as one of the romances of modern science, and this dramatic history assumed a tragic aspect for Great Britain and her Allies in 1914, when it was tardily discovered by the Governments concerned that the predominance of Germany in this branch of applied chemistry meant an overwhelming advantage to the enemy in the production of munitions of war. This intimate connexion between dye-production and the manufacture of high explosives was well known to the small group of English chemists who had devoted themselves to the study of coal-tar products, but the warnings of these experts were entirely disregarded by the superior folk who then, as now, affected to repudiate the truth of the old adage, *Si vis pacem, para bellum.*

It is only too evident that the terrible lessons of the war are being rapidly forgotten by our politicians, without distinction of party, and it is, accordingly, of national interest to survey the changes which have recently been effected in our capacity for the production of dyes and intermediates, bearing in mind the fact that the plants needed for these peace-time requirements would be relied on, in an emergency, for the manufacture of war materials.

Pre-war Period

In the twenty years preceding 1914 the manufacture of synthetic colours was carried on to a limited extent in this country by some eight firms, the largest of which had a share capital of the order of £200,000, but several of the others were on a much smaller financial scale. In many cases the plant was defective and ill-adapted to the purpose of dye-making. The number of chemists employed in supervising the processes and in research work was quite insufficient and the laboratory facilities for these workers were very inadequate. The generally accepted statement that 20 per cent. of our requirements in dyes was then met by the home production of colours is probably an unduly favourable estimate, inasmuch as even this restricted manufacture was to a considerable extent dependent on foreign intermediates which were merely assembled here to be converted into finished dyestuffs.

From time to time the statement occurs in the popular press that synthetic colour-making is an English industry which the Germans stole from us. This, however, is a totally erroneous view to take of the situation. It is true that the first pioneering discovery was made in England, and that certain of the older and simpler coal-tar dyes were manufactured in this country earlier than in Germany. But the fact remains that the great developments, including the establishment of the large Rhenish colour works, were due entirely to German chemists and industrialists. With the aid of large staffs of highly-qualified chemists and other well-trained scientific workers, entirely new intermediates and colouring matters were discovered and produced on a commercial scale, so that in 1914 the manufacture of these complicated organic chemicals was a well-established German monopoly. As an outstanding example of this supremacy it may be mentioned that at this epoch the whole of the vat dyes, including synthetic indigo, were the products of continental firms, and that no attempt had then been made by British manufacturers to produce either these materials or effective substitutes.

Chemists and engineers, working in close co-operation in the German factories, over a period of fifty years, had developed a technical skill in the manufacture of coal-tar products which was largely lacking in this country. Even the inorganic heavy chemicals required in these industrial syntheses were not procurable in sufficient quantities or at reasonable prices. Fuming sulphuric acid, chlorine, sodamide and sodium hydrosulphite were either too costly for the colour-maker or quite unobtainable. Special large-scale appliances for fractional distillation under reduced pressure or for digestion of reagents at high temperatures and under high pressure were not manufactured in this country. Of the few autoclaves then in use by English firms the majority were supplied by the firm of Krupp, and at the outbreak of war much of the dimethylaniline required in the manufacture of tetryl, an important military high explosive, was produced in these Krupp vessels. Even the simpler and more generalised factory plants were deficient in capacity, as was seen when the sudden demand arose for enormous quantities of TNT.

In consequence of these restrictions the few chemists engaged by English firms had no opportunity of gaining practical experience in the large-scale production of the more complicated intermediates and dyes. On the other hand, the dye users were lulled into a false sense of security and were offered every inducement to employ German rather than English colours, even when the latter were procurable. The agents and technical experts of the powerful German syndicates were always at hand to impress the British dyers and printers with the desirability of preferring German dye-wares. This campaign of peaceful penetration was only too successful. Those of the English dye-makers who still endeavoured to compete against their powerful continental rivals were in low water financially, whereas other firms, which, to a large extent, had become distributing houses for German colour-makers, found it much more lucrative to blend foreign dyes than to manufacture their own. Colour faking had become more profitable than dye-making.

The war revealed, as in a lightning flash, the abyss into which the pre-war British dyestuffs industry had fallen, and the next phase in the development of the home colour-trade is the history of a desperate attempt to establish an entirely new dyemaking industry of sufficiently comprehensive character to render the users independent of foreign supplies.

The War Period

This creative task, difficult enough in normal times of peace, was rendered infinitely more complicated by the circumstance that the activities of the newly-erected colour works were largely diverted to the manufacture of service explosives and materials for chemical warfare. Nevertheless, considerable extensions were made in dye-production, and, in addition to supplying suitable dyes for all our naval and military requirements, the British makers manufactured sufficient colour to dye the uniforms and accoutrements of the French and other Allies, whose resources had been diminished by invasion.

Chief among these wartime developments was the formation of the national company (British Dyes, Ltd.), which, in the first instance, was formed by taking over the old-established firm of Read Holliday and Sons, of Huddersfield. Subsequently, an amalgamation was effected with Levinstein, Ltd., of Blackley, a progressive firm which had previously absorbed Claus and Co., Manchester, and had acquired the German-owned synthetic indigo works at Ellesmere Port. The merger company has now been in operation for several years under the title of the British Dyestuffs Corporation, Ltd., an organisation comparable in financial strength with one of the large German combinations.

Meanwhile, a remarkable advance had been made in the direction of vat colours. The Sundour Fabrics Co., of Carlisle, under the direction of Mr. James Morton, had up till 1914 been large users of the modern fast vat dyes, and faced with an entire stoppage of German supplies this firm had, in 1915, begun to experiment on the manufacture of these colours. This audacious attempt on the part of dye users was very successful, and the enterprise, under the name of Scottish Dyes, Ltd., now owns two colour works at Carlisle and at Grangemouth.

In the pre-war period, the British Alizarin Co. manufactured alizarin red and a few other dyes of this series under a convention with the German makers. The war freed the firm from these restrictions, and in its new works at Trafford Park this undertaking now deals with the production of a wide range of colours based on anthraquinone.

The firm of L. B. Holliday and Co., starting at Huddersfield in 1916 as manufacturers of picric acid (lyddite) by a new process, have since developed into a dye-making enterprise covering a wide field of production.

Another German-owned factory situated at Rainbow Port, on the Manchester Ship Canal, was acquired by Messrs. Brotherton, with the result that the company is in a position to carry on the manufacture of colour from coal tar to the finished dye. This firm, which specialises in mordant colours and especially those used on a chrome basis, has also established in this country the large scale production of sodium hydrosulphite, a chemical essential to modern vat dyeing.

Mention should be made of the fact that the Gas Light and Coke Co. and the South Metropolitan Gas Co. now carry the purification of certain coal-tar crudes to a far higher degree of refinement than before 1914. These large gasworks also produce some of the more widely used coal-tar intermediates.

Altogether there are now upwards of twenty firms engaged in the manufacture of dyes and accessory products, with the result that during the later years of the war the requirements of the dye users were largely met by home-made colouring matters, with the exception of certain special dyes imported by the Swiss makers.

During the war period the shortage of dyes was acute and prices were very high. It is not surprising, since everything had to be improvised, that the new dye-makers concentrated on producing the desired colours at all costs without going closely into the matter of economical production. Plants had to be extemporised and experience gained by factory trials under entirely new conditions. Many of the requisite colours were soon forthcoming in sufficient quantities, although at first the methods of production were uneconomical and, moreover, the products were not always uniform as regards strength and purity of shade. Yet so great was the demand that dye consumers gladly accepted these experimental batches of colour even at high prices. It is not apparent that by doing so the users were appreciably hindered in their business, for generally they contrived to pay their dividends even with the heavy prices for colour then ruling.

The Post-War Period

The foregoing conditions were prolonged beyond the Armistice by the industrial boom which then developed, but with the passing of this period of trade inflation new conditions of international competition arose. Cheap foreign dyes again became available, largely as the result of the Sankey judgment, which flooded the country with considerable quantities of these imports.

The prices of dyes, which had risen continuously from 1914 until 1920, now began to fall, and this tendency still prevails at the present time.

The Present Capacity for Dye Production in Great Britain

As already mentioned, upwards of twenty firms are now engaged in manufacturing intermediates and dyestuffs with a total productive capacity far greater than that possessed by the few pre-war factories. This increase has resulted not only from the extension and enlargement of older works, but also by the erection of entirely new factories, and if all these works were fully employed it is estimated that they could produce more than 40,000 tons of dyewares per annum. This mass production of colour would probably more than suffice for the needs of home consumers even in a period of expanding trade, and it is evident that if dye manufacturers are to reduce their overhead charges to the minimum by working at full capacity, they must increase their export trade in dyewares. Some extension would result from an increased demand from the Dominions and British Colonies. Any stimulation of this demand by a preference for British-made dyes would be of inestimable value in decreasing to all consumers the cost of these products. It is worthy of note that Australia, like Great Britain, has adopted the policy of limiting the importation of foreign dyes to those which are unobtainable from British makers.

A well-established dye industry, secure in its home and colonial markets, would probably be in a position to sell its surplus products at economic prices in foreign markets, and it is only by such a comprehensive scheme of home and overseas trade that the community can reap the full benefit of the large additional dye plants established during the last eight years either by the State-aided company or by private enterprise.

The Range of Post-War Intermediates and Dyewares

It cannot be too strongly emphasised that our present dye-producing industry is essentially a new development, still in its infancy, for its beginnings only go back about eight years. During its short lifetime the advances made are little short of revolutionary. Indispensable intermediates which had never before been made in Great Britain are now produced in large quantities and of superlative quality. This noteworthy achievement is the result of the joint labours of chemist and chemical engineer. The successful preparation of these complicated organic chemicals in the research laboratories has been followed by expensive but vitally important trials on a semi-works and then on a factory scale. Special plant has had to be devised, and older apparatus has received important modifications to meet the increasingly stringent demands of the modern colour-maker.

Vat Dyes

Perhaps the most striking example of this phenomenal progress is shown by the vat dyes, a group of colouring matters which includes synthetic indigo and the modern vat colours discovered on the Continent since the beginning of the present century. In 1913 the British production of these extremely valuable dyes (excluding indigo) was *nil*, whilst in 1922 it exceeded 82 tons, being about 40 per cent. of the total home consumption of these colouring matters. This immense improvement redounds to the credit of the chemists and engineers concerned, for it consists not merely in working out complicated syntheses in the laboratory but in designing entirely new plant for the carrying out of difficult and dangerous operations on a manufacturing scale.

These mechanical appliances include large size works autoclaves capable of withstanding high pressures, ammonia-recovery plant and special filtration apparatus adapted for the collection of the costly chemical products. Several British engineering firms now specialise in the construction of chemical plant and a new profession, chemical engineering, has come to the front in solving the difficult problems of the economical manufacture of dyes and other chemical products.

The Krupp autoclave has now been replaced by well-designed British types, and a battery of the latter appliances which has recently been installed at the Grangemouth section of Scottish Dyes, Ltd., possesses all the latest devices for efficient working and regulation, coupled with adequate safeguards for the workers who control these high-pressure operations.

The intricate character of vat dye production is illustrated by the fact that in the production of 30 of these colouring matters by the Scottish firm, 290 intermediates are required, and these are all produced in the two works by a staff of about 200 operatives. Thirty chemists are engaged by this company either in supervising the works operations or in carrying on researches on vat colours and allied products. Of the intermediates required in this industry one of the most important is phthalic anhydride, which is manufactured on a very large scale at Grangemouth by the aerial oxidation of naphthalene with the aid of a special catalyst. This very efficient process, which furnishes phthalic anhydride of chemical purity, is entirely under electrical control; the whole installation constitutes a remarkable feat of chemical engineering representing an important technical improvement over the oleum and mercury-catalyst method practised at the Badische Anilin und Soda-Fabrik.

Three other firms, including the Clayton works of the British Dyestuffs Corporation (formerly Claus and Co.), are now engaged in the manufacture of vat dyes, and owing partly to this internal competition and partly to economies discovered in the course of manufacture, the prices of these colours have fallen considerably since 1920. The price of British indanthrene blue alone is now round about eight shillings a pound, but it has been calculated that, owing to the disparity in the exchanges, this colour could be made in Germany at prices ranging from 1½d. to 6d. a pound! It must, therefore, be obvious that without the protection afforded by the Dyestuffs Act the British vat industry would speedily cease to exist.

Before the war there was in England a camouflaged production of synthetic indigo carried out at Ellesmere Port by Meister, Lucius and Bruning in order to comply with the requirements of the Patent Act of 1907. But, unfortunately, the benefits of this statute were nullified by a legal decision, given shortly after the Act became operative, according to which it was held that the statutory provisions were complied with if any one of the processes of the patent were carried out in this country. Accordingly the German firm brought over the penultimate intermediate for indigo synthesis and carried out only the final steps in their English factory. When the Ellesmere Port works were taken over by Messrs. Levinstein in 1917, the process for indigo production was worked out in its entirety, and at present the Dyestuffs Corporation is turning out indigo at 1s. per ℔. But when the British Government takes reparation indigo, and credits Germany with an amount equivalent to the selling price in that country, the price works out at 2d. per ℔., which is approximately one-quarter of the cost of the raw materials of indigo production in this country. Again it is clearly obvious that the British industry cannot compete against competition of this exceptional character.

It is, however, certain that, if fully employed, the Ellesport Port factory could supply all British requirements, for in 1922 it manufactured over one million pounds weight of indigo, or rather more than the amount imported during the same year.

One of the problems still awaiting complete solution is the manufacture of the important sulphur vat-colour, hydrone blue. It has been prepared here on a small scale, but the colour has not yet been put on the market by British makers. The starting point in this manufacture is the coal-tar product, carbazole, which before the war was not isolated in this country from the anthracene fraction of coal-tar distillation. At present it is being produced of superior quality by at least three firms, including the South Metropolitan Gas Co., the Gas Light and Coke Co., and Messrs. Hardman and Holden, Ltd., the last-named firm also preparing in a state of purity acenaphthene, another coal-tar product entering into the production of certain vat colours. These developments are important steps in the direction of increasing our range of British-made colours.

Azo-Dyes

The azo-dyes constitute the largest section of synthetic colours and in this wide field it may be said that the chief problem is the manufacture of intermediates. The conversion of these materials into colours through the agency of the diazo-reaction is a process which generally proceeds without difficulty when the appropriate intermediates are available. Before the war these substances were to a large extent manufactured in Germany, but at present nearly all the important intermediates are produced on a large scale in British factories, and in many instances by more than one firm. For example, the intermediates derived from naphthalene such as the naphthols, naphthylamines, dihydroxynaphthalenes, gamma acid, H acid, J acid, chromotropic acid and β-hydroxynaphthoic acid are all obtainable from British sources in a state of purity often excelling in this respect the German products of the pre-war period.

Aniline and its homologues were made so efficiently in this country before the war that these bases were exported to Germany in considerable quantity. This tradition is worthily maintained by the Turnbridge works of the B.D.C., by Messrs. Hickson and Partners, of Castleford, who produce the xylidines in excellent quality, and by Messrs. Leitch, of Milnsbridge, who make chemically pure *o*-toluidine and who have even surpassed their pre-war reputation in the manufacture of *m*-phenylenediamine and 2:4-tolylenediamine.

Less advance had, however, been made prior to 1914 in the production of benzidine and other diamines leading to direct cotton azo-colours. This branch of intermediate production has been strengthened very considerably and the benzidine bases are now manufactured by the British Dyestuffs Corporation, by the Clayton Aniline Co., and by Messrs. Hickson and Partners.

Included within the wide category of azo-dyes are many valuable acid mordant colours. One of the fastest of these dyes is diamond black P V, introduced into the list of English dyes only since the war, and now manufactured by two firms.

Miscellaneous Intermediates and Dyes

There are still, however, a few intermediates which have not been produced on a works scale. One of these is resorcinol and another is the so-called naphthol A S (the anilide of β-hydroxynaphthoic acid). But since the raw materials, with one or two exceptions, are available from British sources, it may be anticipated that these and other missing intermediates will before long find their place in the list of British manufactures.

One of the foregoing exceptions is methyl alcohol, of which at present there is a great shortage, owing in part to its consumption as a beverage in America in place of the more wholesome ethyl alcohol. The home production of dimethylaniline, important alike in peace and war, has been hindered and rendered more costly by the dearth of wood spirit, and an adequate supply of this important chemical within the British Empire would be of the utmost value to chemical industry. Given a sufficient quantity of methyl alcohol, the dimethylaniline plant of the B.D.C., which was enlarged for military requirements during the war, is of sufficient capacity to cope fully with the demands of British colourmakers for this important intermediate. The production of other alkylated anilines involves the use of ethyl alcohol and the employment of the industrial quality of this spirit is hindered very considerably by the stringency of the existing Excise Regulations. Some relaxation of these Regulations so as to permit of a wider use of duty-free alcohol would be a valuable assistance to the dye industry as well as to other producers of organic chemicals.

Closely connected with alkylated anilines is the manufacture of malachite and brilliant greens and other more modern dyes of the triphenylmethane series. During the war period there was a big demand for triphenylmethane colours of the patent blue type which are produced in part from alkylanilines. The urgency of this demand from the dye users was so great that the B.D.C. erected in their Dalton works an entirely new plant at a cost of £80,000 for the manufacture of the patent blue series. In May, 1920, one of these colours was put on the market at 25s. per pound to meet the competition of the German product then selling at that price. Ten months later the Corporation introduced an improved brand of the colour somewhat superior to the German type and offered it at 13s. 6d. a pound. In the early part of the present year they were prepared to accept bulk orders for this colour at the very closely cut price of 8s. a pound. Their present reward for this highly successful enterprise is that they have now been met by applications for import licenses for the equivalent foreign colours at prices ranging from 4s. 8d. to 6s. 6d. per pound. Consequently the Corporation have been compelled to close down the plant and to cease manufacture. This was the only possible policy for the directors to adopt, having regard to the interests of their shareholders. Had they, however, carried on at a loss by reducing their selling price still further, say to 4s., it is fairly obvious that the English agents of German manufacturers would have filed license applications on behalf of their colour-using clients at still lower prices. That this experience is not limited to colours of a special group is shown by another example cited by the chairman of the Corporation. Owing to the efficient production of the necessary intermediates, the Corporation was able to produce a valuable direct cotton colour in great demand, at 12s. 3d. per pound, and for large quantities they are prepared to take the exceptionally low price of 4s. 3d., which is considerably under the cost of production. The Licensing Committee appointed under the Dyestuffs Act have received applications to import the German equivalents of this colour at 2s. 9d., and these examples of unfair competition could be multiplied.

The Licensing Committee is now the battleground of the user who desires to import a colour and the maker who objects to its importation on the ground that there is a British equivalent. Formerly applications to import were made on the score of quality, but now that the British-made dyes generally approximate to the Continental type in this respect the applications are increasingly put forward on price grounds. A year ago it was agreed to grant applications if the British prices were either more than three times the pre-war prices of the dyes in question, or higher than the current foreign price if the latter happened to be higher than the three-times factor. The makers agreed to this arrangement on the understanding that some financial assistance would be afforded by the Government, but as this anticipation has not been fulfilled, the expediency of retaining the three-times factor is now being questioned.

In this connexion it should be mentioned that, taken over a wide range of dyes, the average present British price is about two and a half times the average pre-war price, and even in the more limited range of anthraquinone dyes the present price is not more than 2·7 times the pre-war quotation. The reason for these comparatively low ratios is that many of the more easily manufactured dyes can be sold with profit at twice the pre-war price or even less. On the other hand, however, there are special dyes difficult to manufacture which could only be sold with profit on the basis of a five or six times factor.

Hence the three-times factor penalises the adventurous maker who endeavours to produce the more highly specialised dyes, inasmuch as he cannot afford to sell the product of the first trial batches at the three-times factor until he has made the economies arising from longer practical experience and from production to the full extent of his plant.

Due regard must be had, however, to the viewpoint of the British dye-users who claim that, by paying for dyes at three times the pre-war prices, they are bearing an undue share of the cost of establishing a dye-making industry in this country. They see their foreign competitors having access to dyes from German sources offered in neutral markets at prices against which no country with a stabilised currency can compete, and their business instinct revolts at the idea of being compelled to purchase in any but the cheapest markets.

So long as foreign dyers and printers are able to obtain their dyes at ridiculously low prices our dye consumers will clamour for a continual lowering of British prices until they reach the German level. It is, therefore, evident that this policy, if consistently pursued, involves the destruction of the new British dyestuffs industry. Possibly, however, those colour users who are alive to the risks involved in the recovery by the German Interessen Gemeinschaft of the monopoly in dyewares, will call a halt before this desperate position is reached. Recent events in the Ruhr have served to awaken a sense of this danger.

FUTURE PROSPECTS OF THE NEW INDUSTRY

The financial interests involved in the well-being of the newly-created dye industry are very considerable. The cost of land, buildings, plant and machinery involved in the development of the British Dyestuffs Corporation alone represents an expenditure of more than £7,000,000. Other firms have spent large sums in the erection of new works, and all these extensions were made at a time when the cost of building and plant was exceptionally high. In most instances the directors have written off large sums as an offset to the abnormal cost of construction and to the rapid depreciation of their chemical plant. But, even with this wise management, the difficulties of the infant industry are very considerable. One of the chief troubles arises from the present trade depression and the consequent diminution in the demand for dye-wares. There are too few orders to keep the plants running at full capacity, and, consequently, the cost of production tends to increase in spite of the economies effected as the result of greater technical experience.

Before new and important colours can be placed on the market many costly investigations have to be carried out. The research expenditure of the British Dyestuffs Corporation during the last four years has amounted to £400,000. Large and well-equipped laboratories have been established with research facilities comparable with those existing in the German colour works. A special feature of this installation is the provision of experimental plant on a semi-works scale. The research staff consists of upwards of thirty chemists of high scientific attainments. Similar research staffs are maintained by the other large dye-producers. This provision for original research has been justified by the rapid extension of the list of British-made colours which is still in progress, and by the introduction of entirely new dyes such as the ionamines of the Dyestuffs Corporation and the Caledon jade-green series of Scottish Dyes.

The continental makers are continuously engaged in improving the quality of their existing dyes and in introducing new colours, as, for example, the neolan series of mordant dyes by the Swiss makers. A defensive policy of research restricted to the imitation of foreign dyes would result in the British makers being always a little behind the latest improvements. It is, of course, essential that our colour producers should strive unceasingly to reduce the number of non-contentious dyes (dyes not made in Great Britain), but it is also desirable that they should seek for entirely new colouring matters, and in this way retain the initiative, which is as important in industrial competition as in military warfare.

The above-described activities in regard to dyes for textile requirements do not represent the total effort which is being put forth by the British colour makers. Attention is being paid to the production of dyes for non-textile purposes, such as the colouring of foodstuffs, varnishes, lacquers and polishes. This side of dye production is to be seen in the old-established works of Williams Bros, of Hounslow, a firm of classical reputation founded by Greville Williams, and the scene of the manufacture of an early monazo colour, chrysoidine, by the Swiss chemist O. N. Witt.

The preparation of pigment colours of brilliant tint and superior fastness was a speciality of the pre-war German dye factories. The intricacies of this manufacture have now been mastered. Lithol red of excellent quality is prepared by the B.D.C., and by Messrs. Oliver Wilkins and Co., of Derby.

Messrs. Leitch and Co., who have devoted special attention to the pigments of the Hansa-yellow series, now manufacture a full range of these colours. The requirements of the paint and colour trades are now almost completely met by the home production of pigments.

Regarded as a standard for the fixing of prices, the pre-war prices of German dyes are somewhat misleading, because for the bulk of their profits the German firms relied on specialities either in colours or in synthetic drugs, photographic chemicals and other high-grade products. The B.D.C. have extended in the direction of these remunerative specialities, and are producing photographic materials and medicinal products such as acriflavine, novocaine, and other drugs. The discovery of new side lines is of vital importance to the progress of the coal-tar products industries.

The most urgent requirement of the British colour-maker at the present time is a stabilisation of prices for a reasonable period. The unfair competition of German dye-makers depending on the devaluation of the mark as a medium of exchange should be met by strong Government action leading to concerted measures by the Allies against Germany. A firm insistence on the prompt payment of reparations would go a long way towards solving the price problem.

Meanwhile, and in spite of the adverse influences of trade depression, unfair foreign competition, excessive taxation and high cost of production, the new dye-making industry has been definitely established in this country. For the time being the German monopoly is broken, inasmuch as the quality of our home production is equal to that of the best foreign types, and our total output of colour is sufficient to satisfy more than 80 per cent. of the requirements of the colour users. During the dislocation of German dye-making produced by the occupation of the Ruhr this percentage of home production was considerably increased. At the outset of this crisis it was a fortunate circumstance for the consumer that the British dye-makers were in a position to meet his demands in view of the uncertainty of German supplies.

Besides furnishing arsenals of sufficient capacity to meet the varied and extensive needs of modern warfare, the British dyestuffs industry is the only scientific business in this country in which during peace time an adequate number of chemists can be trained in the technique of applied organic chemistry. In a national emergency these highly-skilled workers would be essential to the rapid and efficient production of munitions of war. Moreover, the dye-making industry acts as a feeder to other trades in fine chemicals, such as synthetic drugs, photographic chemicals, artificial resins, synthetic tanning materials, and many other scientific products. The failure of our synthetic-dye industry would mean the rapid disappearance of many allied branches of chemical trade. On the other hand, the industrial supremacy and national security of the British Empire are closely bound up with the well-being and progressive development of the newly-created industry in dyes and intermediates. It is in the public interest that the difficulties attending this recent development should be fully appreciated in order that the youthful industry may be nurtured and safeguarded until it attains to a healthy and vigorous maturity.

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THE ELECTRICAL STRUCTURE OF MATTER*

By Prof. SIR ERNEST RUTHERFORD, D.Sc., LL.D., F.R.S.

The discovery of X-rays by Röntgen was published to the world in 1895, whilst the discovery of the radioactivity of uranium by Becquerel was announced early in 1896. Even the most imaginative of our scientific men could never have dreamed at that time of the extension of our knowledge of the structure of matter that was to develop from these two fundamental discoveries, but in the records of the Liverpool meeting in 1896 we see the dawning recognition of the possible consequences of the discovery of X-rays, not only in their application to medicine and surgery, but as a new and powerful agent for attacking some of the fundamental problems of physics. In applied physics, too, this year marked the beginning of another advance. In the discussion of a paper which I had the honour to read, on a new magnetic detector of electrical waves, the late Sir W. Preece told the meeting of the successful transmission of signals for a few hundred yards by electric waves which had been made in England by a young Italian, G. Marconi. The first public demonstration of signalling for short distances by electric waves had been given by Sir Oliver Lodge at the Oxford Meeting of this Association in 1894.

It is of great interest to note that the benefits of this union of pure and applied research have not been one-sided. If the fundamental researches of the workers in pure science supply the foundations on which the applications are surely built, the successful practical application in turn quickens and extends the interest of the investigator in the fundamental problem, whilst the development of new methods and appliances for technical purposes often provides the investigator with means of attacking still more difficult questions. This important reaction between pure and applied science can be illustrated in many branches of knowledge, particularly in the industrial development of X-ray radiography for therapeutic and industrial purposes, where the development on a large scale of special X-ray tubes and improved methods of excitation has given the physicist much more efficient tools to carry out his researches on the nature of the rays themselves and on the structure of the atom. In this age no one can draw any sharp line of distinction between the importance of so-called pure and applied research. Both are equally essential to progress, and we cannot but recognise that without flourishing schools of research on fundamental matters in our universities and scientific institutions technical research must tend to wither.

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* Presidential Address (abridged) delivered before the British Association for the Advancement of Science in Liverpool, on September 12.

It is my intention to refer very briefly to some of the main features of that great advance in knowledge of the nature of electricity and matter which is one of the salient features of the interval since the last meeting of this Association in Liverpool. In order to view the extensive territory conquered by science in this interval, it is desirable to give a brief summary of the state of knowledge of the constitution of matter at the beginning of this epoch. Ever since its announcement by Dalton, the atomic theory has steadily gained ground, and formed the philosophic basis for the explanation of the facts of chemical combination. In the early stages of its application to physics and chemistry it was unnecessary to have any detailed knowledge of the dimensions or structure of the atom. It was only necessary to assume that the atoms acted as individual units, and to know the relative masses of the atoms of the different elements. In the next stage, for example, in the kinetic theory of gases, it was possible to explain the main properties of gases by supposing that the atoms of the gas acted as minute perfectly elastic spheres. During this period, by the application of a variety of methods, many of which were due to Lord Kelvin, rough estimates had been obtained of the absolute dimensions and mass of the atoms. These brought out the minute size and mass of the atom and the enormous number of atoms necessary to produce a detectable effect in any kind of measurement.

Whilst the vaguest ideas were held as to the possible structure of atoms, there was a general belief among the more philosophically minded that the atoms of the elements could not be regarded as simple unconnected units. The periodic variations of the properties of the elements brought out by Mendeléef were only explicable if atoms were similar structures in some way constructed of similar material. We shall see that the problem of the constitution of atoms is intimately connected with our conception of the nature of electricity. At the same time the idea was generally gaining ground that an explanation of the results of Faraday's experiments on electrolysis was only possible on the assumption that electricity, like matter, was atomic in nature. The name "electron" had even been given to this fundamental unit by Johnstone Stoney, and its magnitude roughly estimated, but the full recognition of the significance and importance of this conception belongs to the new epoch.

To clarify these somewhat vague ideas, the proof in 1897 of the independent existence of the electron as a mobile electrified unit, of mass minute compared with that of the lightest atom, was of extraordinary importance. It was soon seen that the electron must be of a constituent of all the atoms of matter, and that optical spectra had their origin in their vibrations. The discovery of the electron and the proof of its liberation by a variety of methods from all the atoms of matter was of the utmost significance, for it strengthened the view that the electron was probably the common unit in the structure of atoms which the periodic variation of the chemical properties had indicated. In the early development of this subject science owes much to the work of Sir J. J. Thomson, both for the boldness of his ideas and for his ingenuity in developing methods for estimating the number of electrons in the atom, and of probing its structure. He early took the view that the atom must be an electrical structure, held together by electrical forces, and showed in a general way lines of possible explanation of the variation of physical and chemical properties of the elements, exemplified in the periodic law.

In the meantime our whole conception of the atom and of the magnitude of the forces which held it together were revolutionised by the study of radioactivity. It was soon shown that the atoms of radioactive matter were undergoing spontaneous transformation, and that the characteristic radiations emitted, viz., the α, β, and γ rays, were an accompaniment and consequence of these atomic explosions. The wonderful succession of changes that occur in uranium, more than thirty in number, was soon disclosed and simply interpreted on the transformation theory. The radioactive elements provide us for the first time with a glimpse into Nature's laboratory, and allow us to watch and study, but not control, the changes that have their origin in the heart of the radioactive atoms. These atomic explosions involve energies which are gigantic compared with those involved in any ordinary physical or chemical process. In the majority of cases an α particle is expelled at high speed, but in others a swift electron is ejected often accompanied by a γ ray, which is a very penetrating X-ray of high frequency. The proof that the α particle is a charged helium atom for the first time disclosed the importance of helium as one of the units in the structure of the radioactive atoms, and probably also in that of the atoms of most of the ordinary elements. Not only then have the radioactive elements had the greatest direct influence on natural philosophy, but in subsidiary ways they have provided us with experimental methods of almost equal importance. The use of α particles as projectiles with which to explore the interior of the atom has definitely exhibited its nuclear structure, has led to artificial disintegration of certain light atoms, and promises to yield more information yet as to the actual structure of the nucleus itself.

The influence of radioactivity has also extended to yet another field of study of fascinating interest. We have seen that the first rough estimates of the size and mass of the atom gave little hope that we could detect the effect of a single atom. The discovery that the radioactive bodies expel actual charged atoms of helium with enormous energy altered this aspect of the problem. The energy associated with a single α particle is so great that it can readily be detected by a variety of methods. Each α particle, as Sir Wm. Crookes first showed, produces a flash of light easily visible in a dark room when it falls on a screen coated with crystals of zinc sulphide. This scintillation method of counting individual particles has proved invaluable in many researches, for it gives us a method of unequalled delicacy for studying the effects of single atoms. The α particle can also be detected electrically or photographically, but the most powerful and beautiful of all methods is that perfected by Mr. C. T. R. Wilson for observing the track through a gas not only of an α particle but of any type of penetrating radiation which produces ions or electrified particles along its path. The method is comparatively simple, depending on the fact, first discovered by him, that if a gas saturated with moisture is suddenly cooled each of the ions produced by the radiation becomes the nucleus of a visible drop of water. The water-drops along the track of the α particle are clearly visible to the eye, and can be recorded photographically.

In the meantime a number of new methods had been devised to fix with some accuracy the mass of the individual atom and the number in any given quantity of matter. The concordant results obtained by widely different physical principles gave great confidence in the correctness of the atomic idea of matter. The method found capable of most accuracy depends on the definite proof of the atomic nature of electricity and the exact valuation of this fundamental unit of charge. We have seen that it was early surmised that electricity was atomic in nature. This view was confirmed and extended by a study of the charges carried by electrons, α particles, and the ions produced in gases by X-rays and the rays from radioactive matter. It was first shown by Townsend that the positive or negative charge carried by an ion in gases was invariably equal to the charge carried by the hydrogen ion in the electrolysis of water, which we have seen was assumed, and assumed correctly, by Johnstone Stoney to be the fundamental unit of charge. Various methods were devised to measure the magnitude of this fundamental unit; the best known and most accurate is Millikan's, which depends on comparing the pull of an electric field on a charged droplet of oil or mercury with the weight of the drop. His experiments gave a most convincing proof of the correctness of the electronic theory, and gave a measure of this unit, the most fundamental of all physical units, with an accuracy of about one in a thousand. Knowing this value, we can by the aid of electrochemical data easily deduce the mass of the individual atoms and the number of molecules in a cubic centimetre of any gas with an accuracy of possibly one in a thousand, but certainly better than one in a hundred.

The idea of the atomic nature of electricity is very closely connected with the attack on the problem of the structure of the atom. If the atom is an electrical structure it can only contain an integral number of charged units, and, since it is ordinarily neutral, the number of units of positive charge must equal the number of negative. One of the main difficulties in this problem has been the uncertainty as to the relative part played by positive and negative electricity in the structure of the atom. We know that the electron has a negative charge of one fundamental unit, whilst the charged hydrogen atom, whether in electrolysis or in the electric discharge, has a charge of one positive unit. But the mass of the electron is only 1/1840 of the mass of the hydrogen atom, and though an extensive search has been made, not the slightest evidence has been found of the existence of a positive electron of small mass like the negative. In no case has a positive charge been found associated with a mass less than that of the charged atom of hydrogen. This difference between positive and negative electricity is at first sight very surprising, but the deeper we pursue our inquiries the more this fundamental difference between the units of positive and negative electricity is emphasised. In fact, as we shall see later, the atoms are quite unsymmetrical structures with regard to the positive and negative units contained in them, and indeed it seems certain that if there were not this difference in mass between the two units, matter, as we know it, could not exist.

It is natural to inquire what explanation can be given of this striking difference in mass of the two units. I think all scientific men are convinced that the small mass of the negative electron is to be entirely associated with the energy of its electrical structure, so that the electron may be regarded as a disembodied atom of negative electricity. We know that an electron in motion, in addition to possessing an electric field, also generates a magnetic field around it, and energy in the electromagnetic form is stored in the medium and moves with it. This gives the electron an apparent or electrical mass, which, while nearly constant for slow speeds, increases rapidly as its velocity approaches that of light. This increase of mass is in good accord with calculation, whether based on the ordinary electrical theory or on the theory of relativity. Now we know that the hydrogen atom is the lightest of all atoms, and is presumably the simplest in structure, and that the charged hydrogen atom, which we shall see is to be regarded as the hydrogen nucleus, carries a unit positive charge. It is thus natural to suppose that the hydrogen nucleus is the atom of positive electricity, or positive electron, analogous to the negative electron, but differing from it in mass. Electrical theory shows that the mass of a given charge of electricity increases with the concentration, and the greater mass of the hydrogen nucleus would be accounted for if its size were much smaller than that of the electron. Such a conclusion is supported by evidence obtained from the study of the close collisions of α particles with hydrogen nuclei. It is found that the hydrogen nucleus must be of minute size, of radius less than the electron, which is usually supposed to be about 10^{-13} cm.; also the experimental evidence is not inconsistent with the view that the hydrogen nucleus may actually be much smaller than the electron.

There is the strongest evidence that the atoms of matter are built up of these two electrical units, viz., the electron and the hydrogen nucleus or proton, as it is usually called when it forms part of the structure of any atom. It is probable that these two are the fundamental and indivisible units which build up our universe, but we may reserve in our mind the possibility that further inquiry may some day show that these units are complex, and divisible into even more fundamental entities. On the views we have outlined, the mass of the atom is the sum of the electrical masses of the individual charged units composing its structure, and there is no need to assume that any other kind of mass exists. At the same time, it is to be borne in mind that the actual mass of an atom may be somewhat less than the sum of the masses of component positive and negative electrons when in the free state. On account of the very close proximity of the charged units in the nucleus of an atom, and the consequent disturbance of the electric and magnetic field surrounding them, such a decrease of mass is to be anticipated on general theoretical grounds.

We must now look back again to the earlier stages of the present epoch in order to trace the development of our ideas on the detailed structure of the atom. That electrons as such were important constituents was clear by 1900, but little real progress followed until the part played by the positive charges was made clear. New light was thrown on this subject by examining the deviation of α particles when they passed through the atoms of matter. It was found that occasionally a swift α particle was deflected from its rectilinear path through more than a right angle by an encounter with a single atom. In such a collision the laws of dynamics ordinarily apply, and the relation between the velocities of the colliding atoms before and after collision are exactly the same as if the two colliding particles are regarded as perfectly elastic spheres of minute dimensions. It must, however, be borne in mind that in these atomic collisions there is no question of mechanical impacts such as we observe with ordinary matter. The reaction between the two particles occurs through the intermediary of the powerful electric fields that surround them. Beautiful photographs illustrating the accuracy of these laws of collision between an α particle and an atom have been obtained by Messrs. Wilson, Blackett, and others, while Mr. Wilson has recently obtained many striking illustrations of collisions between two electrons. Remembering the great kinetic energy of the α particle, its deflection through a large angle in a single atomic encounter shows clearly that very intense deflecting forces exist inside the atom. It seemed clear that electric fields of the required magnitude could be obtained only if the main charge of the atom were concentrated in a minute nucleus. From this arose the conception of the nuclear atom, now so well known, in which the heart of the atom is supposed to consist of a minute but massive nucleus, carrying a positive charge of electricity, and surrounded at a distance by the requisite number of electrons to form a neutral atom.

A detailed study of the scattering of α particles at different angles, by Geiger and Marsden, showed that the results were in close accord with this theory, and that the intense electric forces near the nucleus varied according to the ordinary inverse square law. In addition, the experiments allowed us to fix an upper limit for the dimensions of the nucleus. For a heavy atom like that of gold the radius of the nucleus, if supposed to be spherical, was less than one-thousandth of the radius of the complete atom surrounded by its electrons, and certainly less than 4×10^{-12} cm. All the atoms were found to show this nuclear structure, and an approximate estimate was made of the nuclear charge of different atoms. This type of nuclear atom, based on direct experimental evidence, possesses some very simple properties. It is obvious that the number of units of resultant positive charge in the nucleus fixes the number of the outer planetary electrons in the neutral atom. In addition, since these outer electrons are in some way held in equilibrium by the attractive forces from the nucleus, and, since we are confident from general physical and chemical evidence that all atoms of any one element are identical in their external structure, it is clear that their arrangement and motion must be governed entirely by the magnitude of the nuclear charge. Since the ordinary chemical and physical properties are to be ascribed mainly to the configuration and motion of the outer electrons, it follows that the properties of an atom are defined by a whole number representing its nuclear charge. It thus becomes of great importance to determine the value of this nuclear charge for the atoms of all the elements.

Data obtained from the scattering of α particles, and also from the scattering of X-rays by light elements, indicated that the nuclear charge of an element was numerically equal to about half the atomic weight in terms of hydrogen. It was fairly clear from general evidence that the hydrogen nucleus had a charge one, and the helium nucleus (the α particle) a charge two. At this stage another discovery of great importance provided a powerful method of attack on this problem.

The investigation by Laue on the diffraction of X-rays by crystals had shown definitely that X-rays were electromagnetic waves of much shorter wave-length than light, and the experiments of Sir William Bragg and W. L. Bragg had provided simple methods for studying the spectra of a beam of X-rays. It was found that the spectrum in general shows a continuous background on which is superimposed a spectrum of bright lines. At this stage H. G. J. Moseley began a research with the intention of deciding whether the properties of an element depended on its nuclear charge rather than on its atomic weight as ordinarily supposed. For this purpose the X-ray spectra emitted by a number of elements were examined and found to be all similar in type. The frequency of a given line was found to vary very nearly as the square of a whole number which varied by unity in passing from one element to the next. Moseley identified this whole number with the atomic or ordinal number of the elements when arranged in increasing order of atomic weight, allowance being made for the known anomalies in the periodic table and for certain gaps corresponding to possible but missing elements. He concluded that the atomic number of an element was a measure of its nuclear charge, and the correctness of this deduction has been recently verified by Chadwick by direct experiments on the scattering of α particles. Moseley's discovery is of fundamental importance, for it not only fixes the number of electrons in all the atoms, but shows conclusively that the properties of an atom, as had been surmised, are determined not by its atomic weight but by its nuclear charge. A relation of unexpected simplicity is thus found to hold between the elements. No one could have anticipated that with few exceptions all atomic numbers between hydrogen 1, and uranium 92, would correspond to known elements. The great power of Moseley's law in fixing the atomic number of an element is well illustrated by the recent discovery by Coster and Hevesy in Copenhagen of the missing element of atomic number 72, which they have named 'hafnium.'

Once the salient features of the structure of atoms have been fixed and the number of electrons known, the further study of the structure of the atom falls naturally into two great divisions: one, the arrangement of the outer electrons which controls the main physical and chemical properties of an element, and the other the structure of the nucleus on which the mass and radioactivity of the atom depends. On the nuclear theory the hydrogen atom is of extreme simplicity, consisting of a singly-charged positive nucleus with only one attendant electron. The position and motions of the single electron must account for the complicated optical spectrum, and whatever physical and chemical properties are to be attributed to the hydrogen atom. The first definite attack on the problem of the electronic structure of the atom was made by Niels Bohr. He saw clearly that, if this simple constitution was assumed, it is impossible to account for the spectrum of hydrogen on the classical electrical theories, but that a radical departure from existing views was necessary. For this purpose he applied to the atom the essential ideas of the Quantum Theory which had been developed by Planck for other purposes, and had been found of great service in explaining many fundamental difficulties in other branches of science. On Planck's theory radiation is emitted in definite units or quanta, in which the energy E of a radiation is equal to $h\nu$ where ν is the frequency of the radiation measured by the ordinary methods and h a universal constant. This quantum of radiation is not a definite fixed unit like the atom of electricity, for its magnitude depends on the frequency of the radiation. For example, the energy of a quantum is small for visible light, but becomes large for radiation of high frequency corresponding to the X-rays or the γ rays from radium.

In applying the quantum theory to the structure of the hydrogen atom Bohr supposed that the single electron could move in a number of stable orbits, controlled by the attractive force of the nucleus, without losing energy by radiation. The position and character of these orbits were defined by certain quantum relations depending on one or more whole numbers. It was assumed that radiation was only emitted when the electron for some reason was transferred from one stable orbit to another of lower energy. In such a case it was supposed that a homogeneous radiation was emitted of frequency ν determined by the quantum relation $E=h\nu$ where E was the difference of the energy of the electron in the two orbits. Some of these possible orbits are circular, others elliptical, with the nucleus as a focus, whilst if the change of mass of the electron with velocity is taken into account, the orbits, as Sommerfeld showed, depend on two quantum numbers, and are not closed, but consist of a nearly elliptical orbit slowly rotating round the nucleus. In this way it is possible not only to account for the series relations between the bright lines of the hydrogen spectrum, but also to explain the fine structure of the lines and the very complicated changes observed when the radiating atoms are exposed in a strong magnetic or electric field. Under ordinary conditions the electron in the hydrogen atom rotates in a circular orbit close to the nucleus, but if the atoms are excited by an electric discharge or other suitable method, the electron may be displaced and occupy any one of the stable positions specified by the theory. In a radiating gas giving the complete hydrogen spectrum there will be present many different kinds of hydrogen atoms, in each of which the electron describes one of the possible orbits specified by the theory. On this view it is seen that the variety of modes of vibration of the hydrogen atom is ascribed, not to complexity of the structure of the atom, but to the variety of stable orbits which an electron may occupy relative to the nucleus. This novel theory of the origin of spectra has been developed so as to apply not only to hydrogen but to all the elements, and has been instrumental in throwing a flood of light on the relations and origin of their spectra, both X-ray and optical. The information thus gained has been applied by Bohr to determine the distribution of the electrons round the nucleus of any atom. The problem is obviously much less complicated for hydrogen than for a heavy atom, where each of the large number of electrons present acts on the other, and where the orbits described are much more intricate than the orbit of the single electron in hydrogen. Notwithstanding the great difficulties of such a complicated system of electrons in motion, it has been possible to fix the quantum numbers that characterise the motion of each electron, and to form at any rate a rough idea of the character of the orbit.

These planetary electrons divide themselves up into groups, according as their orbits are characterised by one or more equal quantum numbers. Without going into detail a few examples may be given to illustrate the conclusions which have been reached. As we have seen, the first element hydrogen has a nuclear charge of 1 and 1 electron ; the second, helium, has a charge 2 and 2 electrons, moving in coupled orbits on the detailed nature of which there is still some uncertainty. These two electrons form a definite group, known as the K group, which is common to all the elements except hydrogen. For increasing nuclear charge the K group of electrons retain their characteristics, but move with increasing speed, and approach closer to the nucleus. As we pass from helium of atomic number 2 to neon, number 10, a new group of electrons is added consisting of two sub-groups, each of four electrons, together called the L group. This L group appears in all atoms of higher atomic number, and, as in the case of the K group, the speed of motion of the electrons increases, and the size of their orbits diminishes with the atomic number. When once the L group has been completed a new and still more complicated M group of electrons begins forming outside it, and a similar process goes on until uranium, which has the highest atomic number, is reached.

It may be of interest to try to visualise the conception of the atom we have so far reached by taking for illustration the heaviest atom, uranium. At the centre of the atom is a minute nucleus surrounded by a swirling group of 92 electrons, all in motion in definite orbits, and occupying but by no means filling a volume very large compared with that of the nucleus. Some of the electrons describe nearly circular orbits round the nucleus ; others, orbits of a more elliptical shape whose axes rotate rapidly round the nucleus. The motion of the electrons in the different groups is not necessarily confined to a definite region of the atom, but the electrons of one group may penetrate deeply into the region mainly occupied by another group, thus giving a type of inter-connexion or coupling between the various groups. The maximum speed of any electron depends on the closeness of the approach to the nucleus, but the outermost electron will have a minimum speed of more than 1000 kilometres per second, whilst the innermost K electrons have an average speed of more than 150,000 kilometres per second, or half the speed of light. When we visualise the extraordinary complexity of the electronic system we may be surprised that it has been possible to find any order in the apparent medley of motions.

It is possibly too soon to express a final opinion on the accuracy of this theory which defines the outer structure of the atom, but there can be no doubt that it constitutes a great advance. Not only does it offer a general explanation of the optical and X-ray spectra of the atom, but it accounts in detail for many of the most characteristic features of the periodic law of Mendeléef. It gives us for the first time a clear idea of the reason for the appearance in the family of elements of groups of consecutive elements with similar chemical properties, such as the groups analogous to the iron group and the unique group of rare earths. The theory of Bohr, like all living theories, has not only correlated a multitude of isolated facts known about the atom, but has shown its power to predict new relations which can be verified by experiment. For example, the theory predicted the relations which must subsist between the Rydberg constants of the arc and spark spectra, and generally between all the successive optical spectra of an element, a prediction so strikingly confirmed by Paschen's work on the spectrum of doubly ionised aluminium and Fowler's work on the spectrum of trebly ionised silicon. Finally, it predicted with such great confidence the chemical properties of the missing element, number 72, that it gave the necessary incentive for its recent discovery.

We have not so far referred to the very difficult question of the explanation on this theory of the chemical combination of atoms. In fact, as yet the theory has hardly concerned itself with molecular structure. On the chemical side, however, certain advances have already been made, notably by G. N. Lewis, Kossel, and Langmuir, in the interpretation of the chemical evidence by the idea of shared electrons, which play a part in the electronic structure of two combined atoms. There can be little doubt that the next decade will see an intensified attack by physicists and chemists on this very important but undoubtedly very complicated question.

We must now turn our attention to that new and comparatively unexplored territory, the nucleus of the atom. In a discussion on the structure of the atom ten years ago, in answer to a question on the structure of the nucleus, I was rash enough to say that it was a problem that might well be left to the next generation, for at that time there seemed to be few obvious methods of attack to throw light on its constitution. Whilst much more progress has been made than appeared possible at that time, the problem of the structure of the nucleus is inherently more difficult than the allied problem already considered of the structure of the outer atom, where we have a wealth of information obtained from the study of light and X-ray spectra and from the chemical properties to test the accuracy of our theories.

In the case of the nucleus, we know its resultant charge, fixed by Moseley's law, and its mass, which is very nearly equal to the mass of the whole atom, since the mass of the planetary electrons is relatively very small and may for most purposes be neglected. We know that the nucleus is of size minute compared with that of the whole atom, and can with some confidence set a maximum limit to its size. The study of radioactive bodies has provided us with very valuable information on the structure of the nucleus, for we know that the α and β particles must be expelled from it, and there is strong evidence that the very penetrating γ rays represent modes of vibration of the electrons contained in its structure. In the long series of transformations which occur in the uranium atom, eight α particles are emitted and six electrons, and it seems clear that the nucleus of a heavy atom is built up, in part at least, of helium nuclei and electrons. It is natural to suppose that many of the ordinary stable atoms are constituted in a similar way. It is a matter of remark that no indication has been obtained that the lightest nucleus, viz., that of hydrogen, is liberated in these transformations, where the processes occurring are of so fundamental a character. At the same time, it is evident that the hydrogen nucleus must be a unit in the structure of some atoms, and this has been confirmed by direct experiment. Dr. Chadwick and I have observed that swift hydrogen nuclei are released from the elements boron, nitrogen, fluorine, sodium, aluminium, and phosphorus when they are bombarded by swift α particles, and there is little room for doubt that these hydrogen nuclei form an essential part of the nuclear structure. The speed of ejection of these nuclei depends on the velocity of the α particle and on the element bombarded. It is of interest to note that the hydrogen nuclei are liberated in all directions, but the speed in the backward direction is always somewhat less than in the direction of the α particle. Such a result receives a simple explanation if we suppose that the hydrogen nuclei are not built into the main nucleus but exist as satellites probably in motion round a central core. There can be no doubt that bombardment by α particles has effected a veritable disintegration of the nuclei of this group of elements. It is significant that the liberation of hydrogen nuclei only occurs in elements of odd atomic number, viz., 5, 7, 9, 11, 13, 15, the elements of even number appearing quite unaffected. For a collision of an α particle to be effective, it must either pass close to the nucleus or actually penetrate its structure. The chance of this is excessively small on account of the minute size of the nucleus. For example, although each individual α particle will pass through the outer structure of more than 100,000 atoms of aluminium in its path, it is only about one α particle in a million that gets close enough to the nucleus to effect the liberation of its hydrogen satellite.

This artificial disintegration of elements by α particles takes place only on a minute scale, and its observation has only been possible by the counting of individual swift hydrogen nuclei by the scintillations they produce in zinc sulphide.

These experiments suggest that the hydrogen nucleus or proton must be one of the fundamental units which build up a nucleus, and it seems highly probable that the helium nucleus is a secondary building unit composed of the very close union of four protons and two electrons. The view that the nuclei of all atoms are ultimately built up of protons of mass nearly one and of electrons has been strongly supported and extended by the study of isotopes. It was early observed that some of the radioactive elements which showed distinct radioactive properties were chemically so alike that it was impossible to effect their separation when mixed together. Similar elements of this kind were called " isotopes " by Soddy, since they appeared to occupy the same place in the periodic table. For example, a number of radioactive elements in the uranium and thorium series have been found to have physical and chemical properties identical with those of ordinary lead, but yet to have atomic weights differing from ordinary lead, and also distinctive radioactive properties. The nuclear theory of the atom offers at once a simple interpretation of the relation between isotopic elements. Since the chemical properties of an element are controlled by its nuclear charge and little influenced by its mass, isotopes must correspond to atoms with the same nuclear charge but of different nuclear mass. Such a view also offers a simple explanation why the radioactive isotopes show different radioactive properties, for it is to be anticipated that the stability of a nucleus will be much influenced by its mass and arrangement.

Our knowledge of isotopes has been widely extended in the last few years by Aston, who has devised an accurate direct method for showing the presence of isotopes in the ordinary elements. He has found that some of the elements are " pure "—*i.e.*, consist of atoms of identical mass—while others contain a mixture of two or more isotopes. In the case of the isotopic elements, the atomic mass, as ordinarily measured by the chemist, is a mean value depending on the atomic masses of the individual isotopes and their relative abundance. These investigations have not only shown clearly that the number of distinct species of atoms is much greater than was supposed, but have brought out a relation between the elements of great interest and importance. The atomic masses of the isotopes of most of the elements examined have been found, to an accuracy of about one in a thousand, to be whole numbers in terms of oxygen, 16. This indicates that the nuclei are ultimately built up of protons of mass very nearly one and of electrons. It is natural to suppose that this building unit is the hydrogen nucleus, but that its average mass in the complex nucleus is somewhat less than its mass in the free state owing to the close packing of the charged units in the nuclear structure. We have already seen that the helium nucleus of mass 4 is probably a secondary unit of great importance in the building up of many atoms, and it may be that other simple combinations of protons and electrons of mass 2 and 3 occur in the nucleus, but these have not been observed in the free state.

Whilst the masses of the majority of the isotopes are nearly whole numbers, certain cases have been observed by Aston where this rule is slightly departed from. Such variations in mass may ultimately prove of great importance in throwing light on the arrangement and closeness of packing of the protons and electrons, and for this reason it is to be hoped that it may soon prove possible to compare atomic masses of the elements with much greater precision even than at present.

Before leaving this subject it is desirable to say a few words on the important question of the energy relations involved in the formation and disintegration of atomic nuclei, first opened up by the study of radioactivity. For example, it is well known that the total evolution of energy during the complete disintegration of one gramme of radium is many millions of times greater than in the complete combustion of an equal weight of coal. It is known that this energy is initially mostly emitted in the kinetic form of swift α and β particles, and the energy of motion of these bodies is ultimately converted into heat when they are stopped by matter. Since it is believed that the radioactive elements were analogous in structure to the ordinary inactive elements, the idea naturally arose that the atoms of all the elements contained a similar concentration of energy, which would be available for use if only some simple method could be discovered of promoting and controlling their disintegration. This possibility of obtaining new and cheap sources of energy for practical purposes was naturally an alluring prospect to the lay and scientific man alike. It is quite true that, if we were able to hasten the radioactive processes in uranium and thorium so that the whole cycle of their disintegration could be confined to a few days instead of being spread over thousands of millions of years, these elements would provide very convenient sources of energy on a sufficient scale to be of considerable practical importance. Unfortunately, although many experiments have been tried, there is no evidence that the rate of disintegration of these elements can be altered in the slightest degree by the most powerful laboratory agencies.

It may be urged that the artificial disintegration of certain elements by bombardment with swift α particles gives definite evidence of a store of energy in some of the ordinary elements, for it is known that a few of the hydrogen nuclei, released from aluminium for example, are expelled with such swiftness that the particle has a greater individual energy than the α particle which causes their liberation. Unfortunately, it is very difficult to give a definite answer on this point until we know more of the details of this disintegration.

On the other hand, another method of attack on this question has become important during the last few years, based on the comparison of the relative masses of the elements. This new point of view can best be illustrated by a comparison of the atomic masses of hydrogen and helium. As we have seen, it seems very probable that helium is not an ultimate unit in the structure of nuclei, but is a very close combination of four hydrogen nuclei and two electrons. The mass of the helium nucleus, 4·00 in terms of $O=16$, is considerably less than the mass 4·03 of four hydrogen nuclei. On modern views there is believed to be a very close connexion between mass and energy, and this loss in mass in the synthesis of the helium nucleus from hydrogen nuclei indicates that a large amount of energy in the form of radiation has been released in the building of the helium nucleus from its components. It is easy to calculate from this loss of mass that the energy set free in forming one gramme of helium is large even compared with that liberated in the total disintegration of one gramme of radium. For example, calculation shows that the energy released in the formation of one pound of helium gas is equivalent to the energy emitted in the complete combustion of about eight thousand tons of pure carbon. It has been suggested by Eddington and Perrin that it is mainly to this source of energy that we must look to maintain the heat emission of the sun and hot stars over long periods of time. Calculations of the loss of heat from the sun show that this synthesis of helium need only take place slowly in order to maintain the present rate of radiation for periods of the order of one thousand million years. It must be acknowledged that these arguments are somewhat speculative in character, for no certain experimental evidence has yet been obtained that helium can be formed from hydrogen.

The evidence of the slow rate of stellar evolution, however, certainly indicates that the synthesis of helium, and perhaps other elements of higher atomic weight, may take place slowly in the interior of hot stars. Whilst in the electric discharge through hydrogen at low pressure we can easily reproduce the conditions of the interior of the hottest star as far as regards the energy of motion of the electrons and hydrogen nuclei, we cannot hope to reproduce that enormous density of radiation which must exist in the interior of a giant star. For this and other reasons it may be very difficult, or even impossible, to produce helium from hydrogen under laboratory conditions.

If this view of the great heat emission in the formation of helium be correct, it is clear that the helium nucleus is the most stable of all nuclei, for an amount of energy corresponding to three or four α particles would be required to disrupt it into its components. In addition, since the mass of the proton in nuclei is nearly 1·000 instead of its mass 1·0072 in the free state, it follows that much more energy must be put into the atom than will be liberated by its disintegration into its ultimate units. At the same time, if we consider an atom of oxygen, which may be supposed to be built up of four helium nuclei as secondary units, the change of mass, if any, in its synthesis from already formed helium nuclei is so small that we cannot yet be certain whether there will be a gain or loss of energy by its disintegration into helium nuclei, but in any case we are certain that the magnitude of the energy will be much less than for the synthesis of helium from hydrogen. Our information on this subject of energy changes in the formation or disintegration of atoms in general is as yet too uncertain and speculative to give any decided opinion on future possibilities in this direction, but I have endeavoured to outline some of the main arguments which should be taken into account.

In watching the rapidity of this tide of advance in physics I have become more and more impressed by the power of the scientific method of extending our knowledge of Nature. Experiment, directed by the disciplined imagination either of an individual, or still better, of a group of individuals of varied mental outlook, is able to achieve results which far transcend the imagination alone of the greatest natural philosopher. Experiment without imagination, or imagination without recourse to experiment, can accomplish little, but, for effective progress, a happy blend of these two powers is necessary. The unknown appears as a dense mist before the eyes of men. In penetrating this obscurity we cannot invoke the aid of supermen, but must depend on the combined efforts of a number of adequately trained ordinary men of scientific imagination. Each in his own special field of inquiry is enabled by the scientific method to penetrate a short distance, and his work reacts upon and influences the whole body of other workers. From time to time there arises an illuminating conception, based on accumulated knowledge, which lights up a large region and shows the connexion between these individual efforts, so that a general advance follows. The attack begins anew on a wider front, and often with improved technical weapons. The conception which led to this advance often appears simple and obvious when once it has been put forward. This is a common experience, and the scientific man often feels a sense of disappointment that he himself had not foreseen a development which ultimately seems so clear and inevitable.

It is clear that the splendid period of scientific activity which we have reviewed to-night owes much of its success and intellectual appeal to the labours of those great men in the past, who wisely laid the sure foundations on which the scientific worker builds to-day, or to quote from the words inscribed in the dome of the National Gallery: "The works of those who have stood the test of ages have a claim to that respect and veneration to which no modern can pretend."

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS

The Society of Chemical Industry has in each of the past two years held a dinner in London in the month of October, but for the present year arrangements have been made for an Informal Dinner and a Social Gathering of Chemists under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, which members of these, and of any other of the Chemical Societies, with their friends (including ladies) may attend.

This dinner will be held in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on the evening of Wednesday, October 31, at 7 for 7.30. The price of tickets for ladies or gentlemen will be 12s. 6d. each, not including wine.

Further particulars will be issued later, and the Councils hope that Members of the Societies mentioned, who intend to be present, will make early application for tickets, which must be limited to 300. These will be issued in the order in which applications accompanied by payment are received.

Applications should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2.

A VISIT TO THE ENGINEERING EXHIBITION

By Prof. J. W. HINCHLEY, A.R.S.M., Wh.Sc., M.I.Chem.E.

The Shipping, Engineering and Machinery Exhibition at Olympia, London, which opened on August 31 and will close on September 22, should be visited by all who are interested in the Chemical Industry, for it comes at an opportune time and is full of exhibits of great value. Although trade is bad, we can console ourselves with the knowledge that our credit is good, through the national finances being in good order, and that it ought to be possible to build up again our industrial machine while our competitors are still struggling with unrest. Exhibitions of this kind help towards that end, and this one in particular seems destined to do so.

The number of exhibits which are of direct value to the chemical engineer is very great; several visits will not exhaust the list of possible discoveries. Unfortunately, *discovery* is necessary for the stand system, in which each exhibitor raises barricades against his neighbours, which defeats the real object of the exhibition to a great extent.

An interesting catalogue is issued, but, as is often the case, some of the most interesting exhibits are not mentioned. The classified index, however, is most useful, but could be extended with great advantage.

.Steam power plants and their accessories are shown by the leading firms. The dissected full size chain-grate stoker of Messrs. Babcock & Wilcox, Ltd., and the economiser, with its scrapers in motion, of Messrs. E. Green & Son, Ltd., call for special comment. The model boilers at Messrs. John Thompson's stand give the best practice in Lancashire and similar boilers, and a small vertical boiler shown by Messrs. Robey & Co., Ltd., may be said to be the "latest" in vertical boilers. This boiler is provided with water tubes arranged to give better water circulation than is usual in such boilers.

Messrs. Spencer-Bonecourt, Ltd., show one of their small gas-fired boilers in operation, supplying steam to adjacent stands. The efficiency of the gas governor on this boiler is demonstrated very effectively.

Electric and other motors are shown by many firms; one of these, the "Willing Worker," a small portable or fixed paraffin engine (3 h.p.) exhibited by Messrs. Drummond Brothers, Ltd., together with its associated tools, has great interest for the manufacturer in out-of-the-way places. The associated tools are a specially designed drag saw and a force pump, which form "willing worker units" of great utility.

Every factory manager is aware of the importance of sound design, quality and workmanship in the details of his plant, and of the balance-sheet value of those accessories which, while being effective, need no attention for replacement, repair or breakdown. The exhibition contains a large number of examples of accessories which will attract the practical manager. The B. & S. Packless Valve shown by Messrs. Butler & Son, Ltd., avoids the use of packing, the usual steam leakage and other consequent troubles. The writer has some experience of this valve, the workmanship of which commands admiration. The Reducing Valve of Messrs. Clark & Son, Ltd., is another example of an excellent accessory. It has neither diaphragm nor springs and can be readily adjusted to the required pressure conditions. The same firm exhibits a steam heating system for ships in which only one pipe is used for the connexion with the radiators. The control fitting on each radiator determines circulation by an application of the "Venturi" principle of a converging and diverging nozzle. There seems to be no reason why the system should not be applied to factory and other buildings.

The full-bore valves shown by Messrs. Robey & Co., Ltd., should be carefully inspected. A clear way passage is formed right through the casing while the valve and its seat are sheltered from the flowing fluid. Another valve exhibited by the same firm is a gate valve provided on its back with three stainless-steel pins, which may be screwed on its face and used as a guide for grinding the valve and its seat "true" after removal from the casing. Another gate valve, which has been designed for viscous fluids which tend to cement the parts together, has little more than line contact on the valve face, and the first effect of opening the valve is to "pull" the face of the valve from the seating.

The "Menno" Automatic Compressed Air Grease Cup is another simple device which will recommend itself. The feed of grease is determined by the air trapped and compressed in the upper part of the cup. Apart from the fact that attention to the cup is only required occasionally—every month or so on line shafting, filling being necessary about once a year—the automatic increase of lubricant, should the bearing become warm, is a valuable feature.

Packings for valves and joints of all descriptions are found at many stands.

The J. D. Insulating and Refrigerating Co., Ltd., exhibit a hinge and fastener for doors of refrigerators which ought to be of value on chemical plant. That member of the hinge which is fixed to the door is in two parts, one sliding over the other and held in position by nuts. Should the door sag through wear or other causes, a simple adjustment of the nuts enables the door to close accurately again. The fastener handle is provided with a cam to move the latch and make a tight joint. On opening, the latch may be used for "levering" the door opening when it is cemented in position.

Pipe bending machines are shown at several stands, the well known Kennedy machine at the stand of Mr. Kennedy, and another by Messrs. Major, Robinson & Co., Ltd. A complete hydraulic plant for the purpose is shown by Messrs. T. B. Bilton & Sons, Ltd., and a plant for very thin tubing by Messrs. P. Wilkinson & Sons.

A simple hand machine which deserves special mention on account of its simplicity and cost, and also because coils may be readily made or pipes bent in position by it, is shown by Messrs. Skylux, Ltd.

Measurement, regulation and record keeping are fundamental points in good management and essentials to determine improvement. The Lea Recorder Co., Ltd., show their new "Cubi" meter for coal or similar material. Such a meter enables the engineer in charge to know the amount of coal burnt in every shift. A plate conveyor carries a bed of coal under a hinged flap and a recording mechanism registers the volume of coal passing by integrating the speed of the conveyor with the position of the flap. To demonstrate the practical accuracy of this method the firm shows a volume of small coal perfectly balanced by an equal volume of coal of a larger size.

A simpler type of coal measurer is shown by Messrs. George Kent, Ltd. A spiral vane is inserted in the casing carrying the coal to the boilers or furnaces. The number of revolutions made by the vane determines the volume of coal passing, and is registered by a suitable mechanism. On the same stand may be seen water meters of the Venturi, rotary and piston types for which this firm is justly celebrated.

An interesting instrument—the "Servis Recorder"—is shown by Messrs. Bramco, Ltd. It consists of a small circular box, containing a pendulum and also a clock movement actuating a recording disc of paper. The box is attached to any moving or vibrating part of a machine, lorry, etc. When the particular machine is at work the pendulum vibrates and a point on it marks the registering disc. A complete record is thus obtained of the actual working time of any machine.

The Aster Remote Level Indicator exhibited by the Aster Engineering Co., Ltd., deserves attention. A closed reservoir suspended from a spring balance is connected by flexible piping to the tank, still or boiler above and below the fluid level. It is obvious that the reading of the spring balance will be determined by the level of the fluid and may be transmitted electrically to any place required.

(*To be continued.*)

Dr. A. A. Noyes, director of the Gates Chemical Laboratory of the California Institute of Technology, has been elected an honorary fellow of the Royal Society of Edinburgh.

CORRESPONDENCE

HAFNIUM OR CELTIUM ?

Sir,—According to my opinion, one of the most important questions is whether the element possessing the Moseley No. 72 is to be called Celtium or Hafnium. Having devoted forty-six years to the theoretical and practical study of the elements of the rare-earth series (I was introduced to it in Bunsen's laboratory in 1878), I think that I am enabled to add something to the elucidation of the question. *Celtium* was discovered by Urbain in 1911. He photographed its spectrum, but, unfortunately, he published the wave-lengths of the strong lines only and not of the weak ones. It may be doubted whether the years 1911-12 are the real birthday of Celtium, but most certainly this element, the Moseley number of which is 72, was rediscovered or discovered by Dauvillier and Urbain in spring, 1922 (*cf. Nature*, June 17, 1922), by its Röntgen spectrum (*l.c.*, May 22, 1922).

This discovery was confirmed more than half a year later, but in spite of it Messrs. Coster and Hevesey have used the same method and obtained the same result, though the lines were measured a little more accurately (later on the lines were measured with greater accuracy by Dauvillier and Urbain); the two Danish physicists declare this "72" element a new one, and give it the new name "Hafnium."

A polemic took place between Urbain and the Danish physicists, but only a chemist who is a specialist in this department (a pretty difficult one) is able to see that splendid physicists may show a great want of a truly "chemical sense." First of all they use the names, "Aldebaranium" and "Cassiopeium," in spite of the fact that the International Committee for Atomic Weights has declared eleven years ago, under the presidency of Ostwald, that the names given by the first discoverer, (Neo) Ytterbium and Lutecium, must be adopted, Urbain having the priority of their discovery.

Messrs. Coster and Hevesey give an historical account of the discovery of "new" elements in zircon, but they ignore the names of Linnemann and of Pribram. Equally in their history of the splitting up of Marignac's Ytterbium they ignore the important fact that Nilson, when he discovered Scandium in 1879, not having it quite pure (free from Yb), concluded that it is a tetravalent earth-element with the atomic weight, Sc=180 (*i.e.*, to-day Moseley's No. 72). One of the leaders in the chemistry of the rare-earths could not distinguish whether really this element is ter- or tetra-valent, the earth, R_2O_3 or RO_2. Really Sc more resembles Th than La.

And the Danish physicists regard it as a great sin that Urbain regarded his celtium as a rare-earth element.

Messrs. Coster and Hevesey say that "hafnium" possesses physical and chemical properties quite different from those ascribed to a rare-earth element celtium (*Nature*, April 7). But if you ask (or look for) what these chemical properties are you find almost nothing. From the English articles we learn that it is easily separated from Zr, but only in the recent article in the *Chemiker-Zeitung* do they say "by fractional crystallisation of a salt." Only one more very unimportant property is given: that it forms a phosphate insoluble in water. Well, a look into an elementary text-book of qualitative analysis would have convinced the said physicists that all elements form insoluble phosphates—except the alkalis. Messrs. Coster and Hevesey always speak of their "hafnium" as being an analogue of zirconium, but they never say that its higher analogue is thorium and that it must possess properties lying between the two elements :—

IV	Zr	Ct-Hf	Th
	90	180	232

But we must not forget that Th, being more positive, is quantitatively precipitated as oxalate.

The chief "chemical argument" of Coster and Hevesey against Urbain is that the solutions of Hf are not precipitated by oxalic acid. It may be that in certain circumstances it is true of the pure salt solutions (see the analogous behaviour of Zr), but if they conclude that the fractions in which celtium was found by Urbain were purified by precipitation with oxalic acid and could not therefore contain any element 72, they are perfectly wrong. An element having the properties between Zr and Th must be precipitated by oxalic acid when other rare earths are present and will go down with them into the precipitate. So this great and heavy "chemical" argument disappears like fog.

But last, not least, Messrs. Hansen and Werner have measured the part of the spectrum lying between 2559-3497 A.U., obtained with a one-prism Hilger quartz spectrograph, and give the wave-lengths for 52 "hafnium" lines. I beg to direct the attention to the fact that some of the lines absolutely coincide with the Yb ("Ad") lines measured by Exner and Hatschek in 1911 with great exactness, other lines come extremely near to lines of Yb, Lu and Zr—*i.e.*, within the limits of experimental error due to a one-prism spectrograph.

We must conclude that the said physicists do not know the literature of the subject in question: they do not know the important work published by Exner and Hatschek as long as twelve years ago. The only work they quote is the dissertation of Bachem on the zirconium spectrum published in Bonn (1910), but the lines do not seem to be determined with great exactness.

One other chief argument of the Danish physicists is that the lines (X-ray) observed by Dauvillier and Urbain are not hafnium lines. No proof is given of this assertion, and Coster and Hevesey do not say what these lines, identical with their own, are. They are certainly not lutecium lines.

It may be that the lines of Coster and Hevesey were stronger than those of Dauvillier and Urbain, but when one scientist discovers weaker lines and another scientist stronger lines more than half a year later, is the second scientist to be regarded the true discoverer ?

I beg to ask, what is the good of putting down in print such alternatives as "Es musste demnach entweder die Theorie von Bohr unrichtig sein oder aber die Identifizierung der seltenen Erde Celtium mit dem Element 72." ?

I am a great admirer of Professor Bohr's theory of the atomic structure, but I think the authors would have done better not to mention his name in this connexion, for every rare-earth chemist knows that this "tail" of the fractionation—this most soluble portion—contains a mixture of trivalent and tetravalent earths which are not easily distinguished at once.

Except the X-ray spectrum found by Dauvillier and Urbain, and confirmed by Coster and Hevesey, we have only an incomplete spectrum by Hansen and Werner. No other physical property was determined up to this time (*e.g.*, specific gravity) and chemically this element is very insufficiently characterised. No atomic weight determination is known, and not one salt (except the phosphate) is described.

My opinion is that Prof. Urbain is the real discoverer of celtium and that there is no hafnium.—I am, Sir, etc.,

Prof. Bohuslav Brauner

The University, Prague

PERSONALIA

It is announced that during the meeting of the British Association in Liverpool, the University of Liverpool will confer the honorary degree of D.Sc. upon Sir E. Rutherford, president of the Association; Mr. G. H. Griffiths, treasurer of the Association; and Professors J. C. Maclennan, Neils Bohr and G. M. Lewis, and Dr. J. Schmidt.

The American Chemical Society announces that a trust fund for establishing a fellowship in biological chemistry in the College of Physicians and Surgeons, Columbia University, to be named in honour of the founder, William John Gies, will be presented at the twenty-fifth anniversary of that department on October 1. The committee will also present to Prof. Gies an illuminated book containing letters of appreciation from former students, and from friends in the United States and in Europe.

* * *

From Pittsburg the death is announced of W. F. McCook, founder and president of the Pittsburg Steel Co.

NEWS AND NOTES

SOUTH AFRICA

Production of Vanadium Ore

The *South African Journal of Industries* reports that the two consignments of 25 and 30 tons, respectively, of vanadinite concentrate, averaging 13 per cent. V_2O_5, from the Kaffirs' Krall mine in the Transvaal, constitute the first important shipment of this ore from the Union.

UNITED STATES

Mica in 1921

Mica was produced in 1921 in eight States, the total sales amounting to 2948 short tons, valued at $175,362 and including 741,845 lb. of sheet and 2577 t. of scrap mica. The sales of sheet mica represented a decrease of 56 per cent. in quantity and 78 per cent. in value, compared with decreases of 55 per cent. in quantity and 66 per cent. in value shown by scrap mica. Imports of sheet mica were 164 t. and of splittings 646 t., so that, estimating the export at 70 t., the apparent consumption of sheet mica was 1111 t.—(*Cf. J.*, 1922, 453 R.)

FRANCE

Société Française de Physique

To celebrate its fiftieth anniversary, the French Physical Society is organising a national exhibition to be held in Paris, at the Grand Palais, from November 30 to December 17. The exhibits, classed in nineteen groups, will illustrate the scientific, industrial and commercial applications of physical science, and will include, *inter alia*, apparatus for experimental physics and for biological and physiological physics, electrical and electrochemical apparatus, glassware, insulators, apparatus for optics, photography and the study of light, rare and compressed gases, heat, metallurgy, and measuring and controlling apparatus.

GENERAL

Production of Essential Oils from Citrus Fruits

This industry is centred mainly round the Mediterranean basin and in the British West Indies. Italy is probably the largest producer of essential oils of citrus fruits, the production in 1920 (latest available statistics) being 889,500 kg. and including 635,690 kg. of lemon oil and 111,170 kg. of bergamot oil. Neroli oil is produced in Algeria, and certain amounts are produced in France and Spain. Dominica and other islands of the Leeward Island group produce lime products as well as orange oil. Imports of citrus oils into Great Britain totalled 2,014,325 ℔. in 1921. The consumption in the United States is increasing, imports of lemon oil alone having risen from 450,000 ℔. before the war to nearly 700,000 ℔. in 1922. It is reported that the industrial distillation of citrus oils is being established in Southern India in Mysore.—(*U.S. Com. Rep., May* 14, 1923.)

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Sept.* 7)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina ..	Tinplate, corrugated iron	287
„ ..	Steel piping (tender)	8652/F.L./E.C./2
Australia ..	Steel girders (tender)	12037/E.D./E.C./2
British India	Steel, galvanised sheets (tender) ..	*
Canada ..	Steel tubes	12009/E.D./E.C./2
Egypt ..	Sheet brass	283
Germany ..	Rubber goods, oils ..	278
Italy ..	Oil-mill plant ..	20441/F.W./C.C./2
Netherland East Indies	Soap	286
Netherlands	Leather, paper, dyestuffs, carbonate of soda, yellow soap (tender)	20485/F.W./G.P.
New Zealand	Paper (tender) ..	12019/E.D./M.P.
Norway ..	Iron tubes and fittings	852/15/F.G./E.C./2
South Africa	Tar, tar substitute (tender)	11996/E.D./C.C./2

* The Madras and Southern Mahratta Railway Co., Ltd., 25, Buckingham Palace Road, S.W. 1.

TARIFF CUSTOMS EXCISE

Denmark.—The present issue contains information regarding the marking of imported rubber goods.

Esthonia.—Oil-shale distillation plants and their equipment are admitted duty-free.

Italy.—The manufacturing tax on spirits has been raised, and is now also leviable on methyl alcohol and all other refined alcohols, except ethyl alcohol.

New Zealand.—Glass bottles are now subject to duty, and leathers, goatskins and kidskins are duty-free.

South Africa.—Rebates of duties are allowed on turpentine, oils, tinfoil and motor spirit.

United States.—An investigation is taking place on the differences in cost of production, etc., in respect of metallic magnesium, magnesium alloys, tubing and wire, under the "flexible tariff" regulations.

REVIEWS

TABELLE UND ANLEITUNG ZUR ERMITTELUNG DES FETTGEHALTES NACH VEREINFACHTEM VERFAHREN IN NAHRUNGSMITTELN. FUTTERMITTELN UND GEBRAUCHSGEGENSTANDEN. *By* DR. J. GROSSFELD. *Pp.* 12. *Berlin : J. Springer*, 1923. *Price* 1*s*.

The author explains that the favourable reception which his method has met with, on the part of his colleagues, has caused him to write a short description of what he deems to be a simpler and more rapid process than the older Soxhlet method.

He proposes, for the rapid estimation of fat in such substances as butter, margarine, soap, cheese, cocoa, and baked goods, to dissolve the fat in a given quantity of trichlorethylene (100 c.c.) and to evaporate an aliquot portion (25 c.c.) of the fatty extract. Particulars of the necessary modifications of the method for use with various substances are given. For the convenience of anyone who is sufficiently impressed to use the method, a comprehensive table is appended for the correction for the volume of fat in 25 c.c. of the fatty solution evaporated. E. R. BOLTON

ANLEITUNG ZUR ORGANISCHEN QUALITATIVEN ANALYSE. *By* HERMANN STAUDINGER. *Pp. xiv*+94. *Berlin : Julius Springer*, 1923. *Price* 3*s*.

Inorganic qualitative analysis is apt to degenerate into the mere routine carrying out of a scheme given in the " tables," and for this reason loses much of its educational value. No such systematic tables can be drawn up for dealing with organic products, and consequently the student is compelled to use his own initiative in devising means of separation and identification. For this reason the educational value of organic " spots " is high, and in this country a considerable portion of the student's time has always been devoted to work of this nature. This has not been the case in Germany, but the appearance of Professor Staudinger's book suggests that the value of qualitative organic work is now receiving wider recognition.

Since it is impossible to draw up a systematic scheme which will lead to the identification of any organic compound, books on qualitative organic analysis must be confined to suggesting tests which will gradually narrow down the search and finally lead to identification by the preparation of suitable derivatives. In the book under review organic compounds are first divided into two broad classes, viz., L.F. (leichtflüchtige) and S.F. (schwerflüchtige) Verbindungen, the former consisting of those compounds which boil below 140°. The L.F. class is again subdivided according to the solubility of the compound in water and ether, and finally according to the elements present. The subdivision of the S.F. class is carried out on similar lines, although in greater detail. It will thus be seen that compounds are classified according to their physical properties, rather than according to their chemical reactions, a mistake from an educational point of view. Under each sub-division suggestions are made for the preparation of derivatives. These suggestions are very brief and it is extremely improbable that the average student could carry out the great majority of the preparations without very much further information. For such information the reader is referred to " L," but neither in the list of abbreviations (which is given as a footnote on page 25) nor elsewhere is any explanation of " L " given.

No tables of melting points or boiling points are given, it apparently being intended that the student should refer to Richter's " Lexikon " for information of this nature. This no doubt has the great advantage of familiarising him with the literature, but the time occupied is apt to be excessive, especially when it is merely desired to ascertain whether a given derivative is a solid or a liquid before attempting to prepare it.

The book is well printed on reasonably good paper and is very free from typographical errors. It is not, however, likely to come into general use in this country.

E. DE BARRY BARNETT

DIZIONARIO DI MERCEOLOGIA E DI CHIMICA APPLICATA. *By* PROF. G. V. VILLAVECCHIA, *with the assistance of* PROFS. G. FABRIS, G. ROSSI, A. BIANCHI, *and* R. BELASIA. *Fourth edition, revised and enlarged. Vol. I. Abelmosco-Cuscuta. Pp.* 872. *Milan : U. Hoepli*, 1923. *Price* 36 *lire*.

The issue of a fourth edition of this dictionary of chemical and commercial products testifies to the public appreciation of its worth. Under headings which cover a great variety of subjects, ranging from anthracene, cosmetic waters and plums to white lead, paper, timber, and camphor, are given the names of the product dealt with in various languages, its chemical formula (where possible), its origin, physical and chemical properties, purity, adulteration, uses and other general information. Although the range of subjects covered is so extensive, errors of fact appear to be gratifyingly absent, though in certain cases, *e.g.*, under " Coke," figures need revision. Much of the information of production, trade and customs duties given in small type at the end of each section, is not sufficiently recent to be of much value (though more recent information is given in an appendix), and it is to be hoped that the three forthcoming volumes will be printed on better paper than this one. The dictionary will undoubtedly prove a useful work of reference to scientific as well as commercial readers.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

There is no appreciable change in market conditions. Export business is largely confined to Heavy Chemicals and is being maintained. The Home trade conditions show a slight improvement.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d. per carboy makers' works.
Acid Nitric 80° Tw.	£22 per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton makers' works.
Ammonia Alkali	£7 12s. 6d.—£8 per ton. General export demand good, particularly from the Continent.
Arsenic (White)	£72—£73 per ton. Not much doing.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Copper Sulphate	£25 10s.—£26 per ton.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	6¼d. per lb. d/d.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt· wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Carload lots 9¼d. per lb. Less quantities 10½d. per lb. ex wharf London. Ample supplies.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£8—£10 per ton, according to grade. Market quieter.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d.—6s. 4d. per gall. 60% P.O. Fairly regular demand.
Solvent	6s. per gall. 40% O.P. Demand steady.
Wood Tar	£5—£6 10s. per ton, according to grade. Market quiet.
Brown Sugar of Lead	£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d.—1s. 2½d. per lb. Good demand. Market firmer.
Crude 60's	3s. 3d.—3s. 6d. per gall. Good demand for spot delivery.
Acid Cresylic—97/99	2s.—2s. 5½d. per gall.
Pale 95%	1s. 10d.—2s. 5d. per gall. Market weaker.
Dark	1s. 10d.—2s. 0½d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price.
Anthracene Oil—	
Strained	8¾d.—10d. per gall. Supply short.
Unstrained	8½d. per gall.
Benzole—	Fair enquiry.
Crude 65's	1s. 1½d. per gall.
Standard Motor	1s. 6½d. per gall. delivered buyer's works.
Pure	2s.—2s. 1d. per gall. d/d. buyer's works.

Toluole—90%	1s. 9d.—1s. 10d. per gall.
Pure	2s. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8¼d.—9¾d. per gall. Fair enquiry.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 5d.—1s. 6d. per gall.
Solvent 90/190	1s. 3d.—1s. 6½d. per gall.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Supply short.
Whizzed or hot pressed	£11—£12 per ton.
Naphthalene—	
Crystals	£20 per ton.
Flaked	£20 10s. per ton.
Pitch, medium soft	132s. 6d.—145s. per ton. Market quiet.
Pyridine—90/140	19s.—20s. per gall. Market very strong.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 10d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 7d.—1s. 8d. per lb. Market weaker.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—10d. per lb. naked at works. Price hardening.
Aniline Salts	9½d.—10d. per lb.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	5s. 0d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.—6½d. per lb. Prices firm with a good steady demand.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/24° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
d-Dichlorbenzol	£75 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£90 per ton d/d.
Dinitrotoluene—48/50	8d.—9d. per lb. naked at works.
66/68	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d.—8d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	4s. 10d. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. 1d.—3s. 2d. per lb. Distinctly firmer in price.
Acid, Benzoic	2s. 3d. per lb. Some German makers are stated to be out of stock.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Citric	1s. 5½d.—1s. 6½d. per lb., less 5%.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	5s. 9d.—6s. per lb., according to quantity.
Acid, Salicyclic	2s. 2d.—2s. 4d. per lb.
Acid, Tannic	3s. 3d. per lb.
Acid, Tartaric	1s. 2d. per lb. less 5%. Market continues weak.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 6d. per lb. Market very quiet.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz. for English make.
Barbitone	17s. per lb.
Benzonaphthol	4s. 6d. per lb.
Bismuth Salts	A steady market.
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	
Potassium	6½d. per lb.
Ammonium	7d. ,, ,,
Sodium	7½d. ,, ,,
Calcium Lactate	2s. 6d. per lb. for best makes. Better enquiry.
Chloral Hydrate	3s. 9d.—4s. per lb. Somewhat firmer.
Chloroform	2s. 2d. per lb. for cwt. lots. Demand is poor.
Creosote Carbonate	8s. lb. Demand negligible.
Guiacol Carbonate	8s. 6d. per lb.
Hexamine	3s. 6d. per lb. Continental prices higher.
Homatropine Hydrobromide	30s. per oz.
Hydroquinone	3s. per lb. Competition has lowered price.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.
Magnesium Carbonate—	
Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	65s.—75s. per cwt., according to quality & quantity.
Menthol	A.B.R. recryst. B.P. 64s. per lb.

Mercurials	Very much weaker. Reduced 6d. lb. all round. Quicksilver reduced to £8 15s. per bottle.
Methyl Salicylate	2s. 4d. per lb.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Metol	8s. 9d. per lb.
Morphine and Salts	Prices advanced about 6d. per oz., due to higher price of opium. Alkaloid: Cryst. 11s. 6d., Precip. 11s. 3d., Acetate 9d., Hydrochlor. 9s., Sulphate 9s. per oz.
Paraformaldehyde	3s. 5d. per lb.
Paraldehyde	1s. 4d. per lb. in demijohns, 1s. 4½d. in bottles.
Phenacetin	6s. per lb., with slight shading for large quantity.
Phenazone	7s. per lb.
Phenolphthalein	6s. 6d.—6s. 9d. per lb.
Potass. Bitartrate—99/100% (Cream of Tartar)	88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	3s.—3s. 6d. per lb., according to quantity.
Potass. Iodide	15s. 8d.—15s. 11d. per lb. Good market and strong demand for Japan.
Potass. Metabisulphite	5d. per lb. Spot value somewhat lower.
Potass. Permanganate	10d. per lb. in drums.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz. in bulk packages. Steady demand.
Resorcin	5s. 6d. per lb.
Salol	3s. per lb.
Silver Proteinate	10s. per lb. A weaker market.
Sod. Benzoate	2s. 6d. per lb. for spot supplies. German makers quote 1s. 11d. f.o.b., equal to 2s. 8d. per lb. here.
Sod. Citrate, B.P.C. 1923	2s. 3d. per lb.
Sod. Hyposulphite—Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—87s. 6d. per cwt. Demand not very brisk.
Sod. Salicylate	Powder 2s. 5d.—2s. 7d. per lb., and Crystal at 2s. 7d.—2s. 9d. per lb.
Sod. Sulphite, anhydrous	£27 10s.—£29 per ton, according to quantity for home trade, 1-cwt. packages included. Export prices from £25—£26 10s. per ton.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.—1s. 4d. per lb.
Thymol	14s. per lb. for best white crystal.

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Aubepine	13s. ,, ,,	
Amyl Acetate	3s. ,, ,,	
Amyl Butyrate	7s. 3d. ,, ,,	
Amyl Salicylate	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	3s. 6d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	3s. ,, ,,	
Benzyl Benzoate	3s. ,, ,,	
Cinnamic Aldehyde Natural	17s. 6d. ,, ,,	
Coumarin	18s. ,, ,,	
Citronellol	19s. 6d. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate	10s. ,, ,,	
Ethyl Phthalate	3s. 9d. ,, ,,	
Eugenol	10s. ,, ,,	
Geraniol (Palmarosa)	35s. ,, ,,	Advanced.
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Methyl Anthranilate	7s. ,, ,,	
Methyl Benzoate	6s. ,, ,,	
Musk Xylol	11s. ,, ,,	
Phenyl Ethyl Acetate	10s. ,, ,,	
Phenyl Ethyl Alcohol	16s. ,, ,,	
Rhodinol	45s. ,, ,,	
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Terpineol	3s. ,, ,,	
Vanillin	22s. 3d.—23s. 6d. per lb. Firm with steady demand.	

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Anise Oil	1s. 10½d. ,, ,,	
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Cassia Oil 80/85%	12s. 6d. per lb.	
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Java 85/90%	4s. 2d. ,, ,,	
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Clove Oil	8s. 6d. ,, ,,	
Eucalyptus Oil 70/75%	2s. 3d. ,, ,,	
Lavender Oil	18s. 6d. ,, ,,	
Lemon Oil	2s. 10d. ,, ,,	
Lemongrass Oil	2¾d. per oz.	
Orange Oil, Sweet	12s. 6d. per lb.	
Otto of Rose Oil—		
Bulgarian	34s. per oz.	
Anatolian	24s. per oz.	
Palma Rosa Oil	22s. 6d. per lb.	
Peppermint Oil—		
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Wayne Country	14s. 9d. ,, ,,	
Japanese	13s. ,, ,,	Market rising owing to speculation.
Petitgrain Oil	7s. 6d. per lb.	

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EDITORIAL

THE meeting of the British Association at Liverpool has been a conspicuous success. The attendance was almost, if not quite, a record; the organisation was excellent, reflecting great credit on the local secretaries and committees, the papers and discussions were of a high order and the weather all that could be desired, and better than could be expected. The address of the President, Sir Ernest Rutherford, was broadcasted, and those of us who were in London were able to hear with unusual distinctness every syllable and every change of intonation. If other cities were as well served in this respect as London, the achievement must have given universal satisfaction. The sectional meetings were in many cases full to overflowing, and the public lectures were equally crowded. The British Association made a successful attempt to spread its influence over a wide area; by arrangement with various local societies it organised a series of lectures not only in Liverpool but also in some of the towns in the vicinity. For instance, Sir John Russell gave a lecture in Warrington on plant foods. Sir John Russell, who is in charge of the Experimental Station at Rothamsted, has not only a familiarity with the subject and its history which is probably unique, but he has also the gift—or has taken pains to acquire the art—of explaining his facts in simple and intelligible terms. He traced our knowledge of crops and their increase from the early work of Lawes and Gilbert to the most recent experiments made in the summer of 1923. To many of his audience one of the most interesting features was his account of the value of straw wetted by a spray of water and allowed to ferment. If suitable bacteria are available, the fermented straw seems to have great value as a manure, and it is to be hoped that a detailed account of this will be easily accessible at an early date. Another point of interest was the considerable effect on the growth of the plants of very small quantities of boron, manganese, silicon and some other elements whose importance as constituents of the soil is not usually recognised. Even those whose talk is of the breed of bullocks, as the Scriptures say, could have understood the lecture and profited by it, and we feel sure that in the future such local lectures in the electronic orbits surrounding the nucleus of the meeting itself will be widely appreciated.

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Some little time ago we published a letter from an anonymous correspondent, who, with a good deal of reason, objected to the introduction of the personal element into the discussion of scientific questions. Our correspondent, possibly desirous of being perfectly consistent, omitted to inform us of his identity. In this issue we print a letter from another correspondent who, it would seem, has also a liking for anonymity, as he too has omitted to disclose his identity. We cannot complain if some of those who contribute matter for inclusion in our correspondence columns think fit to utilise a *nom-de-plume*, but we must insist that this anonymity be limited to the printed page only and not extended to the editorial sanctum. In future we hope that our correspondents will, without exception, authenticate their letters by including their names and addresses, *though not necessarily for publication*. It is the universal editorial rule in such cases to apply, as the Persian proverb has it, the padlock of silence to the portals of speech, and though our correspondents make themselves known to us, they can still, if they wish, be content to blush unnamed in print. Our correspondence columns should in time be an interesting and important feature; there are many debatable and doubtful points in our pages, and our readers value very highly the corrections and suggestions which appear, one of which on the theory of the Stream-Line filter appears in this issue. Surface tension and surface action will be extremely important factors in the chemistry of the twentieth century.

SOME ASPECTS OF THE PHYSICAL CHEMISTRY OF INTERFACES*

By Prof. F. G. DONNAN, C.B.E., F.R.S.

It was at the last meeting at Liverpool, in 1896, that I first had the honour of attending a gathering of the British Association. Looking back on that meeting one can say now that it came at the dawn of a new era in the development of physico-chemical science. The X-rays had just been discovered by Rontgen. Perrin had proved experimentally (1895) that a negative electric charge was associated with the cathode rays and had surmised that these so-called " rays " were constituted by electricity in motion, thus corroborating Crookes' brilliant views of a decade earlier and demonstrating that Lenard was wrong. Sir J. J. Thomson had just begun that splendid series of researches which resulted not only in the complete elucidation of the nature of the cathode "rays," but also in the discovery of the negative electron as a constant, universal, and fundamental constituent of all matter. The discovery of the chemically inert elementary gases by Rayleigh and Ramsay had begun in 1894, and the series of investigations which finally led to the recognition of the radio-active transformations of atoms and to the discovery of the nature and constitution of the atom itself, were just beginning. During the last twenty-five years the influence of these discoveries on chemical science has been enormous. There has come about a fresh reunion of physics and chemistry, somewhat analogous to that which occurred in the days of Volta and Davy. During the two decades preceding 1896, physical science had been largely concerned with the phenomena of the " ether," with electric and magnetic fields, electromagnetic waves, and the identification of light and other forms of radiant energy as electromagnetic phenomena. Now that the physicists have brought physical science back to the close and intimate study of matter, physics and chemistry have come together again, and the old and homogenous science of " natural philosophy " has been reconstituted. It is time that the walls which divide our chemical and physical laboratories were broken down, and that the young men and women who come to our Universities to study physics *or* chemistry, should study the facts and principles of a fundamental science which includes both.

In recent years chemists, physicists and physiologists have paid much attention to the phenomena that occur at the surfaces or interfaces which separate different sorts of matter in bulk. During the last quarter of the nineteenth century, both J. Willard Gibbs and J. J. Thomson had shown clearly, though in different ways, the peculiar nature of these interfacial or transitional layers. It was evident that things could happen in these regions which did not occur in the more homogenous and uniform regions well inside the volume of matter in bulk. Such happenings might reveal molecular or atomic peculiarities which would be undetectable in the jostling throng of individuals inside. A surface or surface layer represents a sort of thin cross section which can be examined much more readily than any part of the inside bulk. It is indeed only within comparatively recent years that X-rays have provided a sufficiently fine probe for examining this bulk in the case of crystalline matter.

The living organisms of plants and animals are full of surfaces and membranes. What can happen at surfaces is therefore a matter of great importance for the science of living things. We are bound to hold as long as possible to the assumption that the physico-chemical manifestations of life can be explained in terms of the potentialities of action inherent in electrons, atoms, and molecules. The modes of action of ordered arrays and marshallings of atoms and molecules are of extreme interest, since such modes of action will constitute phenomena non-existent in a disordered multitude of the same atoms and molecules with exactly the same individual powers and potentialities. These phenomena may be intimately connected with the phenomena of living matter, and as the latter evidently require the existence of surfaces and membranes, the idea naturally suggests itself that the special arraying or ordering of individuals occurs at, and may start from, such surfaces.

An essential characteristic of this ordering or arraying may consist in *special orientation*. In the chemical and physical actions occurring in a volume of liquid whose bulk is large compared with its surface, the molecules or atoms probably move towards each other with every sort of orientation, no special type being privileged or distinguished. Should, however, some special orientation be characteristic of interfaces, then it is clear that such interfaces will exhibit new phenomena due to this special sort of arraying. Moreover, if we are dealing with molecules which are ionised into electrically polar constituents, or which, if not actually dissociated can be treated as electrically bi-polar, it follows that, if orientation occurs at interfaces and surfaces, then electrical double layers and electrical potential differences may be set up at such boundaries.

In the theories of Laplace, Gauss, and Poisson the field of force surrounding an attracting element or molecule was regarded as essentially uniform in its spatial relations, *i.e.*, the equipotential surfaces were regarded as concentric spheres with the molecule as a small element at the centre. The older "physical" theories of cohesion according to central forces with uniform orientation have been to some extent replaced, or at all events supplemented, by "chemical" theories according to which the attractive force-fields are highly localised round active chemical groups and atoms, are relatively minute in range, and can be saturated or "neutralised" by the atoms or groups of neighbouring or juxtaposed molecules.

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* Presidential Address delivered before Section B (Chemistry) at the meeting of the British Association for the Advancement of Science held in Liverpool from September 12 to 19. (Abridged.)

Dr. W. B. Hardy has been the chief pioneer in developing these newer theories, having been led thereto by his researches on surface tension, surface films, composite liquid surfaces and static friction and lubrication. As the matter is very important I shall give two quotations from Hardy's scientific papers.

"The corpuscular theory of matter traces all material forces to the attraction or repulsion of foci of strain of two opposite types. All systems of these foci which have been considered would possess an unsymmetrical stray field—equipotential surfaces would not be disposed about the system in concentric shells. If the stray field of a molecule, that is of a complex of these atomic systems, be unsymmetrical, the surface layer of fluids and solids, which are close-packed states of matter, must differ from the interior mass in the orientation of the axes of the fields with respect to the normal to the surface, and so form a skin on the surface of a pure substance having all the molecules oriented in the same way instead of purely in random ways. The result would be the polarisation of the surface, and the surface of two different fluids would attract or repel one another according to the sign of their surfaces." (Hardy, 1912).

These ideas are even more clearly expressed in the following passage. "If the field of force about a molecule be not symmetrical, that is to say, if the equipotential surfaces do not form spheres about the centre of mass, the arrangement of the molecules of a pure fluid must be different at the surface from the purely random distribution which obtains on the average in the interior. The inwardly directed attractive force along the normal to the surface will orientate the molecules there. The surface film must therefore have a characteristic molecular architecture, and the condition of minimal potential involves two terms—one relating to the variation in density, the other to the orientation of the fields of force." (Hardy, 1913.)

Hardy thus bases the notion of molecular orientation at the surface on the existence of unsymmetrical fields of force surrounding the molecule; in other words, the parts of the molecule possessing the most powerful stray fields will be attracted inwards towards the bulk and thus cause a definite orientation of the whole molecule at the surface.

It seems that the cohesional forces are essentially chemical in origin and that they depend in large measure on the presence of "active" atoms or groups of atoms, namely, those possessing strong fields of "residual chemical affinity"; in other words, powerful and highly localised stray fields of electrical or electromagnetic force (or of both types). The existence of such atoms or atomic groups is strong presumptive evidence of the unsymmetrical fields of force postulated by Hardy and therefore of the molecular orientation at surfaces.

The conclusions drawn by Hardy have been amply confirmed by W. D. Harkins and his collaborators, who in a long series of accurate measurements of surface and interfacial tensions have found that with many organic liquids the "adhesional work" towards water is greatly increased by the presence of oxygen atoms (as in alcohols, acids, and aldehydes). They find that the very symmetrical halogen derivatives CCl_4 and $C_2H_4Br_2$ (which possess specially high values for their own cohesional work) give markedly low values for their adhesional work towards water, and that in the case of unsymmetrical molecules, the adhesional work towards water is determined by the presence of certain active atoms or atomic groups.

In his work on static friction and lubrication, Hardy has found that the influence of chemical constitution and the effects of active atomic groups are very pronounced. Thus, comparing aliphatic or open chain compounds, the coefficient of static friction falls (and the lubricating power increases) as we pass through the series hydrocarbon—alcohol—acid. The corresponding ester is in this case a much worse lubricant than the related acid or alcohol. These results suggest, as Hardy has indicated, that friction is caused by the molecular cohesion of surfaces, and that in the action of such lubricants the molecules are oriented with their long axes normal to the surface, whereby the active atomic groups play an important part in "taking up" or saturating a portion of the stray force-fields of the molecules of the solid surfaces, and in orienting and anchoring the lubricant molecules to these surfaces. Many facts lend strong support to Hardy's views. Thus it is true, I believe, that the addition of aliphatic esters improves the lubricating value of hydrocarbon oils, whilst H. Wells and W. Southcomb have demonstrated the marked improvement due to a small addition of a fatty acid. Recently W. E. Garner and S. S. Bhatnagar have shown that the interfacial tension between mercury and B.P. paraffin oil is markedly lowered by small additions of oleic acid; the oleic acid molecules are therefore absorbed or concentrated at the mercury-oil interface, an action which may well be due in part to the fixation and orientation of these molecules at the metal-oil interface.

This question of the orientation of molecules at the surfaces of liquids has been greatly extended in recent years by a detailed study of the extremely thin and invisible films formed by the primary spreading of oily substances on the surface of water. The late Lord Rayleigh showed many years ago that when olive oil forms one of these invisible films on water, there is no fall in surface tension until the surface concentration reaches a certain very small value. He made the highly interesting and important suggestion that this concentration marks the point where there is formed a continuous layer just one molecule thick. With olive oil, he found this critical thickness to be 10^{-7} cm., and concluded that this number represented the order of magnitude of the diameter of a molecule of the oil. Increase in surface concentration beyond this point causes the surface tension to fall, until a second point is reached, after which no further fall in surface tension occurs. Lord Rayleigh assumed that at the second point a layer two molecules thick is formed. The pioneer work of Lord Rayleigh was repeated and extended by H. Devaux and A. Marcelin, who showed the correctness of his first suggestion, namely, that the primary film consists of a *unimolecular* layer. It appears, however, that the fall in surface tension which he ascribed to the building up of a bimolecular layer, must be ascribed to the closer packing of the molecules of the unimolecular layer, and that the second point occurs when these molecules are packed as tightly as possible.

Instead of varying the surface concentration by adding more and more of the oily substance to a definite surface, we may attain the same end by means of a moving boundary and a variable surface, and study the relation between the force of surface-compression (difference between the surface tension of pure water and that of the contaminated surface) and the surface concentration. Although these researches had firmly established the theory of the formation of a unimolecular surface layer and therefore of the existence of a *new "two-dimensional" phase,* Langmuir made a very important advance by connecting this conception with the ideas of chemically active groups and molecular orientation. Influenced no doubt, by the ideas of Hardy, Langmuir reasoned that the formation of these primary unimolecular films must be due to the presence of active groups in the molecules, which are attracted inwards towards the water and thus cause the long open-chain molecules of the fatty acids to be oriented on the water surface with their long hydrocarbon axes vertical and side by side.

Working by means of the method of Devaux, Langmuir put these ideas to the test of experiment, and determined the internal molecular dimensions of a unimolecular layer. His results agree wonderfully well, both with the idea of a unimolecular layer and with that of molecular orientation. If we calculate the average distance between two adjacent carbon atoms in palmitic, stearic and cerotic acids, we obtain a value of $1{\cdot}4\times10^{-8}$ cm. Now this distance must be of the order of magnitude of the distance between the centres of the carbon atoms in the crystal structure of a diamond. This latter distance is known to be $1{\cdot}52\times10^{-8}$ cm. The agreement is striking.

These regularly oriented and unimolecular surface films on water have been recently investigated by N. K. Adam, who, from a closer analysis of the relationship between the force of surface compression and the surface concentration (expressed as area occupied per molecule), has shown that a distinction must be made between the close packing of the polar or active end groups (head groups) of the molecules and the subsequent close packing of the hydrocarbon chains. Adam's results provide an ample confirmation of the theory of unimolecular films of juxtaposed and oriented molecules. If we calculate the average distance between two carbon atoms for the following four acids, we obtain the following results in cm. $\times10^{-8}$:— Myristic acid, 1·6; pentadecylic acid, 1·6; stearic acid, 1·5; behenic acid, 1·5.

Concerning this point some very interesting results have been recently obtained in Sir William Bragg's laboratory by Dr. A. Müller, who has examined layers of crystallised fatty acids on glass plates by an X-ray photographic method. From these results it appears that the unit cell is a long prism, the cross section of which remains constant for the substances investigated, whilst the length of the prism increases linearly with the number of carbon atoms in the molecule. The increase in length of the unit prism per carbon atom in the molecule is found to be $2{\cdot}0\times10^{-8}$ cm. Since it appears likely that there are *two* molecules arranged along the long axis of each unit cell (prism), it would follow that the increase in the length of the molecule per carbon atom added is $1{\cdot}0\times10^{-8}$ cm. Comparing this result with the value for the distance between the carbon centres in the diamond lattice, the carbon atoms in the long hydrocarbon chains of the higher saturated fatty acids appear to be arranged in a zig-zag, or more probably in a spiral or helix. If this be so, the closer packing or compression of the juxtaposed molecules in the unimolecular films, as indicated by Devaux, Langmuir, and Adam, may be explained to some extent by the straightening out of these zig-zags, or perhaps by the "elastic compression" of the helices.

As Langmuir pointed out, the question of the formation of unimolecular surface films can be attacked in a different manner. It is known that gases or vapours can be condensed or adsorbed by solid and liquid surfaces. The question then arises, does the formation of primary unimolecular films ever occur in such cases? Hardy made the suggestion that the formation of the primary unimolecular film in the spreading of oily substances on water might be due to adsorption from the vapour. To examine this question, Mr. T. Iredale has recently measured in my laboratory the fall in the surface tension of mercury caused by exposing a fresh mercury surface to vapours of increasing partial pressure. Working with the vapour of methyl acetate, Iredale found by applying Gibbs' formula that at a temperature of 26° C. and a partial pressure of 62 mm. of mercury, the excess surface concentration of the adsorbed vapour was $4{\cdot}5\times10^{-8}$ g. per square centimetre of surface. Therefore there are $0{\cdot}37\times10^{-15}$ molecules of methyl acetate adsorbed per square cm., and that the area per molecule is 27×10^{-16} sq. cm. As under the conditions corresponding to this calculation the molecular surface layer was probably not quite saturated (in the unimolecular sense), we may expect the value found to be of the same order of magnitude but somewhat greater than the values found by Adam for the cross section of the head group of the higher saturated fatty acids (25×10^{-16}) and of the esters (22×10^{-16} for ethyl palmitate and ethyl behenate). We may, therefore, say that Iredale's results appear to indicate the formation of a primary unimolecular layer built up by adsorption from the vapour phase.

Let us now consider another type of formation of surface layers at the surfaces of liquids—namely, the case where a substance dissolved in a liquid concentrates preferentially at the liquid-air or liquid-vapour interface. Gibbs, and later J. J. Thomson, have shown that if a dissolved substance (in relatively dilute solution) lowers the surface tension, it will concentrate at the surface. In 1908 S. R. Milner applied the same method to aqueous solutions of sodium oleate, and arrived at a mean value of $1{\cdot}2\times10^{-10}$ gram mols. excess concentration per sq. cm. of surface. For a dilute solution, we can calculate q, the amount concentrated or "adsorbed" in the surface per sq. cm. (excess surface concentration) by making use of the equation of Gibbs,

$$q = -\frac{d\gamma}{d\mu}\ .$$

where γ=surface tension and μ=chemical potential of the adsorbed substance in the bulk of the solution. Writing $\mu=\mathrm{RT}\log a+k$, where a="activity" of the solute, and k is a quantity dependent only on the temperature and nature of the solute and solvent, $d\mu=\mathrm{R\,T}\,d\log a$, and so Gibbs' equation can be written in the form

$$q = -\frac{1}{\mathrm{RT}}\,\frac{d\gamma}{d\log a}.$$

If for very dilute solutions (or for so-called "ideal" solutions) we put $a=c$, we can write

$$q = -\frac{1}{\mathrm{RT}}\,\frac{d\gamma}{d\log c} = -\frac{c}{\mathrm{RT}}\,\frac{d\gamma}{dc}.$$

In this way Milner has calculated from Whatmough's data for aqueous solutions of acetic acid that the "saturation" value of q is $3{\cdot}3\times10^{-10}$ mols. per sq. cm., from which it follows that the area per molecule in the surface is 50×10^{-16} sq. cm. In a similar manner, Langmuir has calculated from B. de Szyszkowski's data for aqueous solutions of propionic, butyric, valeric, and caproic acids that the surface area per molecule adsorbed in the saturated layer is equal to 31×10^{-16} sq. cm., whilst Harkins has arrived from his own measurements for butyric acid at the value 36×10^{-16} sq. cm.

In 1911 Dr. J. T. Barker and myself made a direct determination of q for a solution of nonylic acid in water, which showed that for a practically saturated surface layer, the surface area per molecule is 26×10^{-16} sq. cm.

These various values are not very different from the values found by Langmuir and by Adam for the oriented unimolecular layers of practically insoluble fatty acids resting on the surface of water. That in the present case some of the values are larger might easily be explained on the ground that these adsorption layers are partially, or completely, in the state of "surface vapours." For Adam and Marcelin have recently made the important discovery that the unimolecular surface films investigated by them may pass rapidly on increase of temperature from the state of "solid" or "liquid" surface films to the state of "vaporised" surface films, in which the juxtaposed molecules become detached from each other and move about with a Brownian or quasi-molecular motion, probably communicated to them by the thermal agitation of the water molecules to which they are attached. The question as to whether the simplified form of Gibbs' equation yields a sufficiently accurate value for the excess surface concentration can scarcely be decided without more experimental data.

There is another very interesting phenomenon relating to the surfaces of liquids and solutions—namely, the existence of an electrical potential gradient or potential difference in the surface layer. These interfacial potential differences are of great importance, and play a fundamental rôle in determining the stability or instability of many colloidal states of matter. The liquid-gas interface offers the simplest case of such interfaces, and so the investigation of the potential differences which may exist at this interface is a matter of fundamental interest. In 1896 F. B. Kenrick developed, on the basis of earlier experiments of Bichat and Blondlot, an electrometric condenser method for the comparative determination of the gas-liquid P.D.'s. His results show that substances (such as the aliphatic alcohols and acids) which concentrate at the surface produce a very great change in the surface P.D., whilst highly dissociated univalent inorganic salts, such as KCl, do not. Kenrick's results have been much extended by an investigation carried out with the same type of apparatus by Prof.

T. Thorwaldson in my laboratory. The general result of these experiments can be described in the following terms :—

Consider the system :

Aqueous Solution of KCl (conc.=c)	Air	Aqueous Solution of KCl (conc.=c)
A		B

The positive potential of A will be equal to that of B. If we now add to the solution B a small quantity of a substance S (generally a a non-electrolyte or weak electrolyte) which has a strong tendency to concentrate at the air-B interface, it is found that the positive potential of A rises markedly above that of B, the value of the quantity, positive potential of A minus that of B, varying with the concentration of S in the way that is characteristic of adsorption phenomena. What is the interpretation of this phenomenon ? If we were to assume that there was practically no P.D. at the interface A-air, it would follow that the effect of S is to make the positive potential of the bulk of B markedly below that of the air. The same result would follow if we were to assume that at the interface A-air there exists a P.D. which makes the positive potential of the bulk of A markedly below that of the air outside. Both these assumptions would lead to the conclusion that in the surface layer of the solution at the A-air interface there must exist either no electrical double layer, or else one with its *positive* half oriented towards the air side. Now Quincke has shown that a bubble of air in water placed in an electrical potential gradient travels towards the anode—*i.e.*, the bubble behaves as if it were negatively charged. From this it would follow that the P.D. at the air-water interface is such that the *negative* half lies towards the air side. As an electrolyte such as KCl is negatively adsorbed at an air-liquid surface, it is probable that a P.D. of the character indicated by Quincke's experiment exists at the A-air interface. If we accept this conclusion, it follows that the effect of S is markedly to *reduce* this P.D. (or to reverse it). Now the P.D. at the air-water interface is probably due to the existence of a double layer containing hydroxyl ions on the outside and hydrogen ions on the inside, or to oriented water molecules regarded as electrical bi-poles. If S is a non-electrolyte (or a substance which possesses little self-ionisation), we can understand why its concentration at the surface could result in the reduction of this P.D.

The experiments of Thorwaldson show that a substance such as the hydrochloride of methyl violet has a powerful effect on the P.D. at the air-water interface. It is probable that in this case the complex basic dye cation is drawn into, or " adsorbed " in, the outside layer next to the air, the result of this being a reduction or possibly reversal of the original potential difference.

Kenrick found that if gases such as hydrogen and coal gas be substituted for air, there is no effect on the surface P.D.

When liquids are sprayed or splashed, or when gases are bubbled through liquids, the gas often acquires an electrical charge, whilst the liquid acquires an opposite one (so-called " waterfall " electrification). Originally, Lenard thought that the effect was due to a " contact electrical " action between the gas and the liquid, whilst J. J. Thomson was inclined to ascribe it to a sort of partial chemical action between them. It is known that there are produced in the air or gas relatively slow-moving carriers, both positive and negative. Lenard has quite recently changed his views, and ascribes the origin of these carriers to the tearing off of very small portions of the outside layer of the electrical double layer existing in the surface of the liquid. It may be mentioned that Kenrick, Thorwaldson, and McTaggart came to the conclusion that the surface P.D.'s measured by them were not connected, or at all events not connected in any simple manner, with the phenomena of waterfall electrification. We may say, therefore, that if there be a relation between these two types of phenomena, it is a complicated and still largely obscure one.

The subjects which I have been discussing have an interesting bearing on the formation and stability of foams and froths. If air be violently churned up with water, only comparatively large bubbles are produced, and these quickly rise to the surface and burst. If now a very small quantity of a substance which concentrates at the air-water interface be added, an almost milk-white " air emulsion " of small bubbles is produced, which rise to the surface and produce a relatively durable froth. It is clear that the diminution in interfacial tension facilitates the subdivision or dispersal of the air. The existence of the surface layer will also confer a certain amount of stability on the resultant froth, since it will give rise to forces which resist the thinning of a bubble wall. Any sudden increase in the surface will produce a momentary diminution in the concentration or " thickness " of the surface layer, and hence a rise in surface tension, which will persist until the normal thickness or concentration is readjusted by diffusion of molecules from the inside volume—a process which in very dilute solution will occupy a perceptible time. That this explanation (due to the late Lord Rayleigh) is correct can be seen from the fact that very often stronger solutions of the same surface-active substance scarcely foam at all. In this case the readjustment of the equilibrium thickness or concentration of the surface layer occurs with such rapidity (owing to the greater concentration of the molecules in the inside volume) that practically no rise in surface tension, and hence no counteracting force, comes into play. These effects will be the more pronounced—other things being equal—the greater the mass and hence the smaller the motion of the solute units, as in the case of large molecules or colloidal micelles. It is probable, however, that the explanation of the stability of very durable forms, as, for example, those produced by the sea at the sea coast, by beer and stout, by aqueous solutions of soap or saponin, etc., is often more complex, and that we must seek it in the formation of very viscous or semi-rigid or gel-like membranes at the interface. Moreover, small solid particles may contribute to the stabilisation of a froth, as in the case of the "mineralised froths" of the ore flotation process; and the preferential aggregation of small particles in the interface between two phases has been demonstrated in the experiments of W. Reinders, F. B. Hofmann, and many others.

How far do the phenomena which are characteristic of a gas-liquid interface occur also at the interface between two immiscible or partially miscible liquids. Many years ago Gad and also Quincke showed that a fatty oil (such as olive oil) is very readily dispersed in the form of an emulsion by a dilute solution of caustic soda. Some experiments which I once made showed that a neutral hydrocarbon oil could be similarly emulsified in a dilute aqueous solution of alkali if one of the higher fatty acids was dissolved in it, whilst the lower fatty acids do not produce a similar action. It was shown that the action runs parallel to the lowering of interfacial tension and must be ascribed to the formation of a soap, which lowers the interfacial tension and concentrates at the interface.

If a substance which is dissolved in one liquid A, and which is practically insoluble in another liquid B, is found to have, in very dilute solutions, a strong effect in lowering the tension at the interface A-B, the following interesting questions arise:—

(1) What is the amount of the surface concentration or adsorption per sq. cm. of interface?
(2) Can it be calculated by means of the simplified Gibbs equation?
(3) How does the surface adsorption vary with the concentration?
(4) Does the "saturation" value correspond to the formation of a unimolecular layer?

Some of these questions were experimentally investigated in my laboratory by W. C. McC. Lewis. For the liquid A water was chosen, and for B a neutral hydrocarbon oil. Working with sodium glycocholate as the surface-active substance, it was found that the experimentally measured surface adsorption q was much greater than that calculated by means of the equation

$$q = -\frac{c}{RT}\frac{d\gamma}{dc}.$$

For example, a 0·2 per cent. aqueous solution at 16° C. gave a directly measured value of $q=5\times10^{-6}$ g. per sq. cm., whilst the calculated value was 5×10^{-8} g. per sq. cm., practically a hundred times smaller. A similar type of discrepancy was found for Congo Red and methyl orange. If we calculate from the experimentally found surface adsorption of sodium glycocholate the value of the surface area per molecule, we obtain about $0{\cdot}9\times10^{-16}$ sq. cm. A similar calculation for Congo Red gives a correspondingly low figure. If we compare these values with those previously obtained for the air-liquid surface, it is clear that in the present case we are not dealing with simple unimolecular layers, but with adsorption layers or films many molecules thick. But if we calculate from Lewis' results the surface area per molecule as deduced from the surface tension measurements by the simplified Gibbs formula, we arrive at values of the order of 90×10^{-16} (sodium glycocholate) and 100×10^{-16} (Congo Red). These are values which are consistent with the gradual building up of a unimolecular layer (of possibly heavily hydrated molecules or micelles). It is possible, therefore, that the Gibbs equation gives the surface concentration of the primary unimolecular "two dimensional" surface phase, and that any building up of further concentrations beyond this layer does not affect the surface tension. It is true that in the case of substances such as sodium glycocholate, and especially Congo Red, in aqueous solution, there is a considerable amount of uncertainity as to the nature and molecular weight of these substances as they exist, not only in the bulk of the solution, but especially in the surface phase. In a later investigation Lewis determined the surface adsorption of aniline at the interface mercury-aqueous alcoholic solution, and found in this case a very fair agreement between the observed and calculated results. This case is more favourable, since we can be in little doubt concerning the molecular weight of the solute units. The mean observed value for the surface adsorption was $2{\cdot}7\times10^{-8}$ g. per sq. cm. Hence the number of molecules per sq. cm. of interface $=2{\cdot}7/93\times10^{-8}\times6{\cdot}06\times10^{-23}=0{\cdot}17\times10^{-15}$, and the surface area per molecule$=58\times10^{-16}$ sq. cm. Langmuir's calculation from Worley's measurements of the surface tensions of aqueous solutions of aniline gives at the air-water surface the value 34×10^{-16} sq. cm. for the area per molecule of aniline. We may conclude, therefore, that Lewis' measurements in this case point to the building up of a primary unimolecular layer, unaccompanied by any further concentration or "condensation" of molecules or colloidal micelles.

The relation between surface adsorption and fall of interfacial tension at a mercury-water interface was further investigated by W. A. Patrick, who concluded that, although there was a correspondence between the two phenomena, the surface adsorption could not be calculated from the simplified Gibbs equation. If we were to accept this conclusion as correct, we might find an explanation either in the suggestion made above, or in the possible invalidity of conclusions drawn from the use of the simplified Gibbs equation; either because the simplifications introduced are not justified, or because the existence of electrical or other factors requires an extension or elaboration of the original equation. This matter has been discussed by Lewis, by A. W. Porter, and by various investigators of electro-capillary phenomena.

From very accurate measurements of the interfacial tensions of the aqueous solution-mercury interface, W. D. Harkins has calculated (by means of the simple Gibbs equation) that when the interface is saturated as regards butyric acid molecules coming from the aqueous solution, the surface area per molecule is 36×10^{-16} sq. cm.

Here, again, a calculation by means of the Gibbs equation seems to point to the formation of a primary unimolecular layer. Experiments similar to those of Lewis have been recently made by E. L. Griffin, who has measured directly the adsorption of soaps from aqueous solutions at a mineral oil-water interface. The average surface per molecule adsorbed was, for sodium oleate, 48×10^{-16} sq. cm., for potassium stearate, 27×10^{-16} sq. cm., and for potassium palmitate, 30×10^{-16} sq. cm.

These figures are very interesting, for they would appear to indicate the formation of unimolecular surface layers. It may be mentioned here that T. R. Brigges has investigated the adsorption of sodium oleate at a benzene-water interface, and finds that the amount of soap adsorbed at the interface increases rapidly at first with small increases in the concentration of the solution, and then remains very nearly constant while the concentration of the solution undergoes great increase. This is just what one would expect from the building up of a saturated surface or surface layer (whether unimolecular or otherwise).

We have seen that in the case of the air-water surface there exists an electrical separation or potential difference in the surface layer, and that certain substances can produce pronounced variations, or even reversals in sign, of this electrical double layer. It becomes a matter, therefore, of great interest to inquire whether similar phenomena occur at the interface between two immiscible liquids, and, if so, to ascertain whether such electrical charges or double layers bear any relation to the "stability" of pure emulsions, or fine dispersions of one liquid in another. It is well known that those disperse or finely heterogeneous states of matter known as colloidal solutions depend in part for their stability on the existence of such electrical potential differences. We might expect, therefore, that an investigation of these emulsion systems would throw some light on the general theory of what are called "suspensoid" or "lyophobic" colloidal states. Investigations with these objects in view were carried out some years ago in my laboratory by R. Ellis and F. Powis. The method employed was to measure directly by means of a microscope the motion of minute globules (suspended in water) under the influence of a known electric field. The experiments of Powis brought out the very important fact that when the interfacial P.D. (whether positive or negative) is above a certain value, which was about 0·03 volt for his conditions, the rate of coagulation or coherence of the oil drops is relatively small, but rapidly increases when the P.D. falls inside the zone –0·03 to +0·03 volt. Under definite conditions there exist, therefore, what we may, speaking broadly, call a *critical potential* and a *critical potential zone.* When the P.D. is outside this zone the emulsion is comparatively very "stable." Very small concentrations of electrolytes, which, as we have seen, increase the P.D., increase this stability. As soon as the concentration of any electrolyte is sufficient to bring the P.D. into the critical zone, the stability of the emulsion undergoes a sudden and very marked decrease, and relatively rapid coagulation occurs. Take, for example, the case of thorium chloride. On increasing the concentration we find that the interfacial P.D. traverses successively the following regions :—

(1) Above the critical value (and negative).
(2) Inside the critical zone (negative and positive).
(3) Above the critical value (and positive).
(4) Below the critical value (and positive).

In exact correspondence with this series we find that the emulsion goes through the following states :—

(1) Stable (oil particles "negative").
(2) Unstable and flocculating (oil particles negative or positive).
(3) Stable (oil particles positive).
(4) Unstable and flocculating (oil particles positive).

Here we see a very striking analogue and explanation of the phenomena observed by Joly in studying the effect of aluminium salts on the sedimentation of clays, and of the numerous examples of the so-called "irregular series" observed in the flocculation of suspensoid hydrosols by salts with polyvalent cations.

These studies of oil emulsions (and of the glass-water interface), by means of the micro-cataphoresis method, have thrown a great deal of light on many previously ill-understood points in the theory of colloids. If, for example, the P.D. between the particles of a suspensoid hydrosol and the aqueous fluid are not above the critical potential, coagulation will occur. But very small concentrations of certain electrolytes can raise the P.D. and stabilise the hydrosol. This is the explanation of the well-known "peptising" action. Higher concentrations of even the same electrolytes will reduce the P.D. below the critical potential, and produce flocculation. We see also that rapid coagulation will occur before the P.D. becomes zero. It is obvious, therefore, that coagulation of a lyophobic hydrosol will occur before the iso-electric point is reached, and that Hardy's famous rule requires revision.

There is not time or space at my disposal to enter into the much discussed question as to the inner mechanism of the action whereby ions (and electrically charged micelles) set up or vary the potential difference in the interfacial layer. According to Freundlich's original theory we must ascribe an independent effect to each ion, which will depend on the sign of its charge, its specific adsorbability, and electro-valency and the nature of the already existing double layer. A different theory was proposed by Freundlich in order to explain the results obtained in the electroendosmotic experiments of Elissafoff. According to this point of view, the "solid" surface acts chemically (as an acid, base, ampholyte, or salt), whereby it may dissociate off an ion or ions, and itself become an ionised surface. Invading foreign ions may then alter this ionisation equilibrium; or they may simply combine with the ionised surface and form neutral insoluble spots (compare the views of Freundlich, Gyemant, and Kolthoff). J. N. Mukherjee has suggested that ions are attached to the surface by chemical forces, and has attempted to work out an electro-kinetic theory of ion adsorption. It is probable that surfaces very often do act ionically or chemically, and that specific actions of this sort must often be taken into account in dealing with the great variety of material presented in the study of surface actions. Nevertheless, in the case of the hydrocarbon oil droplets studied by Ellis and Powis, or the gas-liquid interface studied by Kenrick, Thorwaldson, and McTaggart, any *specific* chemical activity or ionisation of the oil or gas would seem improbable. Any theory which attempts a general treatment of the problem must be prepared to deal with cases such as these.

Many measurements have been made of the potential differences between solids and liquids, or between pairs of immiscible (or partly miscible) liquids, using electrometric methods. Thus Haber and Klemensiewicz determined the potential difference at a glass-water solution interface, and found the glass to act like a hydrogen electrode. It will be at once obvious that these results are not in agreement with those obtained by cataphoretic and electroendosmotic methods. A somewhat similar type of discordance has been observed in the electrometric measurements of the potential difference between solid paraffin and an aqueous solution made by G. Borelius, and of the P.D.'s between pairs of liquids made by R. Beutner, E. Baur, and others. Freundlich and Gyemant have drawn attention to the fact that in all such electrometric measurements, where in the process of the measurement an electric current must pass from one phase to the other, we measure the total or "thermodynamic" potential difference between the phases in bulk, whereas in determinations by the methods of electroendosmose and cataphoresis, we measure only a portion of this total potential difference. These "electro-kinetic" P.D.'s, although of fundamental importance in relation to the stability of suspensoid (lyophobic) systems, need not, and in general will not, coincide in value with the total (thermodynamic) potential differences. I drew attention to a quite analogous difference in discussing the measurements of the potential differences at gas-water interfaces made by Kenrick and by McTaggart.

We may illustrate this point by considering the P.D. between two immiscible phases, L_1 and L_2, in equilibrium with each other, and each of which contains dissolved in it the electrolyte KA. If ϵ denote the positive potential of L_2 above L_1, and F the quantity of electricity associated with an ionic gram equivalent, then by a virtual variation of the equilibrium system it follows that

$$(\mu_K)_1-(\mu_K)_2=F\epsilon=(\mu_A)_2-(\mu_A)_1$$

where the subscripts refer to the cation or anion and to the phases L_1 or L_2 and the μ's denote the chemical potentials per gram equivalent (partial equivalent free energies) of the ionic constituents in the bulk of the two phases. Whatever may be the "electro-adsorption" or ion adsorption of K and A at the interface L_1—L_2, it is clear that ϵ depends only on the "bulk" values of the respective chemical potentials, which likewise determine the surface concentrations. If the phases L_1 and L_2 be not in equilibrium, then velocity or diffusional terms will enter into the equations, and the potential difference will be partly or wholly a "diffusional potential."

In dicussing the "stabilities" of hydrocarbon oil emulsions, it must not be forgotten that I was dealing with very dilute *suspensions* of oil in water, produced by mechanical agitation without the addition of any "emulsifier." I pointed out that in the emulsification of oils in water by means of soap, the soap lowers the interfacial tension and concentrates at the interface. When we wish to produce oil emulsions in the ordinary sense of the term we must use some such emulsifying agent, and for this purpose many substances are employed, such as soap, gum acacia, gelatin, casein, starch, etc. All these substances concentrate or condense on the surfaces of the oil globules. If we may regard these surface films as very mobile from the molecular-kinetic point of view, it is clear that they will confer an increased degree of stability on the emulsion. For any sudden decrease of interface (caused, for example, by coalescence or partial coalescence of two adjacent globules) will produce a momentary increase in the surface concentration or thickness of the adsorption layer, and so a decrease in the interfacial tension, if the surface layer is not saturated. It may require a perceptible time for the molecular-kinetic motion (especially in the case of large molecules or hydrated micelles) to readjust the equilibrium between the surface layer and the bulk.

It is probable, however, that the stability of the emulsion is in many cases due to the fact that the surface films possess a very viscous, quasi-rigid, or gel-like character, so that a more mechanical explanation is necessary. As S. U. Pickering showed, oils may be emulsified in water by the gels of certain basic salts ; and A. U. M. Schlaepfer has shown that emulsions of water in kerosene oil may be obtained by means of finely divided "carbon." Nevertheless, even in cases where an emulsifier is used, we may hope to succeed in obtaining a more precise physical analysis of the system. It is interesting in this connection to note that Mr. W. Pohl has recently found in my laboratory that when a neutral hydrocarbon oil is emulsified in water by means of sodium oleate, the electrical potential difference at the oil-water interface is almost doubled, and that the effects of alkalis and salts on this potential difference are very similar to those found when no emulsifier is employed.

I cannot conclude this account of certain aspects of surface actions and properties without making a passing, though all too brief, reference to the beautiful investigations of Sir George Beilby on the amorphous layer. He has shown that when the surface of crystalline matter is subjected to shearing stress there is produced a surface layer of a vitreous or amorphous character—a "flowed" surface—in which the particular ordered arrangement of the molecules or atoms which is characteristic of the crystalline matter largely disappears. Working at University College, London, Dr. Travers and Mr. R. C. Ray have recently obtained a very interesting confirmation of the Beilby Effect. The heats of solution (in kilogram calories per gram mol) of vitreous silica and silver sand (silica as crystalline quartz) in aqueous hydrofluoric acid were found to be 37·24 and 30·29 respectively. After grinding for fifteen hours the corresponding values were 36·95 and 32·46 respectively. If we assume that the internal energy of the amorphous phase produced by grinding is the same as that of the vitreous silica (silica glass), we can calculate from these results that about 31 per cent. of the crystalline silica has been converted by grinding into "amorphous" silica. The densities of silica glass and silver sand were found to be 2·208 and 2·638 respectively. After fifteen hours' grinding the density of the latter was lowered to 2·528. On the same assumption as before, it follows that about 26 per cent. of the quartz has been converted into the vitreous condition. The difference between the figures 31 and 26 is doubtless due to the approximate character of the assumption underlying the calculations and to experimental errors. There seems little doubt, however, about the soundness of the main conclusion—namely, that the mechanical action of shearing stress on crystalline matter is to produce a random molecular or atomic distribution in the surface layers.

This discussion, necessarily brief and limited, of certain aspects of the properties of surfaces—molecular orientation, surface concentration or adsorption, electrical or ionic polarisation—has dealt very largely with states of thermodynamic equilibrium. The chief interest of such studies has always appeared to me to lie in their possible ultimate bearing on the phenomena of life. We must remember, however, that the activities, and indeed the very existence, of a living organism depend on its continuous utilisation of an environment that is not in thermodynamic equilibrium. A living organism is a consumer and transformer of external free energy, and environmental equilibrium means non-activity, and eventual death.

It is probable, therefore, that along and across "living surfaces" there is a continual flux of activity. Does the very existence of these surfaces depend on some special sort of activity ? Questions such as these must make us cautious as regards any premature generalisation from simple physico-chemical results. But there is encouragement if we may assume that the physico-chemical manifestations of life are functions of the same powers and potentialities of electrons, atoms, ions, and molecules that we find in what we call inanimate environments. Life would then be simply a new functional relationship of very old parameters. at all events in so far as its various physico-chemical "mechanisms" are concerned.

In the totality of its activities and relationships, however, a living organism is an individual, and to arrive gradually at an understanding of this "individualisation" it will be necessary to study very carefully the laws pertaining to the intimate and particular modes of action of simpler individuals. The actions of an individual are conceived by science as determined by its internal state and by its relation to its environment. As we pass from certain peculiar atomic states, where the actions appear to have no relation to environment, to molecules, colloidal micelles, and living cells, the effects of the environment in determining activity seem to become more and more pronounced.

The internal state of a living cell or organism may arrive from time to time at "critical" points and "critical" transformations. Whatever may be the relation of such possible critical states to the previous cell-environment reactions the resulting events will be immediately determined by the special internal nature and activity of the cell itself. Is this "special internal nature and activity" simply a special type of organisation or arrangement of the positions, shapes, sizes, orientations and motions of electrons, atoms, ions, and molecules? To this oft-put question the answer of physico-chemical science is still in the affirmative. More complex individuals are not cloaked in any mysterious "law of complexity." Probably future progress will depend more on the investigation of the special nature, situation, and action of individuals than on the statistical thermodynamic treatment of the average behaviour of the "crowd."

THE BOHR ATOM AND THE PERIODIC LAW*

By N. V. SIDGWICK, D.Sc., F.R.S.

The essential peculiarity of the Bohr atomic model lies in the division of the successive groups of electrons into sub-groups. The electrons are rotating round the nucleus in orbits whose shapes are determined by the laws of ordinary dynamics (the electrostatic attraction of the nucleus being balanced by centrifugal force), but subject to the quantum restriction, which makes a certain set of orbits alone possible. Each orbit is defined by two quantum numbers, the first representing roughly the major and the second the minor axis of an ellipse; if the two are equal, the orbit is circular. Thus, if the principal quantum number of the group is, say, 3, the second may be 1, 2, or 3, giving three sub-groups 3_1 (long ellipse), 3_2 (ellipse) and 3_3 (circle). Hence a group of principal quantum number n can contain n sub-groups. The maximum number of electrons in a sub-group is found to be $2n$, though a smaller number may have considerable stability. Thus the maximum number of electrons possible in a group is $2n^2$ (2, 8, 18, 32).

The most stable arrangements of electrons are those of the inert gases :—

		1_1	2_1	2_2	3_1	3_2	3_3	4_1	4_2	4_3	4_4	5_1	5_2	5_3	6_1	6_2
Helium ..	2	2														
Neon	10	2	4	4												
Argon ..	18	2	4	4	4	4	–									
Krypton ..	36	2	4	4	6	6	6	4	4	–	–					
Xenon ..	54	2	4	4	6	6	6	6	6	6	–	4	4	–		
Emanation ..	86	2	4	4	6	6	6	8	8	8	8	6	6	6	4	4

It will be noticed that the largest groups are not on the outside, as in Langmuir's theory, but in the middle.

The development of these groups in the periodic table takes place in four different ways. (1) The establishment of two 1_1 orbits in H 1 and He 2. (2) The development of an 8-group (two fours) in the first short period (Li 3—Ne 10), repeated in the second short period (Na 11—A 18), in the second half of each of the two long periods (Cu 29—Kr 36 and Ag 47—Xe 54) and in the last quarter of the fifth period (Au 79—Em 86). (3) A third form of growth occurs in the first half of each of the two long periods, or rather just after their beginning (Sc 21—Ni 28 and Y 39—Pd 46) and in the third quarter of the fifth period, from about Hf 72 to Pt 78. In each of these places there are in the outer (valency) group of electrons two sub-groups of 4 expanding into three of 6; this involves 10 elements instead of 8, and so the single inert gas is replaced by the triad of Mendeléeff's eighth group. (4) The fourth type occurs in the rare-earth group (Ce 58—Lu 71), in which three sub-groups of 6 grow into four of 8, giving the 14 rare-earth metals.

The most general types of development are (2) and (3). (2) is that of the first two short periods, and is sufficiently familiar. Type (3) ($2\times4\longrightarrow3\times6$) occurring in the neighbourhood of the three triads, leads to quite a new series of properties. These elements all form metallic ions of variable valency, with marked colour and paramagnetic power, and they are all of high catalytic activity; moreover in the triads we find successive elements very similar to one another. All these properties are no doubt due to the same cause: that an arrangement of the outermost (valency) electrons in sixes has a less definite stability than an arrangement in fours, so that various groupings are possible which differ little in energy. Among the rare-earth metals (type 4) similar relations hold (small change of properties with increasing atomic number, colour, catalytic and paramagnetic power); but since the growth is that of an inner electronic group, the change in properties is still smaller, and for the same reason the absorption bands in the spectrum are far narrower than they are in the triads.

This is a very brief outline of the development of the periodic table on Prof. Bohr's theory. Of the almost innumerable relations between the structure and the behaviour of the elements which might be discussed, I will confine myself to one, which is not generally recognised, the relation between the atomic structure and the co-ordination number.

Combination between atoms involves a re-arrangement of their electrons with an increase of stability; and this can take place in two ways, either by the actual migration of an electron from one atom to another (ionic or polar link) or by the "sharing" of electrons (two to each link) between two atoms (non-polar link, covalency). This second kind of link, as Prof. G. N. Lewis, to whom its recognition is mainly due, has pointed out, is the only one which really deserves the name of link or bond; it is this alone which determines structure in the organic sense, as indicated by isomerism or stereoisomerism. How this sharing of electrons is effected is still uncertain. Each such electron certainly forms part of the constitution of both the atoms which it joins; and I have suggested that the electron encircles both nuclei. This point, however, I will not now discuss. I will only assume, what I think is beyond dispute, that a shared electron occupies an orbit of the same general type, but different from those of the unshared electrons.

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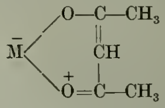
Now the number of such non-polar links which an atom can form is primarily determined by the number of electrons which it can contribute to, or receive from, the atom to which it is linked; that is, by what we ordinarily term the valency. Sulphur, for example, with six valency electrons, can take up two methyl groups to make this number up to 8, as in argon. This limit, however, is not final. The sulphur can take up another methyl group (form a third covalency), if it expels an electron to make room for the new one, giving the positive $(CH_3)_3S$ ion. It can form a fourth covalent link, as in H_2SO_4, probably by itself contributing both of the electrons to two of links. Thus by a redistribution of electrons the atom can exert more than its normal number of covalencies. There is, however, a definite limit to the number which can be so exerted, and it is the nature of this limit which I propose to discuss. Those compounds in which the number of covalencies is larger than we should expect from the ordinary behaviour of the element really constitute the co-ordinated compounds of Werner. The stereoisomerism which many of them exhibit is a proof that the linkages are of the normal non-polar kind; the assumption of a special kind of subsidiary or co-ordination linkage is quite unnecessary.

An examination of these compounds shows that whilst an element may exhibit different co-ordination numbers, the maximum value of this number is definitely related to its position in the periodic table, that is, to its atomic structure, and in the following simple way. The maximum co-ordination number—the largest number of covalent links that the atom can form—is equal to the number of electrons in a sub-group of its valency electrons, or, in other words, to twice the principal quantum number of the group to which the valency electrons belong. In the first short period (Li 3—Ne 10) the valency electrons are in the 2-quantum group, for which the limit of a sub-group is 4. Here therefore the co-ordination number cannot exceed 4; this fact is generally admitted by the Werner school. In the second short period (Na 11—A 18), the valency electrons are in the 3-quantum group, and so a covalency of 6 is possible, as we see in $K_2[SiF_6]$ and SF_6. Indeed, this covalency is possible for any atom above neon. The 4-quantum group begins to be filled up after we have got past nickel, and though a co-ordination number of 8 is rare (the most conclusive example is OsF_8, b.pt. 47·5°) we find it as early as zirconium.

The best evidence for this conclusion is afforded by the acetylacetone compounds. These derivatives are formed by the replacement of the hydroxylic hydrogen in the enolic form $HO{\cdot}C(CH_3){=}CH{\cdot}CO{\cdot}CH_3$ (which may be abbreviated to HA) by the metal, which then joins itself to the ketonic oxygen by sharing two of the electrons of the latter. This gives rise to the grouping



each acetylacetone group forming two covalent links with the metal. Aluminium, for example, forms a volatile compound AlA_3, with a co-ordination number of 6. Boron, on the other hand, although trivalent, like aluminium, does not form BA_3 but a salt $[BA_2]X$ (X=anion). This shows that its covalency is limited to 4, its valency electrons being in the 2-quantum group, whilst that of aluminium, where they are in the 3-quantum group, can be 6. Again, whilst Si 14 and Ti 22, in which the 3-quantum group can contain the valency electrons, give 6-co-ordinated compounds $[SiA_3]X$ and $[TiA_3]X$, it is found that Zr 40, in which the 3-quantum group is already filled and the valency electrons are in the 4-quantum group, forms an 8-co-ordinated compound ZrA_4; and similarly we have CeA_4 and ThA_4.

This relation, that the maximum covalency or co-ordination number is equal to the number of electrons in a valency sub-group, is perhaps surprising. Since a covalency of n means the sharing on $2n$ electrons, we might have expected the highest covalency to be equal to half the number of electrons in a group (4, 9, 16) or half the number in a sub-group (2, 3, 4). The fact that it is equal to the number in a sub-group suggests that the pair of shared electrons forming one link occupy orbits with the same principal and different secondary quantum numbers: that the fully co-ordinated atom has two full sub-groups of shared electrons.

This may be made clearer if we calculate the "effective atomic number" of the atom in question, and resolve it, on the Bohr system, into the most probable groups and sub-groups. The effective atomic number is the actual number of electrons, shared or not, which are attached to the atom in the particular compound. It is attained by adding to the actual atomic number one for every substitution link and two for every link where the two electrons are taken from another atom (as in the link to the ketonic oxygen in the acetylacetone compounds), and allowing for electrons added or removed by ionisation. In the resolution the lines of the Bohr theory are followed as closely as possible. The following may be given as examples ; electrons of the same group are enclosed in brackets, and sub-groups of shared electrons are italicised :—

Al $= 13$ . . . : (2) (4,4) (3)
Al in $[\mathrm{Al}]\mathrm{Cl}_3 = 13 - 3 = 10$: (2) (4,4)
Al in $\mathrm{AlA}_3 = 13 + 3 \times 3 = 22$: (2) (4,4) (*6,6*)
S in $\mathrm{SF}_6 = 16 + 6 = 22$: (2) (4,4) (*6,6*)
Zr in $\mathrm{ZrA}_4 = 40 + 4 \times 3 = 52$: (2) (4,4) (6,6,6) (*8,8*) (4,4)
Co in $[\mathrm{Co(NH_3)_4Cl_2}]\mathrm{Cl} = 27 + 4 \times 2 + 2 - 1 = 36$
= (2) (4,4) (6,*6*,*6*) (4,4)

The relation between the nature of the symbol so obtained and the stability of the compound can only be elucidated by further investigation. In order to calculate the effective atomic number we must, of course, know the molecular weight of the compound and its ionisation, if any. It will be observed that the familiar octet is a phenomenon connected with the 4-co-ordinated compounds ; with covalencies of 6 or 8 it is replaced by a stable group of 12 or 16 electrons. This relation of the co-ordination number to the structure can only be accounted for by the Bohr theory, since the division into sub-groups on which it depends is one which that theory alone assumes.

I have not discussed the position of hydrogen, which must differ greatly from that of the other elements. The molecular weight of hydrofluoric acid, and the evidence for its ionisation into H^+ and F_2H^- have led Prof. Lewis to the formula H[F—H—F], in which the hydrogen exerts a covalency of 2, by sharing one of the " lone pairs " of a fluorine ion. This seems quite in accordance with the principles laid down above. The valency electron in hydrogen occupies a 1-quantum orbit. The group and the sub-group are here identical, their maximum size being 2, so that a covalency of 2 should be possible. The symbol for this divalent hydrogen atom would be $2 \times 1_1 + 2 \times 2_1$. The first quantum number would necessarily be different in the two pairs of orbits. But the behaviour of helium, in which one of the electrons may occupy either a 1_1 or a 2_1 orbit, would indicate that such a structure is not impossible. Fluorine, perhaps on account of its small atomic volume, is peculiarly able to develop the highest covalency of an atom, as we see in SF_6 and OsF_8. Also the only alternative structure for H_2F_2, which is $[H_2F]F$, on the analogy of $[(C_6H_5)_2I]I$, not only leads to a type of ionisation which is not in accordance with the facts, but also assumes a state of combination of the halogen which, though reasonably stable with iodine, is very unstable with bromine, and is scarcely if at all known with chlorine or fluorine. It does not of course follow that because hydrogen is in this sense divalent in its compound with fluorine, it is so in its compounds generally ; but it may be so in some cases.

Dyson Perrins Laboratory, Oxford

THE CONTINUOUS MEASUREMENT OF LARGE VOLUMES OF WATER

(FROM A CORRESPONDENT)

The recent paper, " The Storage and Handling of Water," read by Mr. J. B. Ball, of Kilmarnock, at the summer meeting of the Institution of Mechanical Engineers, included an interesting discussion on the scientific principles of the measuring of bulk supplies of water. When the water has a free surface and sufficient fall, the principle of the " V " or " Weir " notch is generally used. That is to say, the water is allowed to flow through a series of weirs or notches of known dimensions, placed side by side as may be required, a " V "-notch recorder being essentially an instrument for measuring continuously the height of the water flowing through the notch and recording this direct in gallons of water. The same principle is of course used in the chemical industry for boiler-feed water and, to a limited extent, in measuring, for example, acids, the " V " notch being of an antimony-lead alloy. A modern instrument for bulk water supply, such as the " Williamson " supplied by Messrs. Glenfield and Kennedy, Ltd., includes both a device for giving a continuous record in the form of a curve, by means of a pen and chart driven by clockwork, and an integrating mechanism to add up the figures. Further, the instrument when necessary is arranged in a duplex form so that a separate record can be kept of the compensation water, often always flowing from reservoirs.

When the water is flowing in very large pipes either the " Venturi " or the " Pitot " tube principle is adopted, and the latest development of the " Pitot " tube in this connexion is the " Cole " recording pitometer. The flow of the water is measured by means of a composite rod introduced into the pipe through a 1-in. stopcock. This rod contains the usual " Pitot " tube, a small tube bent with one end facing the flow and the other the reverse way, and the recording device is essentially a very delicate and sensitive differential pressure recorder graduated direct in gallons of water. The flow of the water in the pipe of course causes a difference in pressure in the tube circuit, the leg facing the stream having a slightly-increased pressure due to the action of the water, and the other leg a slight reduction because of a tendency to suction due to the water flowing away from the pipe. This difference of pressure is proportional to the velocity of the flow in the pipe—that is, the volume—and in this way an accurate record of any amount of water can be obtained.

The "Venturi" tube principle consists essentially of a constriction inside the pipe, one form of which is a simple hollow disc. Since the same volume of water is always flowing in the pipe at any one portion, the velocity through the disc is greater since the same bulk of water has to pass through less space. Consequently, a small pipe at the disc has a slightly greater pressure than one in the ordinary flow, and in the same way as in the "Pitot" tube this small difference of pressure is a measure of the amount of water flowing, this principle also being used in the metering of steam.

COMBUSTIBLE MATTER IN BOILER ASHES *

By W. S. PATTERSON, M.Sc., A.I.C.

The amount of combustible matter in the ashes discharged from boilers is often entirely neglected in the consideration of the boiler efficiency. When care is exercised it does not assume a large proportion of the total carbon consumed, but without attention strikingly large figures may be obtained, working under modern boiler conditions with artificial draught, moving grate, and mechanical stoking. This paper is intended to review briefly the extent and causes of such losses and to indicate methods of mitigation.

There are two ways by which combustible matter may be passed into the ashes. First, the coal ash may have a low fusion temperature and, attaining a semi-molten condition on the hearth, may absorb adjacent particles of coke, preventing further access of air and therefore combustion of such particles. Such carbon would be present embedded in the fused ash, and the discharge so formed is usually called clinker. The loss due to this cause is referred to as "fusibility loss" in this paper.

The second cause of the loss of carbon to the ashes is governed by mechanical effects produced on the grate. Under this heading is grouped losses due to irregular and too rapid movement of the grate, inadequate aeration of the fuel bed, and the use of fuel unsuited chemically and physically to the design of the grate. Such losses of combustible matter will be referred to as "mechanical losses," the carbon being present in the ashes as small pieces of free cinder, the average carbon content of these being about 90 per cent. in the samples reported.

It is shown later that in practically all cases the bulk of the carbon transferred to the ash discharge can be attributed to these "mechanical losses." To arrive at some general idea of the extent of the losses of combustible matter occurring in practice, samples of coal, together with the ashes formed from them, have been collected from several large boiler installations. Names and localities are omitted, but in all cases the conditions of combustion are those of mechanical stoking devices and grates and artificial draught. The samples were all taken during actual practice and are not special test samples. Table I gives the proximate analysis of the fuels, their calorific value, and the percentage of combustible matter in the ashes. Column 4 clearly shows the large variations in the amount of carbon lost in the ashes which occurs in practice.

TABLE I

Coal	Volatile matter 1	Fixed carbon 2	Ash 3	% Carbon in ashes 4	Carbon in ashes as % of coal 5	Calorific value of coal 6	Available calorific value 7	Size of coal 8
A	28·90	51·16	16·34	17·24	3·34	12,285	11,801	⅛in slack.
B	27·96	50·94	17·38	11·61	2·40	12,199	11,851	Dust to ½in. pieces.
C	25·38	50·54	18·88	22·84	5·50	11,826	11,029	Small slack.
D	24·98	52·68	20·38	13·22	3·00	12,107	11,672	¾in slack.
E	30·84	57·30	9·70	11·22	1·20	13,675	13,501	1in. slack.
F	24·86	47·60	25·40	30·44	11·00	11,254	9,659	Dust to ½in. pieces.
G	28·18	51·62	14·18	15·88	2·60	12,336	11,959	Clean pea slack.
H	26·00	46·36	23·68	17·64	5·00	10,788	10,063	½in. slack.
K	26·06	48·04	22·00	13·40	3·40	11,453	10,960	⅛in. slack.
L	23·49	61·49	25·02	21·04	6·60	13,557	12,600	Dust to 1in. pieces.
M	33·47	52·73	13·80	5·20	0·75	12,843	12,735	1in. nuts.
N	7·53	69·86	22·61	31·00	9·80	12,100	10,679	Fine anthracite slack.
O	20·42	69·87	9·71	9·3	0·97	14,208	13,913	Clean 1in. slack.
P	26·06	60·82	11·00	25·20	3·77	13,555	13,009	½in. slack.
Q	26·80	43·44	28·16	40·48	19·10	10,512	7,743	Very fine slack.

Figures varying from 5 per cent. to 40 per cent. have been obtained. The weight of carbon lost in the ashes reckoned as a percentage of the original coal has been calculated from the carbon in the ashes. Thus, in case A, since the coal contains 16·34 per cent. ash and the discharge from the grate contains 17·24 per cent. carbon, $17{\cdot}24 \times 16{\cdot}34 \div 82{\cdot}76 = 3{\cdot}34$ per cent. of carbon in the ashes calculated on the coal. Table I, col. 5, gives these values. Taking the calorific value of carbon as 14,500 B.Th.U. per lb., deduction is then made of the available calorific value of the fuel reckoned on the actual carbon gasified. Taking case A again, we get 14,500×3·34÷100 =484 B.Th.U. as the heating value, lost in the ash discharge, per lb. of coal consumed. The available calorific value is therefore 12,285—484=11,801 B.Th.U. (*cf.* Table I, col. 7).

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* Communication to the Yorkshire Section

In some cases the loss is very large and attention to the clinker discharge would result in a much improved combustion efficiency. To ascertain the relative proportion of the "fusibility losses" and the "mechanical losses" another set of experiments was carried out.

The figures for carbon in ashes given in Table I, col. 4, were the result of tests on the completely sampled ashes, and therefore include both "fusibility" and "mechanical" losses.

From each batch of ashes another laboratory sample was prepared by grinding up several large lumps of clinker. The combustible matter was obtained and calculated on the original ashes. Small particles of cinder representing "mechanical losses" were in this way eliminated and only the "fusibility losses" were determined. It was assumed that the cinder particles in the ashes contained 90 per cent. carbon, a figure confirmed by actual tests. The relative losses due to the two causes were then calculated as follows:—

In the case of sample A considering 100 parts of boiler ashes,

If X=amount of free cinder,
100—X=clinker.

$$\text{and } 2{\cdot}88\,(100-X)+90X=100\times17{\cdot}24$$
$$X=16{\cdot}3;$$

i.e., there are 16·3 parts free cinder (90 per cent. C.) and 83·7 parts clinker (2·88 per cent. C.) per 100 parts ashes discharged.

Hence, the actual amount of combustible matter lost in clinker per 100 parts ashes is 2·88×83·7÷100=2·41 per cent. By difference, the amount lost in the discharge by mechanical effects in the form of free cinder is 17·24—2·41= 14·83 per cent. The figures given in Table II, cols. 3 and 4, were obtained in this way.

TABLE II

Sample	% Carbon in clinker 1	% Carbon in completely sampled ashes 2	Carbon in clinker as % of total ashes 3	(2–3) carbon in cinder 4	Softening point temperature of coal ash °C. 5
A ..	2·88	17·24	2·41	14·83	1200
B ..	1·66	11·60	1·47	10·13	1260
C ..	0·65	22·84	0·48	22·36	1350
D ..	5·10	13·22	4·61	8·61	1130
E ..	1·30	11·22	1·15	10·07	1320
F ..	4·32	30·44	3·00	27·44	1140
G ..	0·50	15·88	0·41	15·47	1250
H ..	1·51	17·64	1·31	16·34	1290
K ..	2·82	13·40	2·37	11·03	1180

The results are interesting because they indicate what a large share of the loss of carbon can be attributed to what have been called "mechanical losses" (cols. 3 and 4).

The softening point of nine of the coal ash samples was determined (Table II, col. 5). There is distinct evidence of a relationship between the fusibility of the coal ash and the amount of unconsumed carbon in the clinker. Samples D, F and K show the highest content of carbon, and these are also the three ashes having the lowest softening temperatures; sample A is somewhat exceptional.

Considerable difficulty lies in the way of diminishing the loss of carbon due to fusibility of the ash. However, in all cases examined this quantity is only a relatively small proportion of the total loss.

The causes bringing about the more important "mechanical losses" can fortunately be eliminated by careful working and attention to the plant. Excessive grate speed is the first cause. Since the efficient combustion of any fuel has a time factor, loss of carbon must occur if the period during which the fuel is on the grate is not long enough to effect combustion under the conditions of the hearth. A higher rate of steaming may be produced by increasing the speed of the grate, but it may easily be obtained at the expense of producing a clinker containing 25 per cent. of combustible. The speed of the grate should be the minimum rate compatible with the maintenance of the steam pressure.

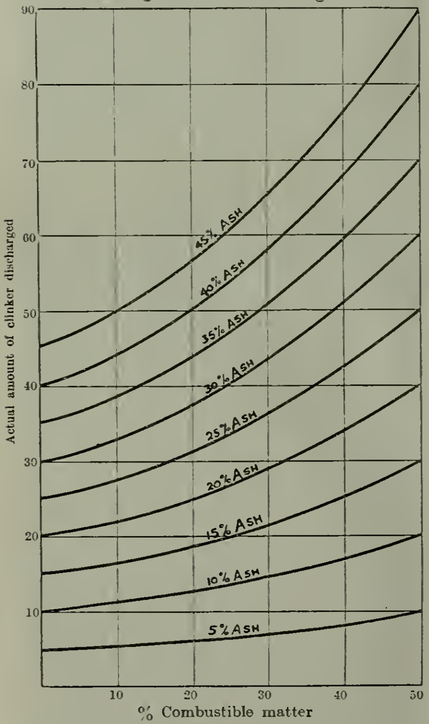
The next cause of the "mechanical losses" is the unsuitability of the design of the grate and the hearth for the fuels used. A fine slack cannot be burnt with efficiency on a grate designed for a large coal without some alteration being made. In one case 11·22 per cent. of combustible matter in the ashes was obtained from a plant when a clean 1-in. nut coal was used. The same plant, operating under similar conditions, produced an ash discharge containing 40·48 per cent. of combustible matter, when the fuel was a fine slack. This is perhaps an extreme case, but it serves to emphasise the importance of considering the suitability of the fuel to the conditions of the plant, as well as the calorific value and price when purchasing large supplies of coal.

The condition of the grate is also of importance in considering the amount of carbon lost to the ashes. A badly burnt grate owing to distortion will have gaps in it through which particles of cinder are riddled and also will have solid areas through which air cannot pass, and hence carbon on such areas will be transferred to the ash discharge. Frequent examination of mechanical grates is the best method of prevention here.

Adequate air supply through the incandescent fuel will always be an important factor in minimising loss of carbon to the ashes, since even with a perfect grate and slow speed of working, along with a suitable fuel, loss of carbon must result from insufficient air supply through the fuel bed. This cause is best eliminated by attention to the flue gases, and an intelligent interpretation of their composition.

It should be noted that for any given percentage of combustible matter in the ashes the actual loss of carbon calculated on the original coal becomes greater, with increasing amounts of ash in the fuel. Thus with 10 per cent. ash in the coal and 20 per cent. carbon in the discharge from the grate we get a loss of 2·5 per cent. of the carbon in the coal, whilst with 40 per cent. ash and still 20 per cent. combustible matter in the discharge, the loss of carbon becomes 10 per cent. The actual amount of discharge from the grate, in each of the above cases, per 100 tons of fuel consumed is 12·5 tons and 50 tons, respectively.

A graph is appended showing for different amounts of ash in the coal the relationship between the combustible matter in the ashes and the actual weight of ashes discharged.



Graph showing relation between carbon in ashes discharged, and the amount of the discharge for various percentages of ash in coal

Knowing the amount of ash in the coal used, and the weight of discharge obtained, the percentage of combustible matter in the ashes is obtainable.

The subject of the loss of carbon in ashes is of considerable importance now stoking operations are tending increasingly to become mechanical.

High thermal efficiencies in boiler practice cannot be obtained unless the fuels are chosen with consideration for the design of the hearth and grate and the conditions under which these must operate in practice. What might be called the combustion efficiency of the hearth with respect to any type of coal should have equal consideration in the purchase of fuel supplies, as the calorific value and price.

The author would like to acknowledge his indebtedness to Miss P. Ackroyd for much assistance in the preparation of samples and in the laboratory work.

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS

The Society of Chemical Industry has in each of the past two years held a dinner in London in the month of October, but for the present year arrangements have been made for an Informal Dinner and a Social Gathering of Chemists under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, which members of these, and of any other of the Chemical Societies, with their friends (including ladies) may attend.

This dinner will be held in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on the evening of Wednesday, October 31, at 7 for 7.30. The price of tickets for ladies or gentlemen will be 12s. 6d. each, not including wine.

Further particulars will be issued later, and the Councils hope that Members of the Societies mentioned, who intend to be present, will make early application for tickets, which must be limited to 300. These will be issued in the order in which applications accompanied by payment are received.

Applications should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2.

FORTHCOMING EVENT

Sept. 25. Society of Chemical Industry, *Birmingham and Midland Section.* Joint visit with the Midland Junior Gas Association to the Gas Exhibition at Bingley Hall, Birmingham. Meeting at 6 p.m. (1) "Specific Heat of Coal in Relation to its Composition," by G. Coles, B.Sc. (2) "A New Gas-Fired Combustion Furnace," by T. J. Hedley. (3) "Improvements in Nett Value Calorimetry, with a description of an automatic device for temperature and pressure correction," by C. H. Beasley.

INSTITUTE OF METALS

The Annual Autumn Meeting was held in Manchester on September 11 and 12. An interesting feature of the meeting was the formal opening by Sir George Beilby of the new metallurgical laboratory of the University of Manchester, in which accommodation is provided for up to 35 students and 10 research workers. The second Autumn Lecture was delivered by Lieut.-Col. Sir H. Fowler, K.B.E., who spoke on "The use of non-ferrous metals in engineering," and pointed out that it could be said that the use of non-ferrous metals by engineers was the ultimate object of all papers read before the Institute. Copper had been in long use, and alloyed with tin and zinc, its uses were as endless as were those of white metals. Aluminium was one of the most interesting metals, and recent investigations had opened up a new field for its use. Alloys of other metals were helping to solve the problems arising out of recent advances in engineering practice.

The following are summaries of the papers presented :—

(1) "The Cause of Red Stains on Sheet-glass," E. A. Bolton, M.Sc. After reviewing the various explanations of the cause of red stains, the author said that the stains occurred through reactions of copper oxides in the scale formed during annealing and the pickling medium. Cupric oxide, contrary to the usual opinion, was as harmful as cuprous oxide. Oxides of copper might be present owing to the action of acid left through careless washing after pickling, the presence of iron in the brass, and the use of impure rolling oils. The main cause was the use of the old-fashioned annealing furnace in which the flames impinge directly upon the brass. Possible remedies for the trouble were suggested.

(2) "Brinell Hardness Numbers," H. W. Brownsdon, M.Sc., Ph.D. The author drew attention to the desirability that Brinell numbers for non-ferrous metals should be expressed in figures that can be compared, and it was suggested that balls and loads should be used for which the ratio of the load in kilograms divided by the square of the ball diameter in millimetres was constant. Some one fixed ration should be invariably used for one class of alloys, *e.g.*, for copper alloys with Brinell hardness numbers from about 40 to 200 the choice should rest between the ratio 5 standardised in the United States or the ratio 10 favoured in this country.

(3) "Stereotyping," A. H. Mundey and G. Gartland, M.Sc. The evolution of stereotyping from its invention in 1750, by a practical metallurgist, W. Ged (an Edinburgh goldsmith), was traced from the plaster of Paris process to the use of papier-maché flong, and from the simple stereo plates for flat bed machines to the elaborate requirements of the modern newspaper.

(4) "The Crystallisation Effect on Galvanised Iron Sheets," J. D. Hannah, M.Sc., and E. L. Rhead, M.Sc. The authors have investigated the causes of failure to produce galvanised zinc surfaces having large characteristic spangles and state that the metal (iron or steel) had practically no influence on the result if the temperatures were satisfactorily maintained, that pure zinc did not yield the desired large spangles, and that too high temperatures led to the production of a zinc-iron compound which crystallised in needles on the metal and interfered with the development of the spangles. The presence of tin or aluminium did not produce the results, whereas the addition of zinc did so immediately. The effects obtained were ascribed to the separation of the impure zinc forming the layer on the metal sheet into conjugate solutions—lead-rich and zinc-rich—at the dipping temperature, and to the method of subsequent crystallisation. Bismuth introduced similar effects. The temperature at which good results could be obtained was limited by the tendency to form excessive amounts of the iron-zinc compound, and the time occupied in dipping and cooling.

(5) "Effects of Rate of Cooling on the Density and Composition of Metals and Alloys," R. C. Reader, Ph.D., M.Sc. The densities of pure metals were not affected by their rate of solidification, nor were those alloys which solidified at a constant temperature. With alloys that solidified over a range of temperature, the rate at which they passed through this range seriously affected the density, the slower the rate of solidification the lower being the density. Alloys possessing a long solidifying range were less dense in the centre than at the outside when prepared in cylindrical chill moulds. Rapid solidification greatly affected the composition of alloys that solidified over a range of temperature. When prepared in chill these alloys were richer on the outside in the component of the lower melting point and richer in the centre in the component of the higher melting point. Sand castings of these alloys were uniform. Alloys that solidified at constant temperature were uniform in composition throughout, whether prepared in sand or chill moulds.

(6) "The Effect of Small Quantities of Nickel upon High-Grade Bearing Metal," A. H. Mundey and C. C. Bissett, B.A., B.Sc., B.Met. A brief account was given of a practical trial of the effect of varying small quantities of nickel upon a tough well-reputed bearing metal, containing, per cenc., tin 93, antimony 3·5 and copper 3·5. Nickel was now added to this alloy, possibly as a means of identification though merit was also claimed for it. It was concluded from the results of physical tests that the beneficial results of nickel in an alloy of the character employed were yet to be demonstrated.

(7) "The Measure of the Change of Volume in Metals during Solidification," Hikozo Endo.

The paper contained the results of measurement of the change of volume during solidification or melting of a number of metals having low melting-points up to 1100° C. and forms the first report of the results of a long series of experiments which are to be extended to other metals having higher melting-points. The method of investigation consists in measuring the change of buoyancy of a metal suspended in an inactive liquid during its solidification or melting by means of a thermobalance.

(8) "The Constitution and Age-hardening of the Quaternary Alloys of Aluminium, Copper magnesium and Magnesium Silicide," Miss L. V. Gayler. The alloys dealt with contained up to 6 per cent. copper, 4 per cent. magnesium and 4 per cent. magnesium silicide, and it was shown that when these components were present in aluminium, any two of them had a marked effect on the solubility of the third, the sum of the effects being that ultimately $CuAl_2$ and Mg_2Si were both thrown out of solution. If copper and magnesium were present in a ratio greater than approximately 12 to 15, alloys quenched from high temperatures age-hardened at room temperature, whereas if the ratio of copper to magnesium were less than 12 to 5 no age-hardening took place, as there was little difference in the solubility of Mg_2Si at high and low temperatures. The slight increase in hardness obtained on further heat treatment of these quenched and aged alloys was due to the small difference in solubility of copper at the quenched and ageing temperature. The age-hardening of alloys of the Duralumin type was due primarily to Mg_2Si, copper causing very little age-hardening. The addition of magesium and copper was important as both reduced the solubility of Mg_2Si at high and low temperatures and subsequently reduced the maximum age-hardness due to Mg_2Si.

(9) "The Electrochemical Character of Corrosion," U. R. Evans, M.A. Experiments were described indicating that the corrosion of metals was mainly, probably entirely, electrochemical in character. Of the two main types, that accompanied by evolution of hydrogen gas was characteristic of reactive metals placed in acid solutions, but the velocity varied greatly with the degree of purity of the metal. Where this type was impossible, slower corrosion could occur at a rate determined by the diffusion of oxygen to the metal, and comparatively independent of the purity. When a metal was immersed in a solution of potassium chloride, one alkali was produced at the cathodic portions, the chloride of the metal was formed at the anodic portions, and hydroxide was precipitated where these meet. The electric current could be measured, and is found to account for the greater part of the corrosion observed. Generally the cathodic areas were those to which air had free access, whilst the anodic areas were those protected from aeration. Corrosion usually proceeded most rapidly at the comparatively "unaerated" places, hence the intense corrosion observed in "pits" and over areas covered up by porous corrosion-products.

(10) "Experiments with some Copper Wire; Cohesion a Function of both Temperature and Cold Work," D. H. Ingall, B.Sc. Five examples of copper wire were used representing soft annealed and four degrees of cold work given by 25, 40, 50 and 75 per cent. reduction of area by drawing. The cohesion at elevated temperatures was determined by placing given loads on the wire at atmospheric temperature, heating the wire and determining the temperature at which it broke. All the samples gave similar graphs (plotting cohesion against temperature), in which with rise of temperature the cohesion decreased along a straight line to a constant critical temperature of 350° C., beyond which the cohesion was represented by a sharply descending curve. The equations to the straight lines $C=a-bT$ and to the curves $TC^n=k$ (C=cohesion and T=temperature) showed that the percentage increase of the constant b and the percentage decrease of the constant n were represented by the corresponding percentage reductions for any given cold reduced wire.

(11) "Investigation of the Effects of Impurities on Copper," D. Hanson, D.Sc., C. B. Marryat, B.Sc., and Grace W. Ford, B.Sc. Studies of the effect of oxygen, up to a concentration of 0·36 per cent., on the mechanical and physical properties of pure copper, showed that oxygen had a relatively small effect on the properties of copper and was neither seriously deleterious nor remarkably beneficial. The mechanical properties were not much affected by small quantities of oxygen, nor was the electrical conductivity. The relatively small effect of oxygen was without doubt due to the fact that the solubility of the oxide in solid copper was so low that, for all practical purposes, oxygen could be regarded as insoluble in solid copper. The oxygen-bearing metals must, therefore, be considered as a heterogeneous mixture of pure copper and finely divided particles of cuprous oxide, and within the range of composition investigated the percentage of copper greatly exceeded that of cuprous oxide. The materials consisted essentially of a soft ductile copper matrix, in which harder particles of cuprous oxide were distributed, and the properties of the series were such as would be expected from a mechanical mixture of such constituents. These conclusions, however, were applicable strictly only to pure copper containing oxygen and free from other impurities. The effect of the simultaneous presence of other impurities might be very appreciable, and required special investigation.

(12) "Hardness Tests on Crystals of Aluminium." Hugh O'Neill, M.Met. Two pieces of aluminium strip were treated separately by the process worked out by Prof. Carpenter and Miss Elam, but only the first became a single crystal. By accident it was annealed for a

short time just below its melting point and upon its upper surface three series of parallel ridged markings were visible. X-ray examination showed that this surface was a rhombic-dodecahedral (011) face, whilst two crystals chosen from the second piece proved likewise to be presenting octahedral (111) and cube (001) faces respectively. Brinell tests showed that at low loads the different crystallographic planes resisted penetration to different degrees, and gave indentations of different shapes. In the Brinell sense the (110) face was the "hardest" and the cube (001) face appeared to be the "softest." But the load required to immerse the ball—and probably eventually to make it perforate the metal—was apparently the same in all cases. Crystal boundaries were also found to be without any appreciable effect in increasing the resistance of aluminium to penetration. In terms of Meyer's formula. $L=ad^n$, where L is the applied load and d the diameter of the indentation produced, *if a* 1 *mm. ball were used* then, whilst n varied from 2·483 for the (001) face to 2·274 for the (011) face, a was a constant for annealed aluminium. It was independent of the presence of grain boundaries and, in single crystals, of grain orientation.

(13) "The Behaviour of Metals under Compressive Stresses," H. I. Coe, M.Sc. Compression tests carried out on small cylinders of metals showed that with successive increments of loads plastic flow occurred, after the elastic limit had been exceeded, at an increasing rate. At a certain load the rate of flow for a given increment of load underwent a more or less abrupt change, very soft metals, such as tin and lead, becoming perfectly plastic, harder metals becoming more plastic than under preceding loads and immediately succeeding loads. When this particular load was expressed as a stress per sq. in. of the enlarged section of the cylinder, it was found that the value obtained agreed very closely with the maximum load per sq. in. in tension of the same material. The term "critical plasticity" was used to indicate the change in the rate of plastic deformation which most metals exhibited at a particular load. Annealed metals appeared to commence flowing at a comparatively low load and continued to do so at an increasing rate up to the load corresponding to critical plasticity; the same metals, however, in the worked condition were much more resistant to compressive stresses until they approached near the load corresponding to critical plasticity, when they suddenly collapsed and a marked temporary flow occurred.

(14) "A Dilatometric Study of the Transformations and Thermal Treatment of Light Alloys of Aluminium," Albert M. Portevin and Pierre Chevenard. Light aluminium alloys (density less than 3) capable of being hardened by quenching followed by tempering included the Duralumin group, whose essential characteristic was their magnesium content. The work of Rosenhain, Archbutt, Hanson and Gayler had linked up the phenomena of quenching shown by these alloys, with the variation of the solubility, in solid aluminium, of the compound Mg_2Si formed between magnesium and the silicon always present in commercial aluminium. But the solubility curves of this definite compound, Mg_2Si, in solid aluminium, had only been indirectly traced by the examination of alloys quenched at different temperatures, the transformations having hardly been studied, until last year, directly by direct physical measurements—in particular, by the investigation of thermal expansion. From their experimental work, the authors conclude that:—(1) The application of dilatometric methods, using the recording differential dilatometer, permitted the study of the transformations and the mechanism of heat-treatment of the light alloys of aluminium-magnesium-silicon, and in general of alloys containing two phase, univariant transformations. (2) The study of the constant temperature transformation by the differential dilatometer, using a high sensitivity apparatus, led to general expressions representing the phenomena as functions of time and temperature. (3) The phenomena of quenching and tempering in the aluminium-magnesium-silicon alloys could be interpreted by the known variations in the solubility of Mg_2Si in the solid state, without it being necessary to assume any further transformations in these alloys.

(15) "Equilibrium in the System Gold-zinc (based on Investigations of Electrical Conductivity at high temperatures)." Prof. P. Soldau. The alloys of gold and zinc belong to the type of AR-brasses, A and R being metals belonging to the first and second groups of the periodic system respectively. As in chemical nature these alloys were very close to the alloys of copper with zinc, *i.e.*, to the ordinary brasses, investigation of the nature of the alloys of gold and zinc should help to throw light on the complicated transformations which take place in the alloys of copper and zinc below their melting temperature. The author has thus investigated the alloys of gold and zinc, taking advantage of several different methods of physico-chemical analyses, that check and complement one another. Special attention was paid to the determination of electrical conductivity at high temperatures, which has necessitated the construction of a special apparatus. To check this, it was used for the determination of the transformation temperatures in iron and steel, which have been accurately determined by various physico-chemical methods. When the results obtained by the electrical conductivity method at high temperatures and by quenching showed a complete concordance, then that former method could be recommended for the investigation of other metallic systems.

ACADÉMIE DES SCIENCES

Monsieur Lacroix, the perpetual secretary of the Académie, gave an interesting account, at the meeting held on August 27, of a meteorite found in the Haut Garonne district, and containing the rare mineral aldhanite (calcium sulphide).

On September 3, Monsieur Joubin communicated the results of experiments made by Mme. Randoin on the food value of the oyster. The author claimed that the oyster possessed the highest known content of vitamin C, only the lemon being comparable with it in this respect. Using guineapigs affected with scurvy, it was found that 15 g. of oysters given in summer contained sufficient vitamin C to prevent the occurrence of the disease, a smaller amount being necessary in winter. This large content of vitamin was correlated with the food ingested by the mollusc. During the same meeting, note was taken of a brochure by Monsieur M. Delacre entitled, "An Essay on Chemical Philosophy."

On September 10, Monsieur J. L. Breton gave an account of an interesting article by Prof. Cotton on "The Magnetic Saturation of Iron." Monsieur Breton also presented a note by Monsieur P. Dumanois on a new process for dehydrating air, a process which has become necessary owing to the storage of large quantities of absolute alcohol or mixtures of alcohol and petrol used as motor fuel. If special precautions are not taken, the presence of moist air may cause either diminution in the concentration of the alcohol, or effect the stability of the mixture. The device consists in passing the air through a small tank provided with baffles and containing alcohol which absorbs moisture from the air. An automatic control is provided to ensure a constant level of alcohol in the tank.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held on September 13, 1923. In the absence of the chairman and vice-chairman, Sir John Brunner, Bart., occupied the chair. Before commencing the business of the day sympathetic reference was made to the death of Dr. E. K. Muspratt, and it was resolved to send a letter expressing the condolences of the Council to Sir Max Muspratt, Bart.

It was decided that the Association should tender evideuce before the Committee, which had been set up by the Minister of Health, to consider and report upon the use of preservatives and colouring matters in food.

The industry is very interested in publicity, and in order that the public may be kept informed, the Council authorised the General Manager to proceed with the preparation of two films illustrative of the distillation of coal, and of the heavy chemical industry.

The provisions of the Smoke Abatement Bill, 1923, were examined, and whilst the new Bill is a little more favourable than that introduced into the last Parliament there are still several matters which require adjusting from the standpoint of the Chemical Industry. The General Manager was instructed to secure amendments that will safeguard the position.

The General Manager reported that the plans for the Chemical Section of the British Empire Exhibition are now complete and the whole of the available space has been allocated. The Scientific Section is making great headway under the guidance of Dr. H. Levinstein, and it is expected this Section will prove of great interest to the general public.

It was decided to hold the next annual meeting of the Association within the precincts of the Exhibition on Thursday, July 10, 1924.

Sir William Alexander presented a very interesting report on the Ruhr situation, which showed that the occupation by the Franco-Belgian forces had not had the effects anticipated in some quarters of bringing the German dyestuff industry to a standstill.

Amongst other matters of routine which were dealt with was the election of the Cwmbran Chemical Co., Ltd., to membership of the Association.

PERSONALIA

Mr. C. W. Heppenstall has been elected chairman of the advisory board of Pittsburgh business and scientific men organised to cooperate with the work of the Department of Mining and Metallurgy of the Carnegie Institute of Technology.

Prof. C. Matignon, vice-president of the Société de Chimie Industrielle has been appointed an Officer of the Legion of Honour.

F. W. Zerban has succeeded C. A. Browne as chemist in charge of the New York Sugar Trade Laboratory.

Prof. N. Parravano has succeeded Prof. Paternò as director of the Chemical Institute of the University of Rome.

Prof. Raffaello Nasini has been elected president of the Italian Association for General and Applied Chemistry for the period 1923-25.

On September 2, Wilhelm Ostwald, the well-known physical chemist, celebrated his seventieth birthday at his residence, "Energie" in Grossbothen, near Leipzig.

Prof. J. Franck, who succeeded Prof. Debyes at Göttingen, has been offered the chair of physics in Berlin University, vacant through the death of Prof. H. Rubens.

* * *

From France, the death is announced of F. Magonnier, managing director of the Société des Usines de St. Gobain.

A VISIT TO THE ENGINEERING EXHIBITION

By Prof. J. W. HINCHLEY, A.R.S.M., Wh.Sc. M.I.Chem.E.

(*Continued*)

Another useful exhibit is the "Arca" automatic regulator shown in operation for controlling the hygrometric state of the air, the temperature, vacuum or pressure in a vessel, or the electrical conditions at any point. A diaphragm valve controlling the admission of water to the operating cylinder which moves the valve admitting the supply of motive fluid (water, steam, gas, etc.) is actuated by water, which also passes through a jet impinging on the end of a lever whose position is determined by a pressure box in the case of a motive fluid, by a series of cotton threads where the hygrometric state is to be controlled, by an ebonite strip for air temperature regulation or by other devices to suit the conditions in question. The lever moves only about one-thousandth of an inch, yet the action is most definite and the regulation most remarkable.

The Cambridge and Paul Scientific Instrument Co., Ltd., exhibit a range of their well known instruments. The Foster Instrument Co., Ltd., show a robust form of electrical indicator and a strain-meter for measuring changes in the strain of a structure due to loading, heating or other forces.

A large number of pumps are exhibited, several being shown at work. The water elevator of Messrs. Boulton and Paul, Ltd., claims one's attention on entering the exhibition, for it is at once seen lifting water through a height of 40 feet. It consists of a cellular endless belt hanging in the water to be lifted and passing over an upper driving pulley. The belt is made by rivetting a zig-zag strip of zinc on the back of an ordinary machine belt. The cells formed carry the water and discharge it as the belt turns round the upper pulley. The apparatus will lift water through a distance of over 300 feet at a high efficiency, and quantities up to 20,000 gallons per hour can be dealt with.

Rotary pumps of different kinds are shown by several exhibitors. The "Squeegee" pump is shown at work by the Avonmore Pump Co., Ltd.; the "Kitson-Utley" by the Kitson Engineering Co., Ltd.; the "Feuerheerd" by Messrs. Stothert & Pitt., Ltd.; and the "Essex" by Messrs. Jobson & Beckwith, Ltd. A new design of hand or power piston pump is shown by Messrs. Zwicky, Ltd. It has valuable features with respect to a filtering device and the simple mechanical arrangements of the valves, gland and other parts.

Welding apparatus of all kinds are shown in operation at several stands. Oxygen sheet-metal cutting plant by several makers may also be seen.

Metallisation, Ltd., demonstrate the "Schoop" process of coating surfaces with lead, copper, tin, zinc, etc. The coating metal, in the form of a wire, is melted by an oxy-hydrogen or other flame and projected by a "pistol" on the surface to be covered. Vessels coated with lead, copper, tin and zinc may be inspected. The thickness of one coating appears to be of the order of 1/100th inch. The artistic results of spraying decorative ironwork with copper, brass, zinc, etc., are very delightful.

The Radio-jet air pump, shown by Messrs. John Musgrave & Sons, Ltd., will attract chemists engaged in distillation work who demand "more and more vacuum." Although the plant shown is intended for marine service, it can be readily adapted for distillation under vacuum.

Air and gas compressors are to be found at many stands. An important exhibit is that of Messrs. Luchard & Co. Low, medium and high-pressure machines are shown, the last up to 7000 lb. per sq. in., of which the compactness and workmanship are admirable. The British Oxygen Co., Ltd., and Messrs. Lacy-Hulbert and Co., Ltd., also show some excellent machines. Several types are shown at work on refrigerating plants by Messrs. John Kirkaldy, Ltd., Messrs. L. Sterne & Co., Ltd., Apeldoornache Machinefabriek, Messrs. West & Beynon, Ltd., and the Kitson Engineering Co., Ltd.

The castings shown by Messrs. Thomas Summerson & Sons, Ltd., deserve close inspection, and chemical engineers should investigate the value of their high tensile "Granfin" cast iron. It is an electric furnace product, free from impurities, and, apart from its simple use, should form a basis for chemical cast irons of great value to the chemical industry.

The Yorkshire Copper Works, Ltd., and Messrs. Allen Everitt & Sons, Ltd., exhibit tubes for condensers and evaporators of copper, brass and special alloys.

"Plymax" is ordinary plywood having a thin sheet of galvanised steel cemented on each side, exhibited by Messrs. Venesta, Ltd. It can be cut by saws and formed by means of corner-pieces, etc., into skips, trucks, barrels, tanks, etc. It ought to be of great value to chemical manufacturers.

It is impossible to avoid the stand of the "Stream Line Filter Co.," or to avoid discussion of the remarkable results obtained. A large filter with a capacity of 10,000 gals. per hour is seen in the centre of the stand, and eight smaller filters are at work on the stand itself. Still smaller laboratory filters are used for demonstration, and working models show the action of the cleaning plugs, which force out the separated solids. One small filter is at work on cyanide sludge, yielding a stiff residue and a clear filtrate. Two others remove dye from solutions, and another filters beer and produces a colourless liquid which is not beer and does not smell like beer, or produces any other filtrate up to a bright beer which is really beer. The concentration of soluble substances of which there is evidence may be due to the stream-line action rather than to edge filtration. At any rate, the filter will produce a profound change in nearly all industrial undertakings. The machine is welcome, however, to the chemical engineer and manufacturer as a means of dealing with problems which are becoming day by day more and more overwhelming.

It is curious to note that the straining apparatus exhibited by Auto-Klean Strainers, Ltd., has a remarkable resemblance to Dr. Hele-Shaw's apparatus. Metal sheets with separating washers are employed, and although straining only is accomplished, the advantages over gauze strainers are well made out.

Another device due to Dr. Hele-Shaw, a flexible joint for piping, is shown by the Victualic Co., Ltd.; the force to be resisted, the pressure in the piping, makes the joint by means of a flexible ring acting like the "U" leather in hydraulic plant. A joint based on the same principle, the "Flexstel," is shown by Messrs. W. H. Dorman and Co., Ltd. Klinger Patents exhibit a valve which has some relationship to these joints. It is a seatless valve in which closing is effected by a cylindrical metallic plunger moving through two jointing rings of flexible material separated by a metallic bush in which are the ports for the passage of the fluid.

Centrifugal separators of excellent workmanship and design are shown by British Separators, Ltd., the De Laval Chadburn Co., Ltd., and by United Water Softeners, Ltd. (the Sharples' machine). The value of these machines for separation work is well known.

For the slow drives required in many types of chemical plant the "H. R." reduction gear shown by the H. R. Gear Co., Ltd., is very attractive. It is an arrangement of worm gearing in an extremely small casing, by which reductions of 100,000 to 1 in its simple form and of 10,000,000 to 1 in the compound form, may be readily obtained. The workmanship and efficiency of the gear are everything that could be desired.

The joinery machinery shown by the Eland Engineering Co. also deserves some notice. A simple lathe and circular saw are mounted together and adapted to form woodwork joints for frameworks; a cylindrical projection and recess is formed and is held together by a screw; the joint replaces the usual costly mortice and tenon.

It is difficult to mention in a short space all the interesting exhibits, but a slide-rule reading to four figures, the "Otis-King Calculator," ought not to be omitted. This is a tubular slide-rule with spiral scales on one tube, with a plain tubular cursor; it is equivalent to a slide-rule of ordinary type, 66 ins. long.

CORRESPONDENCE

THE ATOMIC THEORY AND THE PROGRESS OF CHEMISTRY

SIR,—In January last I heard Sir J. J. Thomson make a statement almost, if not quite, identical with that reported in your editorial of September 7. I was startled, and pondered the matter for some time, finally concluding, on the following grounds, that the statement is too severe a condemnation of the chemistry of the last century. The atomic theory as originated by Dalton and subsequently developed by the application of Avogadro's hypothesis is the basis of the formulæ and equations which have allowed chemists of the last 100 years to develop the synthetic methods that have been so important in both pure and applied chemistry. No one now doubts the truth and the importance of Avogadro's hypothesis, as is evidenced by the publication of the fifth edition of Nernst on "Theoretical Chemistry from the Standpoint of Avogadro's Rule and Thermodynamics." Yet it is hard to see what meaning such a rule could have, apart from an atomic theory.

At the same time I should like to point out that he suggests, even urges, that in the teaching of chemistry the structure of the atom should be the starting point and that it should be brought forward to explain the phenomena of the science from the first. So here is another matter for consideration: will it pay to teach chemistry upside down?—I am, Sir, etc.,

E. PASCAL

Bishop's Stortford College Sept. 12, 1923

THE BRITISH DYESTUFFS INDUSTRY

SIR,—May I be allowed to make the following comments on Prof. Morgan's article on the British Dyestuffs Industry, which appeared in the last issue of *Chemistry and Industry*.

1. Read Holliday and Sons, Ltd., was not in low water financially, but had paid 10 per cent. on its capital for several years. Its management was responsible for dinitrochlorobenzol being available in this country at the outbreak of war, from which so much lyddite was subsequently made.

2. The tragedy of the present dyestuffs industry is that the two men who had long commercial and technical pre-war experience of the industry, have been allowed by directors, without any of this experience, to leave the industry. I refer to Dr. Levinstein and Sir Joseph Turner.

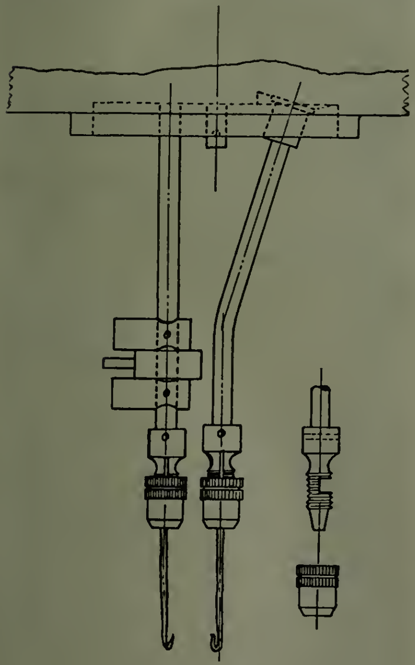
3. Patent Blue at 8s. is 6½ times pre-war price: the direct cotton colour (Sky Blue FF) at 12s. 3d. is twelve times its pre-war price. If prices on this basis are essential to maintain the industry as a national necessity, the colour-user's argument is that the whole burden should not be borne by him. The Government's share in a national necessity is £1,700,000 share capital largely inflated at the formation of the British Dyestuffs Corporation.

4. The present Board of the Corporation has neither technical qualifications nor pre-war commercial experience of the industry. Is it to be wondered at that a Board so constituted cannot live up to a three-times factor.—I am, Sir, etc., C. M. Whittaker

39, Albert Road,
Cheadle Hulme, Cheshire

ELECTRICAL CONTACTS FOR THE BOMB CALORIMETER

Sir,—I have used the bomb calorimeter for a number of years and appreciate the great accuracy of the results obtained thereby, but have always had difficulty in obtaining a suitable adjustment for the electrical contacts, owing to the rapid corrosion of the points. After experimenting with several devices, with more or less success, I have now found that the one shown in the accompanying illustration is most satisfactory, and send it you for publication in the hope that others may find it equally successful.



Screw Adjustments for Bomb Calorimeter

By means of the screw adjustment shown, the terminals may be removed for cleaning or, if and when beyond this stage, replaced by new ones.—I am, Sir, etc., James S. Mann

Langdon Hills, Sept. 11, 1923

THE FINISH OF CHEMICAL GLASSWARE

Sir,—It is an easy matter for those chemists who have access to a power-driven grindstone to grind off at an angle the stems of separating and dropping funnels, condenser inner tubes, etc.

Not all chemists, however, are so fortunately situated, and I venture to suggest to the manufacturers of chemical glassware that the ends of such apparatus should be ground in this way as a matter of standard practice in manufacture. At present it is quite common, for example, to find a condenser inner tube practically full of liquid when it is used in the reflux position, owing to the fact that the end of the tube is drawn off so much that it prevents the return of liquid to the flask and the passage of vapour at the same time.—I am, Sir, etc.,

A. O. Jones
(Lecturer)

Technical College,
Huddersfield
Sept. 11, 1923

THE ORIGIN OF SYMBOLS

Sir,—Your correspondent " Analyst " desires information on the earliest use of symbols in chemistry.

We all know that our alchymistic predecessors used symbols for expressing their ideas and sometimes for hiding their ignorance. However, up to the time of George Wilson, Chymist, each man was a law unto himself. Wilson (c. 1670) held a strict inquiry into the possibility of transmutation, and in each case seems to have co-ordinated the symbols of the varied inventors into standard forms. It is probable that through Wilson's work the pharmaceutical symbols for the drop, drachm, scruple, ounce, pint, etc., were fixed and made eternal.

As chemistry ceased to be an art and became a science these symbols became obsolete, until Dalton on August 26, 1804, used a new set of symbols to explain his atomic theory to Thomas Thomson. Dalton's symbols were simply circles oriented internally to represent a few elements.

It is strange now to remember that Davy held the atomic theory up to ridicule, but was convinced by Mr. Gilbert, who owed his conversion to Dr. Wollaston. Now Dr. Wollaston for argument substituted " Proportion " for " Atom," and shortly afterwards he put out a sliding rule, or rather a set of slide rules, whereby the " Combining proportion of a substance in any weight whatever " could be seen at once. The present writer's great grandfather received an early ivory set of these slide rules with written instructions from Dr. Wollaston, and the writer remembers them being destroyed by the breakage of a winchester of Liq. Potassae. The scales were all provided with symbols in the modern sense : Oxygen, O=unity. Hydrogen, H, was 1/7 ; Nitrogen (Azote) was given as Az, Sodium or Soda as Na, Potass. as Ka, and quite a number of others. The atomic weights even when taken as equivalents were in most cases rather incorrect, but I am of opinion, partly on hearsay evidence from my father, and partly on the contemporary account of Thomson, that the real founder of our chemical symbols and perhaps of volumetric analysis was Dr. Wollaston, and that both subjects came from his slide rule.

I do not know of another of those rules, although an account of a later one much more complete is given in *Phil. Trans.*, 1814, to which unfortunately I have not access. It is rather curious that in the old days men like Boyle, Black and Cullen, who really had something to say, used no symbols, whereas the visionary alchymist and the charlatan held out unintelligible formulae as being proofs of their theories. Is history a cyclic phenomenon ?—I am, Sir, etc., N. C. L.

Paisley

THE STREAM-LINE FILTER

Sir,—I am writing with reference to the description in the editorial of the issue of September 7 of the capabilities of Prof. Hele-Shaw's stream-line filter. The statement there appears that substances in solution (dyestuffs, common salt, copper sulphate, etc.) may be partially "filtered" off.

While not doubting that the solution which emerges is more dilute than the original solution, I make bold to criticise the use of the term "filtered" in this connexion. If we say that some of the solute has been filtered off in the ordinary sense of the word, we make the entirely unjustifiable assumption that the molecules or ions of the solute are larger than those of water.

The phenomenon of the removal of part or all of a solute by such a process is by no means a new one. It may be illustrated with much simpler apparatus than Prof. Hele-Shaw's filter. If a glass tube is packed with glass wool or asbestos and a coloured solution poured through it, it will emerge colourless or, at least, much paler in colour.

The explanation of this was provided by Prof. Sir J. J. Thomson to explain the action of semi-permeable membranes in observations of osmotic pressure. (The action of these membranes is similar in that they allow free passage of the solvent molecules but impede those of the solute.)

This explanation is as follows : The tendency of a liquid is always to diminish its surface energy wherever possible. In most cases, the effect of increasing the concentration of a solution is to diminish the surface tension with a solid surface. Now, suppose we have a solution flowing through a very narrow channel. In order to diminish its surface energy, the solute will tend to accumulate at the sides, and if the channel is long compared with its diameter the solute will be partially or completely removed from the emerging liquid.

I have no doubt that Prof. Hele-Shaw's filter is a perfectly parallel case to the above, and suggest that this explanation of its action is a perfectly satisfactory one.—I am, Sir, etc.

Magdalene College, Cambridge G. E. Watts
Sept. 18, 1923

NEWS AND NOTES

CANADA

Mineral Output in 1921

The following figures showing the mineral production in 1921 have been extracted from the annual report published by the Dominion Bureau of Statistics, Mining, Metallurgical and Chemical Branch :—

Metallic :—	1921	Quantity	Dec. (−) or Inc. (+) per cent.
Cobalt, metallic and contained in oxide	Lb.	251,986	—53·85
Copper	,,	47,620,820	—41·64
Gold	Fine oz.	926,329	+21·09
Iron pig from Canadian ore	Tons	56,564	—25·45
Iron ore sold for export	,,	1,058	—88·09
Lead	Lb.	66,679,592	+85·46
Nickel	,,	19,293,060	—68·55
Palladium	Crude oz.	591	—35·27
Platinum	,,	292	—50·92
Rhodium, osmium, iridium	,,	57	—88·89
Silver	Fine oz.	13,543,198	+1·60
Zinc	Lb.	53,089,356	+33·18
Non-metallic :—			
Actinolite	Tons	78	—22·00
Arsenic, white and in ore	,,	1,491	—39·37
Asbestos	,,	92,761	—53·52
Barytes	,,	270	—64·05
Chromite	,,	2,798	—74·60
Coal	,,	15,057,498	—9·47
Corundum	,,	403	+105·61
Feldspar	,,	29,868	—21·14
Fluorspar	,,	5,519	—50·88
Graphite	,,	937	—57·21
Gypsum	,,	386,550	—9·93
Magnesite	,,	3,730	—79·70
Magnesium sulphate	,,	2,029	+4·21
Manganese	,,	68	—89·52
Mica	,,	702	—68·13
Natro-alunite	,,	30	—
Natural gas	M. cu. ft.	14,077,601	—16·43
Oxides, iron	Tons	9,048	—52·70
Peat	,,	1,666	—63·38
Petroleum, crude	Bbl.	187,540	—4·44
Phosphate	Tons	30	—
Pyrites	,,	32,173	—24·36
Quartz	,,	100,350	—21·78
Salt	,,	164,658	—21·54
Sodium carbonate	,,	197	—
Sodium sulphate	,,	623	—23·18
Strontium	..	—	—
Talc	,,	10,124	—53·28
Tripolite	,,	341	+31·15

The total value of the mineral output was $171,923,342, of which metallic minerals represented 28·7 and non-metallic minerals 51·09 per cent. The two biggest items were gold and coal, representing 11·14 and 42·14 per cent., respectively, of the value of the total output. This total value includes $34,737,428 for the production of structural materials and clay products, the chief items being 2931 tons of fire-clay and 124 t. of kaolin and 5,752,885 barrels of cement.

FRANCE

The Coke Industry

During May, the French coke works belonging to the French coal companies produced, roughly, 160,000 metric tons of coke, compared with 250,000 t. during the same period before the war. Several coke works have been restarted in the Nord District, and others are in such a state of preparation that it is hoped that 140,000 t. a month will be produced at the end of the year in the Nord and Pas de Calais districts alone, or, roughly, 200,000 tons in the whole of France, 120,000 t. being destined for use in blast furnaces (in May, 180,000 t. was used for this purpose). It is estimated, though not on a sure basis, that the coke production of the metallurgical companies amounts to some 120,000 t. per month. In the metallurgical industry many extensions are taking place, and one company alone, the Compagnie des Forges et Acièries de la Marine et Hornecourt will put up a battery of 70 by-product ovens at the end of the year, when the production of coke by the metallurgical industry should probably reach 150,000 t. per month. Altogether it can be estimated that by the end of the year the production of metallurgical coke will have reached 3,200,000 t., compared with 4,000,000 t. in 1914. The actual tendency is to install batteries of 70 coke ovens at a cost of, roughly, 10,000,000 francs and with a capacity of up to 160,000 t. per annum. In 1922 the French consumption of metallurgical coke was 6½ million t., compared with 7 million t. in 1913, 4 millions of this being produced locally and the rest imported. The actual deficit is thus, roughly, 2,000,000 t. per annum.

UNITED STATES

Asbestos in 1921

The asbestos-mining industry in the United States showed a great falling off in 1921, and by the end of the year production had almost ceased. The asbestos sold in 1921 declined about 50 per cent. in both quantity and value below that marketed in 1920. Chrysotile, however, which formed 93 per cent. of the total value, declined 65 per cent. in quantity and 53 per cent. in value. Asbestos was mined in Arizona, California, Georgia, Idaho, and Maryland, making a total of 831 short t. valued at $336,968. The unmanufactured asbestos imported from Canada in 1921 amounted to 71,412 t., valued at $2,687,439. The total general imports amounted to 72,463 t., valued at $2,948,302, as compared with 167,558 t., valued at $9,120,253 in 1920. This was a decrease of 57 per cent. in quantity and 68 per cent. in value.

The total world's production of asbestos in 1921 was 106,500 m.t., being the smallest since 1914. The outstanding features for 1921 are the great decline in the Canadian output of asbestos (82,015 m.t.), which is about half the quantity for 1920 (162,037 m.t.); also the maintenance of the Rhodesian production, which is mostly chrysotile (*cf. J.*, 1921, 254 R.).—(*U.S. Geol. Surv., Sept.* 19, 1922.)

Fuller's Earth in 1921

The activity prevailing in recent years in the fuller's earth industry was checked in 1921 by depression in the petroleum industry, the output of fuller's earth in that year declining by 18 per cent. in quantity and 21 per cent. in value to 105,603 short tons valued at $1,973,848. According to the U.S. Geological Survey, Florida produced 54 per cent. of the total output, 99 per cent. of the output coming from Florida, Georgia, and Texas. The demand for fuller's earth increased late in 1921 and the outlook for 1922 was so good that new deposits were to be developed in Georgia and Pennsylvania. Imports, which had increased in 1919 and 1920, fell off in 1921, reaching the lowest quantity since 1900, and representing only 39 per cent. of the export in the record year 1914. The imports included 9261 short t. of wrought or manufactured fuller's earth and 483 t. of unwrought or unmanufactured fuller's earth, the total value being $119,415.—(*Cf. J.*, 1922, 158 R.)

GENERAL

Tin in 1921

The Imperial Mineral Resources Bureau has now issued a further publication belonging to the series on the Mineral Industry of the British Empire and Foreign Countries, devoted in this case to statistics of the production of, and trade in, tin. From it we extract the following figures showing the world's production of tin ore in terms of metal and the world's smelter production of tin in 1921 :—

	Output of Tin Ore Long tons	Smelter Output of Tin Long tons
United Kingdom ..	679	14,000
Nigeria	5,057	—
Swaziland	234	—
Union of South Africa	720	—
Southern Rhodesia ..	—	4
India	1,362	172
Straits Settlements ..	*	41,917
Federated Malay States	34,490	—
Unfederated Malay States	1,611	—
Australia	2,650	2,985
Bolivia	18,804	60
Germany	—	4,000†
United States	—	10,305
China	11,200	6,134
Siam	6,181	—
Dutch East Indies ..	26,911	—
Other Countries ..	900	500
	110,800	95,000

* Figures not available. † Estimated.

The pamphlet (pp. iv+44) can be obtained from H.M. Stationery Office, price 1s. 6d.

REVIEWS

Practical Physical Chemistry. *By* Alexander Findlay, M.A., D.Sc. *Fourth edition, revised and enlarged. Pp. xvi*+298. *London: Longmans, Green and Co.*, 1923. *Price* 7*s.* 6*d.*

Five successive impressions of Findlay's Practical Physical Chemistry have been issued by the publishers since 1914, when the third edition first appeared. This fact affords very striking evidence of the greatly increased attention which has been given in recent years to the experimental side of physical chemistry in University courses of instruction. In meeting the demand for a fourth edition, the author has taken the opportunity to revise the text and to introduce a certain amount of new matter dealing with forms of apparatus and types of measurement with which all chemical students should have some acquaintance.

In the chapter on optical measurements, descriptions are given of the Abbe refractometer and of the Hilger wave-length spectrometer. In the section on molecular weights, an account of the boiling-point apparatus designed by Cottrell has been included. In actual practice Cottrell's apparatus has been found to give more satisfactory results than can be ordinarily obtained with other forms of ebullioscopic apparatus, in that fluctuations of temperature and errors of determination due to superheating—familiar causes of trouble to most students who have had experience of ebullioscopic work—are very largely avoided.

In the chapter on electromotive forces, sections have been added which deal with oxidation and reduction potentials, and with the methods of electrometric analysis, including the determination of hydrogen-ion concentration. The very frequent use of p_H as a means of expressing the hydrogen-ion concentration of a solution, renders it important that the beginner should realise as clearly as possible the significance of this quantity. The statement that "p_h or pH has been introduced as a symbol for the expression $-\log_{10}h$," where h is the hydrogen-ion concentration (p. 218, footnote 2), can scarcely be regarded as a satisfactory definition. Its physical significance is much more likely to be appreciated if p_H is defined as the logarithm of the number of litres of solution which contain one gram of hydrogen-ion.

The field of colloid chemistry is brought to the notice of the student by the introduction of a few appropriately selected exercises, which serve to illustrate some of the chief characteristics of matter in the colloidal state.

In accordance with the author's desire to preserve the character of the book as a guide through a general course of practical physical chemistry, the bulk of the volume has not been much increased by the revision. Whilst there is much to be said for this conservative policy, it should not be allowed to interfere unduly with the introduction of sections bearing on work which falls within the province of the physical chemical laboratory. Sections dealing with the use of indicators in the determination of p_H values and with the methods employed in the determination of freezing-point curves, for instance, would certainly not be out of place in such a guide. The experimental treatment of types of heterogeneous equilibrium might also receive further consideration since it is only as the result of the experimental investigation of such systems, of the correlation of the experimental data and of the actual construction of diagrams and models, that the distinctive characteristics of complex heterogeneous equilibria are clearly impressed on the student's mind. Furthermore, since electrochemical preparations and electrochemical analyses very frequently form part of the experimental work which is carried out in the physical-chemistry laboratory, it would obviously be of advantage to many students to have short sections devoted to these matters included in the volume.

Whilst, however, there may be considerable differences of opinion amongst teachers of physical chemistry as to what should be included in the compass of an ideal course, there can be no divergence in reference to the view that the high reputation achieved by Findlay's book as a trustworthy and efficient laboratory guide will be fully maintained by the fourth edition. The new material is clearly and adequately expounded, and the more extensive introduction of notes and bibliographical references undoubtedly adds to the value of the book which in its external aspect has been made distinctly more attractive by the substitution of Demy 8vo format for the Crown 8vo of the older editions.

H. M. Dawson

Elementary Physical Chemistry. *By* W. H. Barrett, M.A. *Pp. viii*+243. *London: Edward Arnold and Co.*, 1923. *Price* 6*s.*

This book covers the usual ground in physical chemistry, but differs from most standard books on the subject by giving instructions for performing experiments. These are designed to illustrate the principles as they are introduced, and are not, of course, intended to replace a practical course in the subject. A feature of the book is the presentation of problems at the end of each chapter; nothing assists the student more to fix his ideas on a subject than the working out of such problems. The reviewer feels, however, that the solutions of these might, with advantage, have been given. It is discouraging to the student after he has worked out a problem if he does not know whether his results are correct or not, and the teacher is not always available for every problem.

The order and method of treatment is good, so that continuity is preserved. Few errors have escaped the proof reading, though an index has been omitted in Table 31, p. 181, and the signs of the indices in Table 35, p. 212, are wrong. The book is a useful one and is available at a very low price. John A. Cranston

An Introduction to Theoretical and Applied Colloid Chemistry. *By* Dr. Wolfgang Ostwald. *Authorised translation from the eighth German edition by Dr. M. H. Fischer. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.*, 1922. *Price* 12*s*. 6*d*.

It is necessary in these days for men of science to present their work in popular form, not only to the layman, but also their fellow-workers in other branches. The five lectures in the present volume were delivered in America in 1913–14, but as they have been continuously revised by the author they have much more than a historical interest; in fact, they form an excellent introduction to colloid chemistry.

The selection of matter for such semi-popular lectures is of paramount importance, for the subject must be presented in a manner which is convincing logically and at the same time illuminated by interesting and familiar details. Prof. Ostwald has used his unrivalled command of the subject with a restraint which cannot be too highly praised. In the first lecture he defines the realms of colloid chemistry as the study of those disperse systems which lie between molecular dispersions (" true solutions ") and coarse, unstable dispersions in which the particles are usually visible under the microscope. This point of view is emphasised in the more romantic title of the German edition—*The World of Neglected Dimensions*. The second and third lectures deal with the classification and general properties of colloidal systems.

The last two lectures will be the most interesting to many readers, as they deal with the scientific and technical applications of colloid chemistry. The examples selected cover a prodigious range of human activity. Photochemistry, crystalline liquids, clouds and deltas all come in for consideration before the more obvious applications to biology and medicine. In technical matters colloidal considerations are frequently confined to the working out of a *rationale* of operations as carried out at present, though even this is the first step towards further progress. The beginnings of colloidal processes consciously undertaken are seen in the production of graphite for lubrication by Acheson's process, and in the applications of colloid mills. Many hoary controversies are illuminated by the application of the ordinary ideas of colloid chemistry, notably the constitution of gold and selenium ruby glasses, of ultramarine, and the setting of cement. The application of colloid conceptions to metallurgy is still in its infancy, and justice is done in the final lecture to the exceptionally important work of Benedicks and Gürtler. The ideas developed in relation to such matters as soap manufacture, foods, dyeing, and the vulcanisation of rubber are fairly familiar to the average colloid chemist, but will be novel to many readers.

The translation is, on the whole, good and has not made the book unreadable in its new language, as so often happens. It is, however, invidious to speak of " the classification of *the* colloids " when any substance can take on colloidal form.

The author frankly describes his work as " a propaganda sheet for colloid chemistry." As such it is not to be regarded as a substitute for the systematic works but rather as a stimulus to the study of them. It indicates to the chemist and the manufacturer where they stand with regard to a new and lively science. It is an antidote to the prevalent preoccupation with the crystalloid state of matter, and is particularly to be recommended to minds like that of an eminent professor, who recently remarked to the present reviewer, " When I see a colloid, I pour it down the sink."

P. C. L Thorne

Quantitative Chemical Analysis. *Part I By* Prof. R. M. Caven, D.Sc., F.I.C *Pp. vii*+153. *London: Blackie and Son. Ltd.*, 1923. *Price* 3*s*. 6*d*.

This volume is Part I of a book which is intended to provide instruction for the student of chemistry, after he has passed the most elementary stage, until he is ready to take an honours degree, or diploma, such as that of the Institute of Chemistry. It is based on the work carried out normally by the full-time student in the Royal Technical College, Glasgow. Some simple inorganic preparations with their gravimetric analyses are given at the commencement, but the main portion of the book is devoted to volumetric analysis. Exercises are set in the preparation and uses of standard solutions of acids and alkalis, of potassium permanganate, of potassium dichromate, of iodine and sodium thiosulphate, and of silver nitrate.

The long and successful teaching experience of the author and his well-known lucidity are reflected in the precise and systematic way in which the subject is presented and in the useful hints with which it is rounded off. The publication of Part II of the book will be looked forward to with interest.

W. O. Rutherford, vice-president of the B. F. Goodrich Rubber Co., New York, has been elected president of the Rubber Association of America.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Sept.* 13)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Brassware	7438/3/T.E./E.C./2
Australia	Sodium acetate (tender)	12039/E.D./C.P.
Belgium	Chemicals, pharmaceutical products	291
Brazil	Photographic materials	905/3/F.G./C.C./2
British India	Enamelware, paint (tender)	*
Bulgaria	Creosote (tender)	11456/F.E./C.C./2
Canada	Pulp and paper machinery, brass, copper	289
Finland	Iron, steel, brass, copper	292
Latvia	Lubricating and cylinder oil (tender)	7986/F.R./C.C./2
Norway	Tinplate, olive oil	293
Poland	Coconut and soya bean oil	7931/F.R./C.C./2
Spain	Paint, soap, cement	294
Uruguay	Electrolytic tinned copper wire (tender)	8646/F.L./C.C./2

* Director General, India Store Department, Branch No. 10, Belvedere Road, London, S.E.1.

TARIFF CUSTOMS EXCISE

Bahamas.—Kerosene oils may be imported duty free.

Germany.—The tax on starch sugar has increased to 2,900,000 marks per 100 kg., and to 7,300,000 marks per 100 kg. for other sugar.

Portugal.—Modifications have been made in the duties on sugar and tin manufactures.

South Africa.—A dumping freight duty has been levied on imports of superphosphates and cement.

France, Czechoslovakia.—The issue for September 13 gives a list of reduced duties on goods provided by the Convention concluded on August 17. These reduced rates are applicable to similar goods produced or manufactured in the U.K. and in such other parts of the British Empire as accord the most-favoured-nation treatment to goods from Czechoslovakia.

REPORT

Report on the Industrial and Economic Conditions in Norway, Dated February, 1923. *By* C. L. Paus, *H.M. Commercial Secretary, Christiania. Department of Overseas Trade. Pp.* 81. *H.M. Stationery Office,* 1923. *Price* 2*s.* 6*d.*

The general economic crisis was felt in Norway with increasing severity in 1922. Competition from abroad is serious, and although labour costs have decreased, further wages reductions will have to be effected. Increased industrial activity has led to an increase in the consumption of raw materials, but to some extent this has been met from existing stocks. There have, however, been demands for fresh supplies and the comparative stability of the krone has facilitated transactions in foreign currencies.

Agriculture passed through a critical year, prices—and consequently profits—being low. Lumbering operations were restricted, owing to large stocks of timber being held by the pulping mills. The position of fisheries improved somewhat. In 1922, 1,745,000 gals. of cod liver oil was produced, against 1,263,000 gals. in 1921. No new hydro-electric power schemes have been inaugurated, as new supplies of energy are required only for domestic purposes.

The principal difficulties with which industry had to contend in 1922 were, as in the previous year, high production costs and foreign competition (*Cf. J.*, 1922, 222 R). Large stocks of raw materials bought at high prices hampered the wood-pulp and paper-making industry. The financial condition of this industry is weak, but improvement is expected, as the decrease in British demands has been counterbalanced by a huge increase in exports to the United States and Canada. Exports of cellulose in 1922 are estimated at 225,000 t., of which 25,000 t. was drawn from existing stocks. High production costs and restricted demands have limited the activity of the mining industry, though 400,000 t. of pyrites and 150,000-200,000 t. of iron ore were produced, compared with 231,000 t. and 55,000 t. respectively in 1921; the prices obtained, however, were often less than the cost of production. The copper smelting works, nickel refineries, and nickel, chrome, and molybdenite mines were closed during the whole of the year. Carbide factories were working at about 30 per cent. of capacity, but they have cleared old stocks and are no longer working at a loss. The production of ferrosilicon was about 10,000 t. (half the normal capacity), and exports remained at the same level as in 1921, but were unremunerative. Only about 1000 t. of ferrochrome was produced; an increased demand from Great Britain is now noted, however. The nitrate factories belonging to the Norsk Hydro-elektrisk Kvaelstof A.-S. operated at full capacity in 1922, despite keen competition from Germany. Aluminium factories worked at about one-half their capacity (8000 t. per annum), but demands have now increased. During the year the output of cement was 1,500,000 barrels.

Following are the quantities (in tons) of various commodities imported in 1922, the figures for 1921 being given in parentheses:—Cement, 9576 (18,189); fertilisers, 42,314 (23,540); coal, 1,748,657 (896,593); iron, 90,375 (57,759); copper, brass, aluminium, etc., 1146 (1826); zinc, 3,739 (7635); lead, 750 (379); tin, 167 (212); potash, 1163 (257); bleaching powder, 1662 (354); salt, 183,927 (121,292); Glauber's salt, 10,121 (3740); soda ash, 23,773 (6838); caustic soda, 1741 (858); sulphur, 11,662 (4919); sulphuric acid, 184 (250). Exports included aluminium, 6043 (6266); calcium carbide, 21,004 (15,676); cellulose, 205,775 (82,456); cement, 88,714 (47,962); copper, 177 (894); ferro-chrome, 1426 (528); ferro-silicon, 9846 (5,824); iron ore, 185,307 (7107); matches, 2374 (2442); molybdenite, 15 (59); nitric acid, 1116 (794); ammonium nitrate, 1792 (13,103); sodium nitrate, 32,401 (17,314); sodium nitrite, 1674 (1619); calcium nitrate, 157,558 (81,876); cyanamide, 3899 (5,339); pyrites, 475,864 (223,879).

COMPANY NEWS

BRITISH CELLULOSE AND CHEMICAL MANUFACTURING CO., LTD.

The accounts for the 20 months ending Feb. 28 show a net loss of £491,783, including £210,538 loss on trading account, £229,270 depreciation of surplus unerected plant and losses on plant sold or wholly written off. Transfer fees amounting to £1261 were received, whilst £50,695, representing the balance of the reduction of capital account, was appropriated to meet the losses. The report states that recent developments and extensions will ensure great economies in the cost of production when the demand is increased; and that since the accounts were closed the monthly earnings have been more than sufficient to cover all charges and the debenture interest, but not to meet depreciation. Since the last report was published the authorised capital has been written down from £7,750,000 to £6,000,000, and the Cellulose Holdings and Investment Co., which was formed under the reconstruction scheme, recently agreed to provide the company with £400,000 of new capital. The issued ordinary preference capital amounts to £5,400,000, and the first mortgage debenture stock to £700,000, the company having the right to issue an additional £300,000 of similar stock if required. Freehold land, buildings, plant, machinery, and equipment are valued at £3,445,376, goodwill, patents and patent rights being valued at £1,886,451; stocks amount to £176,494, and cash to £102,580. It is proposed to change the title of the company to British Celanese, Ltd.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Acetic Acid, 40% tech. ..	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric ..	3s. 6d. per carboy makers' works.
Acid Nitric 80° Tw. ..	£22 per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 70s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 10s. per ton makers' works.
Ammonia Alkali ..	£7 12s. 6d.—£8 per ton. General export demand good, particularly from the Continent.
Arsenic (White) ..	£72—£73 per ton. Not much doing.
Bleaching Powder ..	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime ..	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride ..	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Copper Sulphate ..	£25 10s.—£26 per ton.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate ..	6¼d. per lb. d/d.
Potass. Chlorate ..	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76% ..	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98% ..	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate ..	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96% ..	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Carload lots 9¼d. per lb. Less quantities 10½d. per lb. ex wharf London. Ample supplies.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d. Regular demand and short supply.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£10 per ton, according to grade. Market quiet owing to slack demand for non-ferrous metals.
Iron Liquor	1s. 7d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d.—6s. 4d. per gall. 60% O.P. Steady market.
Solvent	6s. per gall. 40% O.P. Good demand.
Wood Tar	£5—£6 10s. per ton, according to grade. More inquiry for forward delivery.
Brown Sugar of Lead	£41—£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d.—1s. 2½d. per lb. Good demand. Market firmer.
Crude 60's	3s. 3d.—3s. 6d. per gall. Good demand for spot delivery.
Acid Cresylic—97/99	2s.—2s. 5½d. per gall.
Pale 95%	1s. 10d.—2s. 5d. per gall. Market weaker.
Dark	1s. 10d.—2s. 0½d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price.
Anthracene Oil—	
Strained	8¾d.—10d. per gall. Supply short.
Unstrained	8½d. per gall.
Benzole—	Fair enquiry.
Crude 65's	1s. 1½d. per gall.
Standard Motor	1s. 6½d. per gall. delivered buyer's works.
Pure	2s.—2s. 1d. per gall. d/d. buyer's works.
Toluole—90%	1s. 7d.—1s. 10d. per gall.
Pure	2s. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8¼d.—9¾d. per gall. Fair enquiry.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 5d.—1s. 6d. per gall.
Solvent 90/190	1s. 3d.—1s. 6½d. per gall.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Supply short.
Whizzed or hot pressed	£11—£12 per ton.
Naphthalene—	
Crystals	£20 per ton.
Flaked	£20 10s. per ton.
Pitch, medium soft	132s. 6d.—145s. per ton. Market quiet.
Pyridine—90/140	19s.—20s. per gall. Market very strong.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 10d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 7d.—1s. 8d. per lb. Market weaker.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d.—10d. per lb.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	5s. 0d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.—6½d. per lb. Prices firm with a good steady demand.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/24° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
d-Dichlorbenzol	£75 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£90 per ton d/d.
Dinitrotoluene—48/50	8d.—9d. per lb. naked at works.
66/68	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.

Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d
p-Nitro-o-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	4s. 10d. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. 1d.—3s. 2d. per lb. Good demand. Firm market.
Acid, Benzoic	2s. 3d.—2s. 6d. per lb. Some German makers are stated to be out of stock.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Citric	1s. 5½d.—1s. 6d. per lb., less 5%. Supply exceeds demand.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	5s. 9d.—6s. per lb., according to quantity.
Acid, Salicylic	2s. 2d.—2s. 3d. per lb. Firm market. Good inquiry.
Acid, Tannic	3s. 3d. per lb. for B.P. quality.
Acid, Tartaric	1s. 2d. per lb. less 5%. Market continues weak.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 6d. per lb. for English manufacture. Imported higher. Market very quiet.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz. for English make.
Barbitone	17s. per lb. for quantity.
Benzonaphthol	4s. 6d.—4s. 9d. per lb. Slight advance in price.
Bismuth Salts	A steady market.
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	
Potassium	6½d. per lb.
Ammonium	7d. „ „
Sodium	7½d. „ „
Calcium Lactate	2s. 6d. per lb. for best makes. Better enquiry.
Chloral Hydrate	3s. 9d.—4s. per lb. Somewhat firmer. English makers are oversold.
Chloroform	2s. 2d. per lb. for cwt. lots. Demand is poor.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	75s. per cwt. ex wharf London.
Guiacol Carbonate	8s. 6d. per lb.
Hexamine	3s. 6d. per lb. Firmly held.
Homatropine Hydrobromide	30s. per oz.
Hydroquinone	3s.—3s. 3d. per lb. Now asked.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.
Magnesium Carbonate—	
Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	65s.—75s. per cwt., according to quality & quantity.
Menthol	A.B.R. recryst. B.P. 65s. per lb.
Mercurials	Very much weaker. Reduced 6d. lb. all round. Quicksilver reduced to £8 15s. per bottle.
Methyl Salicylate	2s. 4d. per lb. Distinctly firmer for English or imported, in view of normal increasing demand.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Metol	8s. 9d. per lb.
Morphine and Salts	Prices advanced about 6d. per oz., due to higher price of opium. Alkaloid: Cryst. 11s. 6d., Precip. 11s. 3d., Acetate 9d., Hydrochlor. 9s., Sulphate 9s. per oz.
Paraformaldehyde	3s. 5d. per lb.
Paraldehyde	1s. 5d. per lb. Demand slow.
Phenacetin	6s. per lb. Unchanged.
Phenazone	7s. per lb. Steady.
Phenolphthalein	6s. 6d.—6s. 9d. per lb., according to quantity and holder.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	2s. 8d. per lb. English makes are meeting foreign competition.
Potass. Iodide	15s. 8d.—15s. 11d. per lb. Good demand.
Potass. Metabisulphite	8d. per lb.
Potass. Permanganate	10d. per lb. for B.P. crystal.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz. Steady market.
Resorcin	5s. 6d. per lb.
Salol	3s. per lb. Limited demand.
Silver Proteinate	10s. per lb. A weaker market.
Sod. Benzoate	2s. 6d. per lb. Improved demand would lead to higher prices as present stocks cannot be replaced at current figures.
Sod. Citrate, B.P.C. 1923	2s. 3d. per lb.
Sod. Hyposulphite—	
Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—87s. 6d. per cwt. Fairly good demand.
Sod. Salicylate	Powder 2s. 6d.—2s. 7d. per lb., and Crystal at 2s. 7d.—2s. 9d. per lb. Prices are likely to move slowly upwards as the season advances.
Sod. Sulphite, anhydrous	£25—£26 10s. per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.—1s. 4d. per lb.
Thymol	14s. per lb. for best white crystal.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 6d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate	3s. ,, ,
Cinnamic Aldehyde Natural	18s. 6d. ,, ,,
Coumarin	18s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	10s. ,, ,,
Geraniol (Palmarosa)	35s. ,, ,, Advanced.
Geraniol	5s. 6d.—12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. per lb.
Linalol ex Bois de Rose	18s. 6d. ,, ,,
Linalyl Acetate	21s. ,, ,,
Methyl Anthranilate	9s. ,, ,,
Methyl Benzoate	6s. ,, ,,
Musk Xylol	11s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	16s. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	2s. 1d. ,, ,,
Terpineol	3s. ,, ,,
Vanillin	22s. 3d.—23s. 6d. per lb. Firm with steady demand.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	30s. ,, ,,
Camphor Oil	75s. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4½d. per oz.
Cassia Oil 80/85%	12s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 2d. ,, ,,
Ceylon	3s. 10d. ,, ,,
Clove Oil	8s. 6d. ,, ,,
Eucalyptus Oil 70/75%	2s. 6d. ,, ,,
Lavender Oil	18s. 6d. ,, ,,
Lemon Oil	2s. 10d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	12s. 6d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	24s. per oz.
Palma Rosa Oil	23s. 6d. per lb.
Peppermint Oil—	
English	14s. 9d. ,, ,,
Wayne Country	14s. ,, ,,
Japanese	12s. ,, ,, Market rising owing to speculation.
Petitgrain Oil	7s. 6d. per lb.

TRADE NOTES

Mauritius in 1921

The colony was prosperous during 1921, despite a fall in the prices of sugar. Exports of sugar totalled 229,225 metric tons, compared with 182,425 t. in the previous year. The exports reached a total value of 157,249,822 Rs., including 287 t. of aloe fibre, as well as rum, vanilla, skins, coconut products, etc. Aloe fibre is now grown over 20,000 acres, and coconuts are cultivated over about 800 acres. A certain area has been planted with sisal, but although vanilla is cultivated its export is negligible. Imports were valued at 105,744,980 Rs., the United Kingdom supplying goods (chiefly textiles, machinery, hardware and soap) to the value of 40,563,000 Rs. Drugs, perfumery, olive oil and indigo are mainly obtained from France and coal from South Africa.—(*Col. Rep.-Ann.*, *No.* 1149, 1923.)

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications made in August for licences under the Dyestuffs (Import Regulation) Act, 1920, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 391, of which 269 were from merchants and importers. To these should be added the 29 cases outstanding on August 1, making a total for the month of 420. These were dealt with as follows:—

Granted, 282 (of which 248 were dealt with within seven days of receipt).

Referred to British makers of similar products, 74 (of which 63 were dealt with within seven days of receipt).

Referred to reparation supplies available, 30 (all dealt with within two days of receipt).

Outstanding on August 31, 34 (mostly dealt with at the meeting of the Committee held on August 31).

Of the total of 420 applications received, 341, or 81 per cent., were dealt with within seven days of receipt.

Japanese Camphor Trade in 1922

H.M. Commercial Counsellor, Tokio, reports that during 1922 the Japanese export trade in camphor showed a marked recovery, the exports amounting to 36,000 piculs as compared with 14,000 piculs and 10,000 piculs respectively in the two previous years, whilst during the March quarter of 1923, the exports of camphor amounted to 14,000 piculs. A large proportion of these exports go to the United States, other large buyers being India and Germany.—(*Bd. of Tr. J.*, *Sept.* 6, 1923.)

PUBLICATIONS RECEIVED

MOULD GROWTHS UPON COLD-STORE MEAT. *By* F. T. BROOKS, M.A., *and* C. G. HANSFORD, B.A. *Food Investigation Board, Department of Scientific and Industrial Research. Special Report No.* 17. *Pp. iv*+142. *H.M. Stationery Office*, 1923. *Price* 1*s*. 6*d*.

1923 YEAR BOOK OF THE AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS. *Pp.* 138. *New York: Howes Publishing Co., Inc.*, 1923.

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EDITORIAL

OUR attendances at meetings of the British Association have been so few and far between that the proceedings and atmosphere still have the charm of novelty. Some of the members regularly attended the particular section to which they were attached; others impartially flitted from chemistry to physics and botany, with occasional visits to education or psychology. They sipped each flower and changed every hour; for are not all sciences here united? It may have been a set of curious chances or it may be a sign of the times, but in several sections we found attention concentrated on things of molecular or even atomic dimensions. Our recollection of chemistry forty years ago is that the science was then more massive; half a pound of iron filings mixed with half a pound of sulphur and buried in a neighbour's flower garden constituted an experiment which he who ran could read. But now we have to consider enzymes which, according to Dr. E. F. Armstrong, are not substances but little inflammations breaking out on the surface of some colloid complex, and we are drawn into the realm of the infinitely little. The small volcano in the flower garden has to be reduced to dimensions where a surface only one molecule thick affords a clue to some catalytic phenomena. In physics our atom-smashers and orbit-weavers, lineal and worthy descendants of Newton and Laplace, trace the effect, on spectral and other manifestations, of the removal of so small a particle as an electron, while botanists and physiologists bring photosynthesis, osmosis, surface tension, hormones and other physical and chemical conceptions to aid them to see the way in which plants and animals construct their cells and fill them with complex materials. The enzyme theory seems " so like the truth 'twill serve our turn as well." The chemistry of the mass has given way to the chemistry of the surface; the study of the leaf has been displaced by the study of the membrane. It is probably due to these facts that integration is necessary to make the explanations intelligible to ordinary minds. But the discussions are in some cases a little difficult for the ignorant. Did not someone say, " They were not made for thee, less thou for them "?

There is a social side to the British Association which is certainly very pleasant and probably very valuable. In the fine reception room much casual conversation was possible, and many of those who had read serious papers found it a relief to intermix grateful digressions. Here one group seemed to be discussing the scientific exhibit at the British Empire Exhibition next year, a record of the achievements of British chemistry during modern times; there, another small knot of chemists appeared to be considering some sort of co-operation among our many societies, a place or, if not, at any rate, a scheme in which their various activities could be more conveniently fitted, as in the Ark, joined without force or strife, all creatures dwelt. In the University Club others foretold the future of chemistry, still—and perhaps always—in its infancy, for that which never is to die for ever must be young. The hospitality offered to the visitors was very generous. As we wandered about our host's garden, admiring the dahlias and watching the great ships go by, we were reminded of the description given by Milton many years ago of his idea of the manner in which the wealthy merchant might welcome a valued guest: " He entertains him, gives him gifts, feasts him, lodges him; his guest comes home at night, prays, is liberally supped, and sumptuously laid to sleep, rises, is saluted, and after the malmsey or some well-spiced brewage, and better breakfasted than he whose morning appetite would have gladly fed on green figs between Bethany and Jerusalem, his guest walks abroad at eight and leaves his kind entertainer in the shop trading all day." This with a change of only two words is what the old poet considered the true hospitality, and though nowadays the evening prayer and the malmsey before breakfast are not universal, the rest of the description could well be applied to the treatment of chemists by their hosts at Liverpool and the vicinity.

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On reading through the crowded list of papers read before Section B (Chemistry) of the British Association, we saw that Prince

Ginori Conti was announced to speak on the utilisation of volcanic steam. This reminded us of the presidential address which Prince Conti delivered in opening the First National (Italian) Congress of Pure and Applied Chemistry held in Rome in June. Very appropriately, Prince Conti took advantage of the occasion to consider the chemist's standing in public estimation, and said that before the war the chemist was considered either as a superior kind of pharmacist or as a magician who, with a wave of his wand, could perform miracles. But the wartime shortage of drugs, dyes and explosives, forced the public to face facts, and thus educated it to a more just appreciation of what the chemists' work really consists. It seems somewhat doubtful if the public appreciation of chemistry is really so far advanced as we could wish, though there has certainly been an improvement. The daily papers are giving more space to, and better accounts of, scientific matters, the demand for popular expositions is growing, and, altogether, signs of greater interest in chemistry are not wanting. But there are also indications that the lessons so painfully taught by the war are in danger of being forgotten. Public appreciation of chemists and their science seems to be hampered by two main difficulties. The confusion, unequalled in any other country, due to the popular interpretation of the title "chemist" is partly responsible. The subject has been discussed long and oft, but it seems of little avail to protest as long as another section of the community has the legal right to utilise the title. In any case, however, the passage of time and the odour of sanctity conveyed by good works will, if we can be content to wait, surely bring a remedy. The other difficulty is, perhaps, even more important as it tends to prevent us from being understanded of the people ; we refer to the technical vocabulary of chemistry. We may give an illustration : Recently, an important provincial paper published a letter from a correspondent who quoted part of the description of how to prepare an organic chemical as an example of incomprehensibility, and then inquired how business men could be expected to understand such jargon. It is strange to us that names such as *Taraxacum densleonis* or *Ceutorhyncus troglodytes* are quoted glibly by people who—so we are asked to believe—are overcome by some kind of phobia when faced with 1-mercapto-2-aminoanthraquinone or hexa-chloro-*p*-xylene. That some kind of virtue resides in the purely "intellectual" value of the one as opposed to the possible commercial use of the other must, we suppose, be advanced as explanation of this difference in mental attitude. But the difficulty is there, and it is more than ever necessary for technical results to be translated into language that can be understood by non-technical persons.

CHEMISTRY IN FRANCE IN THE XVIIth AND XVIIIth CENTURIES

By C. A. SILBERRAD, B.A., B.Sc.

It is always stimulating to have a subject treated in a new way, and still more so when this is well done. There are many works giving the history of chemistry in varying degrees of detail, but there seems to be none on the lines of the one by Dr. Helène Metzger, of which the first volume has just appeared.* Her aim is to trace the development of chemistry during the seventeenth and eighteenth centuries by showing the general state of scientific opinion at the time at which each chemist wrote or worked so as to set his views and discoveries in their correct intellectual surroundings. She gives no biographical details, and emphatically does not hold with Delacre that the only important thing is to determine what each man did, but endeavours to show how the general scientific opinion of the time acted on the various chemists and how their work acted on general scientific opinion. She has confined herself to French chemists and those whose works were translated into French or had any real influence on French chemical thought.

She takes as a starting point the publication of Lemery's *Cours de Chimie* in 1675, and begins by showing what views had been current during the first three-quarters of the seventeenth century, and what was the intellectual *milieu* into which Lemery's book came.

At the beginning of the seventeenth century there was no universally accepted doctrine in chemistry ; to a very large extent each successive savant set himself to evolve a theory to explain all known chemical phenomena, and incidentally the universe as well, with little or no reference to any theories previously propounded. Yet, though at first sight independent, certain general trends of thought are discernible. At this time chemistry was still very largely regarded as a branch of metaphysics, and theories were chiefly made *a priori*, experiments being subsequently interpreted in terms of the theory and not *vice versa* as nowadays.

In the period preceding the publication of Lemery's book the best known authors were Jean Beguin, Davidson, Etienne de Clave, Arnaud, Lefèvre, Glaser, Thibaut and Malbec de Tressel.

Jean Beguin deems the end of chemistry to be the preparation of remedies, and adheres to the three "principles" of Paracelsus—salt, sulphur and mercury, which by this time, to some extent at least, had come to mean qualities rather than substances. Thus they are never obtained pure, but always mixed with more or less of "phlegm" and *caput mortuum*, and this was held to cause much difficulty in the analysis of bodies. He gives considerable details regarding apparatus and experiments.

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* *Les Doctrines Chimiques en France du début du XVIIe à la fin du XVIIIe siècle.* By Dr. Helène Metzger. Part I. Pp. 496. Paris : Les Presses Universitaires de France, 1923. Prix 25 fr.

Davidson is primarily a metaphysician and disregards the medical side of chemistry almost entirely. He holds to Aristotle's four elements (earth, air, fire and water) and also the three "principles" of Paracelsus, "whose mutual reactions produce all bodies." As a consequence, he believes in transmutation, and holds that in solution the solvent "dissolves that which it recognises as more or less homogeneous with itself," thus endowing it with a quasi-intelligence.

Etienne de Clave's work is in marked contrast with that of the author previously named. He discusses the various theories of his predecessors and gives reasons for rejecting them and for adopting his five "elements"—water (phlegm), spirit (mercury), sulphur (oil), salt and earth—which he deems mutually inconvertible, but like others appears to confuse qualities and substances. These five elements in various proportions form all substances. He gives, however, very few experimental results.

Arnaud rather resembles Beguin and defines chemistry as "the art of separating the pure from the impure by means of fire in order to prepare remedies or to perfect the metals." He gives numerous details of chemical processes, but little or no theory, and holds pulverisation to be the chief operation, every chemical operation resulting "in making the powder finer or coarser."

Lefèvre more resembles Davidson in that he goes into much metaphysical detail. He argues in favour of experiment, yet gives practically no account of any experimental work. He holds that the source and root of all things is the "universal spirit," which has in itself "three substances distinct and not different . . . . a hot, a damp and a dry," and which is accordingly "triple in its name, in that by its natural fire it is called sulphur, by its moisture it is mercury, and by its dry root connecting the dampness and fire it is called salt." By the action of certain "ferments" (not further described) this spirit takes the form of various bodies and becomes materialised, adopting more or less of the characters of sulphur, mercury or salt, according to the substance which it becomes—the precise process is decidedly obscure. He holds, however, that all substances can be resolved into two or more of five elements, which are well exemplified when dealing with the distillation of organic materials. They are :—Phlegm, or the watery distillate ; spirit, the gaseous portion ; sulphur, the oily combustible matter ; salt, the part of the solid residue soluble in water ; and earth, the insoluble portion. The chemist can only separate or transfer those elements, which are pre-existent, and consequently he holds transmutation to be possible though not yet effected. Fire, according to Lefèvre, goes towards heaven because "like attracts like." Air is the matrix of the universal spirit, and does not form a part of any compound body, its assistance to combustion being due solely to its removing the products thereof. He gives many "analyses" of organic and inorganic materials which he interprets in the light of his theory, but not forgetting that the main object of such work is the production of remedies.

Glaser accepts the five "principles," which, however, signify rather classes of bodies, but he mainly confines himself to practical details, especially of metals and their compounds.

Thibaut likewise is almost entirely free from theoretical considerations, only giving practical details regarding the apparatus used and the methods of carrying out experiments. He holds that precipitation is due to a combat between the added precipitant and the solvent.

Malbec de Tressel endeavours to uphold the older views ; he adopts the four Aristotelian elements and the three Paracelsian principles, but his views are decidedly confused. He gives, however, accounts of various operations.

The authoress, having thus outlined the theories actually current during the earlier part of the seventeenth century, proceeds to greater detail and begins (Chap. II.) with a sketch of the place held by the "philosophy of metals" in chemical theory at that time.

In early times a close connexion was assumed between the seven planets and the seven known metals, doubtless mainly because both were seven in number and both are bright ; then when astrology came to connect the various parts of the human body (also deemed seven in number) with the planets, it was natural to assume the corresponding metal to have a special influence on that portion of the body. But when more metals were discovered the connexion with the planets came to be regarded as doubtful.

The similarity in appearance of the metals is probably the root cause of the belief in transmutation. A close analogy was also assumed to exist between the organic and inorganic worlds, and metals were regarded as growing or ripening, the imperfect metals developing into the perfect metal gold, and the alchemist sought to accelerate the process. Their ideas are various and somewhat confused, but one chief line of thought appears to have been that gold of itself has no power of assimilating the baser metals unless there is present a special digestive ferment, the philosopher's stone ; and one great object of the adept was to obtain this so as to enable the "seed of gold" (regarded as present in gold) to assimilate to itself the base metals on which it feeds. Further, just as water is necessary to the growth of a plant, so is a liquid necessary to the growth of gold, and this liquid is the "mercury."

Views on the actual composition of the metals were also confused. That they were more or less similar in composition was held certain, both by reason of the general similarity of their properties and as regards several of them by their more special properties. Thus it was held that lead and mercury must be specially closely related by reason of the similarity of their effects on those who worked with them. The general view was that they consisted of mercury and sulphur in varying proportions and of varying purity, though neither the mercury nor the sulphur was the substance now known by that name. Mercury was regarded as the essentially metallic character, the "species of matter which Nature has made to produce gold from"; sulphur was that which by its presence together with the mercury formed the baser metals.

An alternative and later view was that there was one essential metallic substance common in greater or less degree to all metals, but in each metal combined with some material special to that metal, so that to change one metal into another required substitution rather than transmutation.

It must further be remembered that for long it was held that different species of plants were mutually interchangeable. Thus, wheat was held to be transformable into oats. On this ground it was not so unreasonable to assume metals to be changeable one into another.

Thus it appears that the ideas of the alchemists, though to us *prima facie* so fantastic, were not really so devoid of reason. For with the knowledge then available metals appeared much more similar *inter se*, and so might be assumed more easily interconvertible than a metal and its ore. Then given the premise that there is essential similarity between the vegetable, animal and mineral kingdoms, the ideas of growth and ripening follow logically, as also do those of the philosopher's stone and the "mercury."

But why do the alchemists invariably state their results in mystical and enigmatic language? To this there seems no one clear answer. It is hard to believe that all were intentional deceivers, though doubtless many were. One reason was probably the desire to keep results secret or only for those to whom they should personally explain them. Another suggestion is that of Boerhaave, that these directions state rather what it is hoped would be successful than what have been.

As time passed, however, and failure was the result of all efforts at transmutation, doubt as to its possibility became more widespread and the way became more and more clear for views such as the corpuscular hypothesis, though even Descartes held that all visible bodies are transmutable into each other—a natural deduction from his view that the ultimate particles of all consisted of the same material. The fundamental idea of the corpuscular or mechanistic hypothesis was that all bodies consisted of innumerable small particles all of the same material, those of one substance being all of the same shape and different in shape from those of all others. The possibility of changing one substance into another by changing the shape of its ultimate particles was a matter of dispute. Those who held it to be impossible became more and more numerous, and by the end of the seventeenth century the believers in transmutation were negligible in number.

The authoress next (Chap. III) considers the influence of the teachings of Paracelsus, Van Helmont and others. Paracelsus pretended entirely to disregard the teachings of his predecessors and ostentatiously burned the works of Galen and Avicenna, but none the less in reality made much use of their ideas. He laid great stress on "correspondences" and "analogies," and, though he alleged a contempt for astrology, held that there was a close connexion between the planets and the parts of the human body, and as a consequence between the various metals and these same parts. In opposition to Galen, who held that "opposites cure opposites," his view was that "like cured like," which resulted in ideas such as that because gold and the sun and the heart and the sun were regarded as closely connected, therefore gold was a remedy for diseases of the heart, as also anything resembling either, *e.g.* the citron which resembles gold in colour and the heart in shape. Or again salt and fire were analogous because both preserved organic materials from decay. These analogies were extended to the incorporeal world and resulted in fantastic and metaphysical ideas such as that of the microcosm and macrocosm. The very fantastic nature of these developments gradually destroyed them, and with them also the ancient and mediæval philosophy. The great contribution of Paracelsus to science was the incentive he gave to the study of the metals.

In his contempt for Aristotle, Galen and his predecessors generally, Van Helmont resembled Paracelsus, and his system, fanciful though it appears, is a violent reaction against the scholastic philosophy, and is really a systematisation of material phenomena as known to him, always limited by the necessity of conformity with the Biblical cosmogony. He holds that the prime material of all bodies is water, whence everything is derived by the action of specific ferments, which either are, or are accompanied by (it is not clear which) a directing spirit termed the "archeus." (Compare *Genesis* i, 2. "The spirit of God moved on the face of the waters.") That water is the one basic material is held proved by various alleged facts, such as that plants produce solid matter from water, and that water, when evaporated, leaves an earthy residue. The idea of the alcahest or universal solvent is invented whereby all things are reducible to "water." The superior density of many substances is attributed to compression of the water forming them. Air was, however, held to be a separate element, not transmutable into water. It did not support combustion, but was the medium that carried away the products thereof. Van Helmont appreciated the existence of other substances similar to but different from air, and invented the term *gas* to denote them. These substances he held to be transmutable into water, having apparently been led to this view by discovering that water is convertible into steam and back again to water with no change of weight. Later it was observed that air and gases were essentially similar and Van Helmont's "air" came to resemble rather the modern ether. Van Helmont's theories did not spread, and his most important contribution to science was probably his making the constancy of matter as measured by weight the basis of his experiments, though for the time being the chief influence of his views was that they greatly assisted in the final overthrow of the older theories and by holding all matter to be derived from one prime material helped to lead up to the corpuscular hypothesis. The search for the alcahest and for evidence that water was the basic material of all things induced much experimental work.

Next come the dualistic views based on the intrinsic opposition between acid and alkali, whence contrariwise acid and alkali were held to be present wherever any mutual action occurred. Anything soluble must be alkali, and any solvent acid. Thus all fermentation was the result of acid and alkali, and everything in nature including the digestion (solution) of food was explained by the theory, which like its predecessors fell beneath the weight of the subsidiary theories required to "explain" facts, but also like its predecessors was of some value in inducing experimental inquiry. It was finally more or less assimilated by the corpuscular theory which held that acids consisted of sharp pointed particles fitting into holes in the porous particles of alkalis.

The supporters of these various theories disputed with each other in no measured terms, and the authoress gives as an example the famous quarrel regarding the use of antimony in medicine, which, beginning in the sixteenth century was revived in the seventeenth, and formed the subject of a decree of the Parliament of Paris in 1666 authorising the use. The one party urges for example that as antimony cleanses metals so its compounds must cleanse the human body, to which the other retorted that it does this by killing the body and so cleansing it from all earthly impurities; the opponents of either party are stigmatised as charlatans, robbers, fools, infidels, heretics, abortioners, bastards, forgers, etc.

The authoress next traces the currents of thought which led up to the various corpuscular or mechanistic theories. Gassendi held that all substances consist of differently shaped hard particles in perpetual movement in a void, a theory practically, though not theoretically, in agreement with that of Descartes, who, however, added two other forms of "matter," one very subtle, forming the "soul of the world," the other less so, but still much less dense than ordinary matter, being the "material" which conducts light. These three forms of matter he held to fill all space completely. Similar views were held by Boyle, who considered that all bodies consist of infinitely small particles, differing in shape and movement. But it was the clear account he gave of his experimental work that gave him the great influence he had.

In this way the corpuscular theory in one form or another spread throughout the scientific world, and chemistry was to be reduced to ascertaining the shapes of the ultimate particles of which matter consisted, abandoning all attempts to explain the universe. There was still confusion as to what bodies were simple, how far acids differed *inter se*, etc., but Boyle must be regarded as "a true predecessor of our modern chemistry."

Having in this way shown what was the chemical "atmosphere" at the time (1675) of its appearance, the authoress gives an account of Lemery's views as disclosed in his book (*Cours de Chimie*). Lemery scarcely notices, save to disdain, the old scholastic theories and adopts the corpuscular theory without remark as though it were self-evident and generally accepted, but goes into no detail to enable us to decide whether he followed Gassendi's view of particles in a vacuum or Descartes' of a plenum. He endeavours to avoid all description that is mystical or ambiguous, and to base his accounts on actual experiment. Adopting the corpuscular theory he seeks to explain the properties of bodies by the shapes of their ultimate particles, but does not go into great detail. His atoms are endowed with cohesion and hardness. To some extent he adopts the acid-alkali theory already noted, but appears at times to overlook what he has said about it. His experimental facts are really the result of experiment and not what he hopes may be carried out. For every result he has an explanation, though sometimes one that, to modern ideas, appears fanciful.

But as the corpuscular hypothesis suggests little connexion between the various experiments and no theory as regards the composition of compound bodies, he adopts to a greater or less extent the theory of the five principles (mercury, sulphur, phlegm, salt and earth), deducing them from the results of distilling organic matter. But he does not lay great stress on the theory, being quite content to view most of the metals at any rate as primitive entities which cannot be decomposed by human agency, although they may consist of two or more of the "principles."

In short, Lemery shows a great advance towards the modern method of subordinating theories to facts—and of facts he gives many. But it is often hard to interpret his meaning, owing to the impurity of many of the reagents and the confusion of nomenclature. Thus vitriol meant originally ferrous sulphate, then any salt of sulphuric acid, but also came to include other metallic salts, lunar vitriol being nitrate of silver, whilst vitriol of copper included the nitrate and acetate. He gives much information regarding the metals, but his treatment of the chemistry of animal and vegetable matter produced but little result, being mainly limited to distillations and the preparation of drugs. He distilled some 14,000 plants, but was only able to deduce therefrom that this method led to nothing definite, and gradually came to the conclusion that there must be intermediate or proximate principles, and to doubt the true simplicity of the five "principles." Some of his ideas are decidedly fanciful: thus a viper's poison is harmless when swallowed, but dangerous when introduced into the system by the animal's bite, because in the latter case it is violently inserted by the animal by reason of its shape, "which is long and narrow like a gun." But on the whole his work is a great advance on anything that had preceded it in France, and ranks in that country much as the works of Boyle do in England.

The authoress next considers the various views held regarding fire, combustion and calcination. Aristotle held fire to be a principle of lightness diminishing the weight of that to which it was added, and for long it was held to be a definite element. But during the seventeenth century this view was by no means invariable. Van Helmont queried whether it were not an ephemeral phenomenon; the corpuscular theory viewed it as a form of motion, and this was Descartes' view. Though the necessity of air to support combustion and the analogy between combustion and respiration were observed, it was for long believed that there was nothing in the shape of chemical reaction between the air and the body burned. John Mayow held that combustion was due to certain foreign ("igno-ærial") particles in the air. R. Hooke viewed combustion as due to a "kind of particle which rises from the earth." He recognised that air was unnecessary if these particles were otherwise supplied, as in gunpowder.

It was long before the connexion between calcination and combustion was realised. Calcination was "pulverisation by means of fire," and ranked with coagulation and precipitation as a process rather than a chemical reaction. The increase of weight was long regarded as an accident and by no means essential, and was variously explained by such views as that the metal was killed on being calcined and so weighed more, just as it was thought a body weighed more when dead than when living; or else that a volatile salt was attracted from the fuel.

Boyle held light to be corporeal and flame a luminous matter which can combine with other bodies and is able to traverse the walls of vessels. Homburg's view was that a "sulphur principle," which is much the same as the "matter of fire," escapes when a substance burns, whereas when a metal is calcined it combines with this sulphur principle and so increases in weight. It is the escape of the "matter of fire" which causes flame.

Jean Rey seems to have been the first to have thought that the increase of weight on calcination was due to the air, but supported this view by such fantastic arguments that it was accepted by none. He does not, however, conceive of combination occurring, holding rather that the air is entangled in the particles of the metal as water in wet sand.

Cherubin held that so far from any "matter of fire" or other material passing through the walls of the vessel (as held by Boyle), the very reverse must take place, as after calcination in a closed vessel air enters on opening it.

Stahl then placed the cause of combustion in the combustible body itself, holding that in both combustion and calcination phlogiston was evolved, and so at least perceived the essential similarity of the two processes; any increase in weight he held to be due to "foreign particles in the air." This view held ground until Lavoisier showed that what really happened was the evolution of heat and gain of oxygen, an essential and not an accidental constituent of the air. What led up to this change of view is to be the subject of future volumes.

The problems of calcination and combustion were by far the most investigated of all; but others also interested chemists, chief among which were the alleged analyses and syntheses of sulphur; the artificial production of fire from its elements; the nature of phosphorus, discovered at this time by Brand and Kunckel; and the relations of acids and alkalis, subjects which are all treated in this volume.

The differences between the various acids were realised and attributed by Homburg to "different modifications of the same elementary principle." The replacement of one metal by another in combination, as silver by copper and copper by iron, attracted much attention and led first to Geoffroy's theory that if two substances united together came in contact with a third "more nearly related" to one of the two it is replaced thereby, and then later to Bergmann and Berthollet's "affinities."

Thus the mechanistic view or corpuscular hypothesis gradually spread without its being precisely known how. But it left much indeterminate, and when it descended into details, such as the actual shapes of the atoms required to explain various properties and reactions, it became fantastic. Heat was generally explained as due to rapid movements of the ultimate particles, but cold was regarded as an actual substance made up of "pointed particles penetrating the flesh." Solution caused much controversy, though the usual view was that the particles of the solvent being in rapid motion separated the particles of the solute "much as a strong wind does particles of dust," though some held that mutual attractions between the two were also necessary. The authoress also discusses the modification of the mechanistic hypothesis due to Hartsoeker, who held that there were two prime materials, one a continuous subtle fluid always in motion, the other a denser material divided into particles of varying shapes.

Gradually, however, the idea that the shapes of the atoms accounted for the properties fell into disfavour, as it was realised that at best they were largely imaginary, and chemists paid more and more attention to actual experiment, framing temporary theories to explain observed facts.

The foregoing sketch, which only gives the broader outlines of the argument, shows, it is hoped, that the authoress has done that which she set out to do and has done it well. The book is written in that clear style which one has come to expect in a French scientific work, and there is a useful index of the various authors referred to and, to some extent, of the points with which each has dealt. The present volume forms Part I of the work and brings the subject down to the date of publication of Lemery's book (1675).

ON THE CHEMISTRY OF HAFNIUM*

By Dr. G. von HEVESY

Zirconium, discovered in 1789 by Klaproth, was recently found to be a mixture of two different elements of " zirconium " and hafnium. Whilst the oxides of zirconium, like baddeleyite, favas and so on contain only 1—2 per cent. of hafnium, the most common zirconium minerals, the silicates of zirconium, the " zircons," exhibit a hafnium content varying between 1 and 7 per cent. The richest hafnium content is found in secondary zirconium minerals, like alvite, cyrtolith, naegeite and malakon. The zirconium extracted from this mineral contains 21 per cent. of hafnium and an earlier specimen gave a yield of 30 per cent. A specimen of cyrtolith from Rockport, Mass., contains 40 per cent. zirconium and 10 per cent. hafnium. That alvite has an especially high hafnium content was shown by Goldschmidt and Thomasen in Christiania shortly after the discovery of this element. The complexity of zirconium was discovered by following up the conclusions of the atomic theory. Bohr's theory gives a rational interpretation for the sudden appearance of the rare-earth elements in the periodic table. According to this theory the great difference between lanthanum and barium, just like the great difference between most of the neighbouring elements in the periodic table, is due to differences in the outer electronic groups of their atoms. A group of elements preceeding lanthanum shows only differences in the inner electronic groups. To such changes thus correspond only minute differences in the chemical properties; hence the great chemical similarity of the rare-earth elements. As shown by the atomic theory. these changes in the building up of the inner electron groups are brought to completion with the 71st element, cassiopeium, with which the group of the rare-earth elements comes to an abrupt end. When proceeding further to the element 72, we already encounter changes in the outer electron groups and accordingly we should expect this element to be quite different from the rare-earth elements and related in the same high degree to zirconium, as tantalum is to niobium or tungsten to molybdenum. Bury also arrived at the same result.

Hafnium was discovered by using Moseley's method of X-ray spectroscopy. To be able to determine quantitatively the hafnium content of our specimens and fractions, a known amount of the neighbouring element 73 (tantalum) was added to these and the intensity of X-ray lines due to the known amount of tantalum and unknown amount of hafnium compared. This method allows of a simple and accurate determination of hafnium in any preparation.

The methods of separating hafnium from zirconium are based partly on the different solubilities or vapour pressures of the corresponding compounds, partly on the difference in their basicity.

The most practical method of separation is the crystallisation of the double fluorides of potassium or ammonium. The mineral is melted with KFHF and the K_2ZrF_6 extracted with boiling water, in which this compound is soluble to the extent of 25 per cent. On cooling down the greater part of the salt crystallises out. The zirconium double fluoride being less soluble (2·6 per cent. at 20°) than the hafnium double fluoride (nearly 3 per cent. at 20°), the latter accumulates in the mother liquor. Still more convenient is the crystallisation of the highly soluble $(NH_4)_2ZrF_6$, soluble at 20° to the extent of 26 per cent. The ammonium double fluoride of hafnium crystallises in beautiful prismatic (pseudo-hexagonal) crystals. The next suitable method of separation is the crystallisation of the ammonium-zircon oxalate. A soluble zirconium salt, like the sulphate, is precipitated with ammonia, the hydroxide dissolved in an excess of oxalic acid and neutralised with ammonia. By crystallising the oxalate formed, hafnium accumulates in the mother liquor.

Less satisfactory is the result of the crystallisation of the complex sulphate, like the ammonium salt of zirconium and sulphuric acid. The hafnium concentrates here also in the mother liquor.

To purify zirconium from iron and other impurities it is often converted into the oxychloride. By repeatedly crystallising this compound from hydrochloric acid pure zirconium is retained. Hafnium oxychloride is less soluble than zirconium oxychloride; thus while purifying zirconium from iron, its hafnium content is raised at the same time. For example, starting from 100 g. $ZrOCl_2$ containing 1 per cent. hafnium, the 30 g. oxychloride residue obtained after 10 successive crystallisations contained a little over 2 per cent. of hafnium.

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* Read before section B (Chemistry) of the British Association at Liverpool on September 17.

Hafnium is more basic than zirconium, and accordingly when precipitating a solution of a zirconium salt with ammonia the first precipitate contains less hafnium than the successive ones. For example, when precipitating one half of an oxychloride solution containing 1 per cent. hafnium with dilute ammonia, the precipitate contains only 0·8 per cent., whilst the hafnium content of the solution is increased to 1·2 per cent. This difference can be somewhat increased by the presence of large amounts of ammonium chloride in the solution. By boiling a solution of zirconium and hafnium with sodium thiosulphate, zirconium being more strongly hydrolysed, the first precipitate contains a larger amount of zirconium than the successive ones. From a solution of zirconium sulphate, diluted about 1 : 40, a basic zirconium compound precipitates on standing a few days at 39·5°. Also with this process, like many similar ones, the precipitate contains slightly more zirconium than the solution.

The difference in the basicity is also shown on heating the neutral sulphate of zirconium or hafnium; whereas the first mentioned compound begins to decompose above 400°, the decomposition temperature of $Hf(SO_4)_2$ lies about 100° higher.

On dissolving the oxychloride in alcohol and precipitating with ether a higher basic compound $Zr_2O_3Cl_2.5H_2O$ is formed, which was found to be less soluble than the corresponding hafnium compound. This difference in the solubilities was repeatedly used by Mr. V. Thal Jantzen and myself to purify concentrated hafnium preparations from zirconium.

In some cases, including the phosphate, salicylate and so on, the hafnium compounds were found to be less soluble than the corresponding zirconium compounds.

Like zirconium tetrachloride, hafnium tetrachloride also volatilises appreciably at about 250°, and the first distillate contains somewhat more zirconium than hafnium.

Though hafnium is to be placed in the periodic table between zirconium and thorium where formerly cerium happened to be placed, its chemical properties are not intermediate between those of zirconium and thorium, but *much* nearer to the former element. It is of interest to note that in several cases the solubility of the hafnium compound is greater than the solubility of the corresponding zirconium compound and thorium compound as well. Thus the solubility of the hafnium double fluoride is much greater than that of the thorium double fluoride and somewhat greater than the solubility of the zirconium double fluoride.

DISCUSSION ON COHESION

On September 13, Sections B, A and G (Chemistry, Mathematics and Physics, and Engineering) of the British Association held a joint discussion on "Cohesion," which was opened by Sir W. H. Bragg, F.R.S., and was continued by Dr. W. Rosenhain, F.R.S., Dr. A. A. Griffiths and other speakers. We append summaries of the contributions by Sir W. H. Bragg and Dr. W. Rosenhain.

Contribution by Sir W. H. Bragg, F.R.S.

Whatever limitations may at one time have been supposed to define the term "cohesion," and to constitute a separate section of physics and chemistry, we see now that they have no real existence. The forces that bind atom to atom and molecule to molecule are of fundamental importance to our investigations, no matter what branch of science it is that we follow.

The atoms and molecules are so small in comparison with the objects which we handle that experiment can only deal with aggregates of atomic forces. It is, therefore, very difficult to deduce the laws that govern the behaviour of the single atom. In some chemical reaction or some particular change of state the forces may be sufficiently uniform in nature to permit a definite conclusion, but in the class of phenomena which used to be considered as evidences of the action of cohesive forces, such as capillarity, the confusion is considerable; and in the ordinary experiments with rigid bodies it is complete.

In our first attempts we simplify our task by using approximations which seem reasonable, and picture the atom and molecules as centres of force which is exerted in all directions. In such ways, many of the well-known phenomena are accounted for with more or less success, such as the gathering of a liquid into drops, the principal features of surface tension, or some of the departures from perfection in a gas. No satisfactory results are found in the case of a solid except possibly in the case of polar compounds. However, as a consequence of the study of radioactivity and of X-rays, we can now handle the individual atom. Our resolving power, so to speak, is very greatly increased; we begin to see the details and new classifications appear. It is obvious that the information already gathered from the new methods is but a fragment of what we may expect to learn: but we may hope that there is enough new knowledge to be exchanged profitably.

Let us set down what we have already observed. In the first place, there are very strong forces between atom and atom, molecule and molecule, which are limited in their effective range of action to distances much smaller than we have hitherto supposed; small, it may even be, compared to the distances between the centres of atoms as they lie side by side in a crystal. In non-polar compounds in which the separate molecules may be readily distinguished it appears there is the most perfect alignment of the molecules as they are fitted into their positions. A crystal of definite constitution conforms so exactly to rules respecting its angular dimensions that it seems impossible to imagine its form to be merely the result of an average of tendencies. The forces of adjustment cannot, therefore, be thought of vaguely as a force between two points each representing one of the molecules. On the contrary, it is nearer the truth to think that the adjustment is made so as to bring together certain points on one molecule and certain points on the other. The electrostatic attraction of two charged spheres is far from a perfect analogy; we should imagine rather two members of a girder structure being adjusted until the rivet holes are in true alignment so that the rivets can be dropped into their places. The action of one molecule on another depends on their relative orientations and mode of presentment to each other.

We see this well in the case of the organic crystals. The molecule is generally a very complicated structure, of most irregular but constant form. Molecule is attached to molecule in the building of the structure just as girders in a bridge are joined up to form an empty framework. In most cases the crystal contains molecules which are the image of each other in certain planes, or are derived from one another by rotation round some axis, and the arrangement of the molecules gives certain symmetries to the structure. The influence of a molecule exerted in these ways does not extend beyond its neighbours. A molecule may, of course, so affect an immediate neighbour as to influence the position of the next but one, but the action resembles that of the links in a chain.

A simple example may be given. Muller and Shearer have lately measured the thickness of the ultimate flakes of some of the fatty acids and their esters. Measurement of the thickness depends on the fact that when the substances are melted on to glass or mica the flakes form innumerable layers of equal thickness lying on one another, and the crystal, so formed, can then be examined by X-rays. The thickness is found to increase uniformly with the number of carbon links in the chain; and it may be assumed that the thickness is either the exact length or a constant factor of it. Each addition is made in complete independence of the previous length, as if the only thing that mattered was the nature of the attachment of one carbon atom to the next. There is no influence of the ends upon the atoms in the middle. Muller and Shearer also find that the constant increase in thickness of film due to the addition of a carbon atom is different on the two sides of the double-bonded oxygen; but neither side is affected in any way by addition on the other. The successive layers of the acids lie on one another with alternate orientations like a pack of cards arranged in pairs facing each other; whilst the arrangement of the esters resembles that of the ordinary pack. The local smothering of the hydroxyl group has completely altered the arrangement.

Location of action is also found in the atoms, especially the carbon atom. In fact, it is largely due to the latter that such multiplicity and exactness of form is to be found in the organic molecules. The peculiarity of the molecules are all derived from the peculiarities of the atom. In the crystal the atom is attached to three neighbours on one side by bonds differing from those which attach it to its three neighbours on the other. The forces are different at different parts of the atomic surface.

In the molecule there are not only centres of force in different parts, but the strength and probably the natures vary from place to place. The cleavage plane of a crystal, of course, cuts across the weakest bonds. In the chain molecules the monomolecular film grows by the side-to-side attachments of the molecules: and the forces that bind layer to carbon are far feebler: the film will grow more readily than the crystal.

The nature of these forces and their typical differences have, of course, been the subject of much recent study. There is, in the first place, the effect known as electron sharing, which leads to strong and directed attachment and is particularly responsible for the localisation effect. Whatever may be its nature, there is no doubt as to its importance.

Next, there are actions of a different and generally weaker type which are manifested in the binding of molecule to molecule in a crystal; and of atom to atom, as, for example, in sulphur. We may be sure that they are present in metals and alloys. The structure of a metal like aluminium may be likened to that of a polar crystal such as rocksalt, in which the sodium atoms are comparable with those of aluminium and the chlorine atom with electrons. But this is probably far from the whole truth; there is action between the aluminium atoms which are in contact. It would be difficult to explain the variety in form and properties of the various pure metals if they were to be thought of only as a mass of positive spheres and negative point charges.

Lastly, there are the pure electrostatic central actions which are manifested in particular when atoms have become like the atoms of the idle gases either through the addition or subtraction of electrons. In these cases, the action is not localised in a particular spot on the surface or a particular direction from the centre of the molecule. The action is an all-round attraction, a positive charge attracting any amount of negative charges, and *vice versa*, so that crystal structures containing these effects are full of instances of so-called co-ordination. In fact, we may well think of the co-ordination cases studied in chemistry as survivors of the general break-up of a polar crystal. In the case of the polar crystal, it is possible to calculate the effect of the electrostatic forces with some degree of success. For every molecule there is, therefore, some most satisfactory way of attachment to its like, whether similarly oriented or reflected or rotated. Whether or not this arrangement comes about during the formation of a crystal from either a liquid or a gaseous medium, must be a matter of time and environment. Molecule lines up with molecule and the crystal grows ; but there may be great differences in the ease with which molecules slip into their places. Indeed, there is ample evidence of this in the different rates of growth of the faces of any one crystal, showing that attachment is made more readily at one point of a molecule than another. The element of time may possibly come in because a molecule may come nearly into its right place and be held there sufficiently long to get settled in by thermal agitation or otherwise ; if it receives a shock from another molecule before it is settled it may be moved away altogether. It is possible to hazard something as to the formation of a colloidal particle. After all, the same forces that build the crystal build the colloid; we should naturally ascribe the latter to an irregular or incomplete action. We may suppose that the formation of the crystal begins correctly enough, but that errors of adjustment creep in until at last the growth is stopped because fresh molecules cannot find their proper places to fit into. We know that colloidal gold is crystalline in bulk ; it can only be the surface of the colloidal particle that has gone wrong. Possibly the errors are cumulative and end in the production of some feature common to the whole surface such as an actual distribution of electrical charge, or some characteristic which draws to itself ions of a given sign ; so that the colloidal particle becomes charged to an extent depending partly on itself and partly on its surroundings. The twinning of crystals is a regular example of this irregularity. The "active points," as Langmuir termed them, are so distributed over the surface already formed that there is more than one way in which fresh molecules can fit into them ; and once they begin to take up a new way they persist in it. This explanation, though not perfect, must be close to the truth.

These illustrations show that we have a broad and soundly based hypothesis on which to rest explanations of all the phenomena that can be classed under the term "cohesion," even though our present understanding of it is imperfect. We have some guide as to our interpretation of results ; and also hints as to how to proceed in our researches. For example, the crystal as a whole is simply the extension by multiplication of the crystal unit. If we examine the various properties of a crystal whose structure we know, we do at least reduce the infinite complexity of which we spoke at first ; and we may look forward to a knowledge of the active forces localised at various points of the atom and the molecule. Our aim is to substitute this particular and detailed knowledge for our previous rough approximation.

It should not be imagined that the considerations outlined above are in any way antagonistic to the ideas of the internal structure of the atom developed by Rutherford, Bohr and others : there is no conflict between a static and a dynamic view. The points of view are so far apart, and the region which they overlook is so vast, that they cannot be used as yet to correct or support each other to any useful extent. For that we have to wait, but in confidence.

Contribution by Dr. W. Rosenhain, F.R.S.

Thanks to the light which X-ray analysis has thrown on the inner structure of crystals, and the combination of this information with the detailed knowledge of the nature of metals and alloys, obtained by years of metallurgical research, it has become possible to formulate the foundation for a general theory of the nature of alloys. This theory has already furnished surprisingly simple and exact explanations of a large range of phenomena in alloys, so that its fundamental principles may well claim careful consideration—some of them, indeed, can be regarded as experimentally established.

The first of these principles is that when an alloy is formed which is of the nature known as a "solid solution," it consists of the atoms of the two metals built up on a single space-lattice—the atoms of the "solute," in fact, simply take the places of a corresponding number of atoms of the solvent metal, the lattice remaining essentially that of the solvent metal. There is, however, a certain amount of distortion wherever a "stranger" atom is present, and this distortion, which may vary widely both in sign and amount, is responsible for many of the properties of the material.

The second principle may be termed the "law of the limiting parameter" or inter-atomic distance across which the forces responsible for inter-atomic cohesion can act to any appreciable extent. This distance is strictly limited ; if it is increased by any means—as by thermal expansion, by mechanical stress, or by the introduction of stranger atoms—then a limit is soon reached at which the lattice breaks down somewhat suddenly, with the formation of another phase, which may be a liquid or a different lattice. On heating, such a change is simply melting, on straining it is the break-down of elastic behaviour which is known to be accompanied by phase-change, and on alloying with increasing amounts of another metal, the limit of solid solubility results, at a certain point, in the formation of crystals of a new type. From the view point of the nature of the bond which unites atoms in such crystals—what might be termed the "cohesion bond"—this limiting inter-atomic distance is of very great importance.

In many metals cohesion phenomena are, to some extent, complicated by the occurrence of intra-crystalline slip. When such crystals are stressed they do not break but undergo plastic deformation by a process of slip along certain planes within the crystals. Here the atoms which are attached to each other across any surface of slip must be separated, but it is not complete separation as in actual fracture, but a rapid exchange of partners. In such a slip, atoms must pass over one another by many thousands, yet continuity of "bonding" is not lost. At the same time the atoms are to a considerable extent torn from their crystalline arrangement and left in a more or less irregularly arranged condition. This condition of irregular bonding will be referred to later. One point in regard to ductility and the slip phenomena on which it depends, however, should be mentioned. The whole phenomenon is confined to metals crystallising in the two most symmetrical systems: in these alone do we find crystal planes in which the distribution of atoms is sufficiently uniform to allow of the "passing on" of bonds from atom to atom without complete loss of continuity. This explains the striking fact that well-defined inter-metallic compounds are always exceedingly brittle, as also are most inorganic salt crystals and crystals of metals like bismuth and antimony.

The mechanism of ductility by means of slip is intimately connected with another important phenomenon—that of diffusion in solid crystals. The mechanism of diffusion is suggested to be that of movement or "slip" of atoms in rows. These rows need not extend throughout even a single crystal, but may be arranged so as to form continuous circuits of no great length. No great amount of stress is required to bring about slip even on a large scale in metals at the relatively high temperatures where diffusion is rapid, and the requisite stress to bring about such diffusion-slip is provided by the lattice distortion arising from a concentration of stranger or solute atoms in a solid solution of non-uniform concentration. Thus, since the mechanism of diffusion is essentially the same as that of ductility, we should expect ductile materials to allow of easy diffusion, whilst it cannot occur readily, if at all, in brittle crystals. Inorganic salts show no appreciable diffusion until quite near the melting point, and the same applies to brittle metals like antimony and bismuth. Further, a strange or solute atom should diffuse the more rapidly the greater the local distortion it produces in the lattice. An atom very similar to that of the solute should only diffuse very slowly and—if sufficiently similar—not at all. Nickel and copper—two very similar atoms—exhibit extremely slow diffusion as compared with zinc and copper, and recently von Hevesey has shown that the radioactive isotope of lead will not diffuse into the non-radioactive isotope. In this latter case, the two kinds of atoms are so nearly identical that no lattice distortion is set up and hence there is no stress to set the rows of atoms in motion. Were diffusion a phenomenon of a "kinetic" nature, and a constant interchange of atoms took place, these phenomena would not occur.

So far the cohesion of crystalline matter alone has been considered, but non-crystalline matter is also of great interest and importance. If we apply the principle of the "limiting parameter" or inter-atomic distance at which inter-atomic cohesion can become effective, it is perhaps possible to arrive at a picture of the inner structure of an amorphous solid or "congealed" liquid which helps to explain some of the facts of the behaviour of such substances. When a liquid—supposed non-atomic for simplicity—cools down, at or near the freezing-point, the atoms approach one another within the limiting atomic range and adhesions are formed. If the liquid is sufficiently mobile, the type of crystal to be formed sufficiently simple, and the rate of cooling sufficiently slow, these adhesions become grouped into a crystal lattice and crystallisation takes place. In other circumstances, however, this does not occur, and the atoms merely form groups increasing in size with falling temperature, in which the atoms are connected together in an irregular manner; as a rule, any individual atom will be attached, in such an arrangement, to a smaller number of other atoms than in a crystal, so that the packing would be less close. The existence of these relatively large groups of atoms, though still allowing some mobility to the substance, will give it a very much higher viscosity than that of the truly molten, monatomic liquid. With falling temperature and increasing size of bonded groups of atoms, the viscosity will rise rapidly until at last a stage is reached when the groups become so large that, in effect, the whole mass can be regarded as bonded together. In such a state some of the atoms will be attached to neighbours by a considerable number of "bonds," and at the other end of the range we shall have some atoms held only by one or two of their possible means of attachment. If, now, stress be applied to such a body, what will happen? There will be no possibility of plastic deformation by slip, since the slip mechanism does not exist, but three types or stages of deformation will be possible. The first is purely elastic, the inter-atomic attachment being stretched but not broken and contracting again so soon as the stress is removed. On the other hand, there will be some atoms which are held to their neighbours at a distance just below the limiting distance referred to above, and these —if the body is stretched—will break away from at least one of their attachments, although this may only occur in the course of time. Further, where an atom has thus broken away, extra stress will be thrown upon its neighbours, so that the process may spread for a time. When the stress is released, however, these added local elastic strains will tend to work out, with the result that the atoms which had been pulled slightly out of their original position by the breaking of an attachment, will be gradually pushed back again. We have here a rough picture of the mechanism of the visco-elastic behaviour of vitreous and other amorphous materials. If a still higher stress is employed, some of the atoms, if suitably placed, may be moved bodily, by the rupture, either simultaneously, or one at a time, of all their bonds or attachments, into a new position or equilibrium. Such a movement will not throw increased stress on neighbouring atoms, but will rather tend to relieve the existing strains. The movement, therefore, will not be reversible and will have all the character of truly viscous flow. This phenomenon is also well known in vitreous bodies, but it differs widely from viscous flow in true liquids, since a stress of a definite amount is required to initiate it. In very hard and severely undercooled liquids, such a stress may suffice to cause rupture, so that in such materials viscous flow will not occur at all unless the temperature is raised. This crude picture of the constitution of an amorphous solid thus appears to fit the facts fairly well in a general way; it is also consistent with what we know of inter-atomic relationships in crystals, but beyond that it cannot at present be extended.

The nature of an amorphous or vitreous solid is of special interest in regard to the cohesion of solid metals, since there we have to consider not only the cohesion within the crystals, but of one crystal to another. There appear to be three theoretically possible ways in which two atomic lattices, growing towards one another, can adhere to one another. They may, in the first instance, be so formed that certain atoms are common to both lattices. With two systems meeting at any haphazard angle, in space, the number of atoms which can possibly fit on to both lattices without undue distortion can only be very small. Were this so, we should expect to find the junction of crystal to crystal a region of weakness; in actual fact, it is the strongest part of a crystal aggregate. Metals, when forcibly broken, always break through the crystals and not along the crystal junctions. A second possibility is the formation of a zone of intermediate orientation, the one lattice being gradually bent over into the orientation of the other. This is not possible if we maintain the principle of the "limiting parameter," since the radius of curvature of the intermediate orientation could only be very small so that the width of the zone of intermediate orientation would be comparable with the size of the adjacent crystals—and this is certainly not the case. The remaining possibility is that the gap between two adjacent lattices is bridged by a region of irregularly arranged atoms, constituting, in fact, a layer of amorphous material. Many experimental facts can be readily explained by such a structure, among them the fact that whereas a wire made of a crystal aggregate displays a behaviour under stress which requires the presence of some viscous or at least visco-elastic material, a wire made of a single crystal does not.

Finally, it is desirable to notice that the kind of atomic "bonding" to which reference has hitherto been made—what may be provisionally termed "cohesion bonding"—is by no means the only form of attachment between atoms. In a solid solution, we have to deal solely with bonding of this kind, and, correspondingly, we find that the inter-atomic distances, although varying by a few per cent., are roughly constant. When we come to well-defined inter-metallic compounds, on the other hand, we find in some cases greatly reduced inter-atomic distances. Thus in aluminium, the distance between adjacent atoms is of the order of 4·3 A.U., but in the compound $CuAl_2$, aluminium atoms are found with a centre-distance of only 2·42 A.U. It is this which probably constitutes the real difference between a compound and a solid solution; the nature of the inter-atomic bonding must be very different in the compound and can, perhaps, only occur under the influence of some or more atoms of a different kind whose juxtaposition allows of a serious re-arrangement of the atomic electron-shells. The properties of the two kinds of bodies are correspondingly different, notably in regard to ductility, diffusion, and the formation of solid solutions.

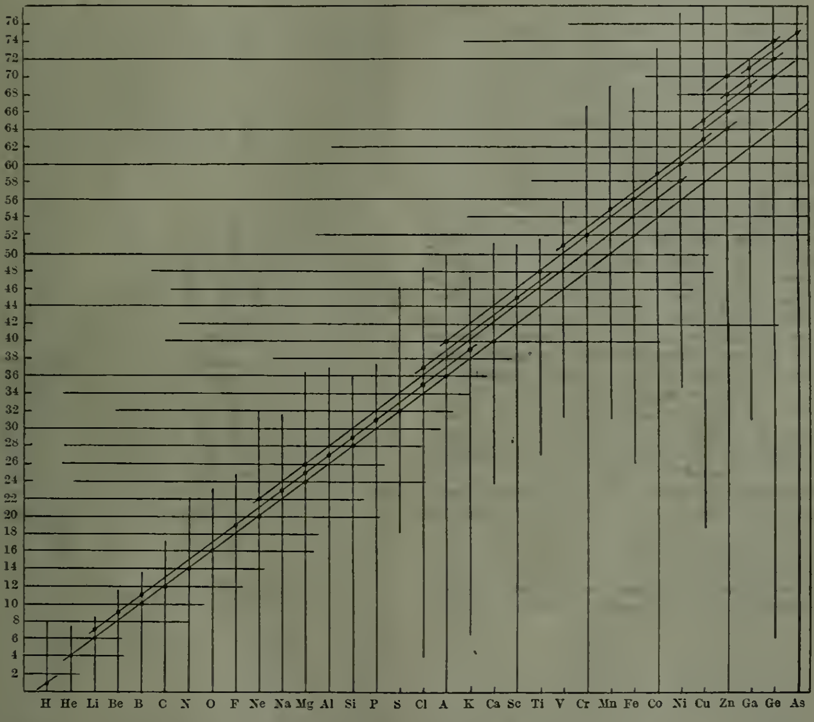
Enough has, perhaps, been said to indicate how the application of results obtained by means of X-ray analysis to the wide range of facts elicited by metallurgical research can hope to throw new light both on the nature of cohesion and on the properties of metals.

NEW DEPOSIT OF SOAPSTONE IN AUSTRIA

It is reported that an enormous deposit of soapstone has been discovered in Zwettl, not far from the Bohemian frontier. The soapstone, which is stated to require very little preparation, can not only be cut, sawn, drilled and polished, but will absorb many colours, a property that should lead to its extensive use in powder form in the colour industry. The deposit is the most important of its kind yet discovered in Central Europe.

ISOTOPES

At Liverpool Dr. F. W. Aston announced to the British Association that he had measured the masses of the isotopes or atoms of a number of elements in addition to those already published. The method adopted was a new one, the details of which were given; the most important results are that scandium is simple with an atomic weight of 45, titanium is simple with an atomic weight of 48, vanadium is simple with an atomic weight of 51, chromium is simple with an atomic weight of 52, manganese is simple with an atomic weight of 55, cobalt is simple with an atomic weight of 59, gallium has two isotopes of masses 69 and 71, germanium has three isotopes of masses 74, 72 and 70, strontium is simple with an atomic weight of 88, yttrium is simple with an atomic weight of 89 and silver has two isotopes of masses 107 and 109. The atomic weights or masses of the first forty elements and a few others are now known and some of these results are shown in the accompanying diagram. It is interesting to note that with the exception of nitrogen the odd elements have odd weights or masses and that with the exception of hydrogen no atomic weight is less than twice the atomic number. A study of such a diagram promotes speculation as to the relationship of the elements which each reader can pursue as he feels inclined, unbiassed, broadly speaking, by any experimental evidence.



In this diagram the vertical lines show the masses of the atoms or isotopes and the elements are placed in the order of their atomic numbers or places in the periodic table. It is interesting to note that lithium, boron, carbon, nitrogen, oxygen, neon, magnesium, silicon, sulphur, argon and calcium all have atoms or isotopes whose mass is twice the atomic number. When we come to elements with higher atomic weights the masses exceed twice the atomic number and the excess becomes greater as we proceed along the periodic table but in an irregular manner which does not appear, so far, to have been reduced to any defined law. Additional determinations are awaited with much curiosity, and no doubt the new method employed by Dr. Aston will produce a considerable number of accurate measurements.

NEW ZEALAND MINERAL OILS

By Prof. THOMAS H. EASTERFIELD, M.A., Ph.D., and NORMAN McCLELLAND.

Many attempts have been made to establish mineral-oil industries in New Zealand, and though the results have so far been disappointing, much has been learned, and it is probable that success will eventually result.

Three classes of oils have, up to the present, been manufactured. These are :—

1. Kauri oil, by the distillation of peat from the kauri-gum lands of the Auckland Province (North Island).
2. Shale oil, by the distillation of bituminous shales in the Southland District (South Island).
3. Petroleum, by direct boring.

1. The production of kauri oil is of comparatively recent development; it is stated that there is an almost unlimited quantity of raw material, yielding nearly 40 gallons of oil per ton of peat. The oil appears to consist largely of the products of cracking of kauri gum, distributed in a finely divided condition through the peat, and to be as complex a mixture as crude rosin oil. As it is understood that work upon this oil is being carried out at Auckland University College, it is not proposed to deal further with it in this paper.

2. A very large field of oil shale exists at Orepuki in Southland, there being evidence that not less than 1,000,000 tons is in sight on the property of one company alone. The shale consists of a bed 4–5 ft. thick, with a rotten roof and a substratum of coal varying from 12 to 20 ft. in thickness.

The New Zealand Coal and Oil Company erected a works on this property in 1899, with an installation of 20 continuous Scotch retorts, together with the usual accessory apparatus. The mine and works were closed down in 1903, after 14,400 tons of shale had been brought to the pithead and a Government bonus of £5000 had been received for the first 100,000 gallons of crude oil produced in New Zealand. The shale yields about 38 gallons of oil and 19 lb. of ammonium sulphate to the ton, together with sufficient gas for heating the retorts.

The crude oil, obtained by a large-scale distillation test, was reported on by Sir Boverton Redwood in 1906. It gave :—

	Per cent.
Burning oil	25·9
Gas oil	3·1
Medium oil	4·0
Lubricating oil	17·6
Hard paraffin	19·0
Soft paraffin	1·1

A similar shale is found at Waikaia, also in the Southland District, but at a considerable distance from Orepuki. Experiments conducted in the Dominion Laboratory (Maclaurin, *Dominion Laboratory Report*, 1912, p. 11) show that the shale is remarkably like that at Orepuki both in composition and yield of oil. The crude oil from Orepuki contains 1·79 per cent., and that from Waikaia 1·9 per cent. of sulphur.

It should, perhaps, be mentioned that the value of the ammonia to the New Zealand shale-oil industry is largely discounted by the fact that the price of sulphuric acid for sulphate making is much higher in New Zealand than in Scotland. A high price for sulphuric acid must also react unfavourably upon the purification processes.

3. Natural mineral oil has been discovered in small quantities in many localities, and boring has been more or less energetically carried out at New Plymouth (west coast of North Island), Kotuku (West Coast, South Island), Dannevirke and Gisborne (east coast of North Island). New Plymouth is the only locality where a considerable flow of oil has at any time been observed, and, even at this centre, the yield has not justified the high hopes at one time entertained.

The following values have been obtained by distilling the oils from these places :—

	New Plymouth, 1906	New Plymouth, 1914	Kotuku (West Coast)	Maruia (Nelson District)	*Waitangi (Gisborne), 850 ft.	†Waiotapu (Auckland)
Sp. gr. of crude oil at 15·5° C.	0·84	0·845	0·886	0·933		0·809
Benzine boiling up to 150°	20 per cent. Sp. gr. 0·764	5·5 per cent. Sp. gr. 0·787	3·8 per cent. Sp. gr. 0·76	Approx. 2 per cent.	25 per cent. Sp. gr. 0·749	Nil.
Kerosene boiling 150°–300°	40 per cent. Sp. gr. 0·82	50·5 per cent. Sp. gr. 0·838	42 per cent. Sp. gr. 0·84	35 per cent. Sp. gr. 0·94	42 per cent. Sp. gr. 0·831	6 per cent.
Oil boiling 300°–400°	37 per cent.	25·5 per cent.	47 per cent.	57 per cent.	28 per cent.	300°–360° 94 per cent.
Paraffin wax in above	13 per cent.	12 per cent.	Trace	Trace	2·2 per cent.	12 per cent.
Residue (pitch)	2 per cent.	1·5 per cent.	5·0 per cent.	6 per cent.		
Contraction of benzine on sulphonation		36 per cent.	5·0 per cent.			
Contraction of kerosene on sulphonation		30 per cent.	32 per cent.	24 per cent.		

The kerosene from all these petroleums is optically inactive. (Those from Waitangi and Waiotapu have not been examined.)

* From report by Dr. Maclaurin, Dominion Analyst, 1920, p. 34.

† ,, ,, ,, ,, ,, ,, ,, 1922, p. 37.

In the neighbourhood of New Plymouth several companies have erected derricks, and probably £150,000 has been spent in borings—a small sum in comparison with that spent in other oil fields before success was finally attained. In 1906 a very promising flow was obtained on the property of the Taranaki Oil Wells, Ltd., at New Plymouth, one well yielding over 250,000 gallons, and a modern refinery was erected to deal with the oil. The operations of this company were stopped owing to the failure of casings in their wells, after a bonus of £10,000 had been obtained from the New Zealand Government for the production of the first 1,000,000 gallons of crude petroleum and a further bonus of £2500 for the production of 250,000 gallons of refined oil. The best flow of oil was said to be obtained at about 2300 ft.

The following description of the oil and its constituents may not be without interest. The oil, though liquid as it runs from the bore, sets to a semi-solid grease owing to the large quantity of solid paraffin dissolved in it. It is practically free from sulphur and from acid and basic constituents. The gravity of the various distillates is higher than that of the distillates of similar boiling point usually found in commerce. The smell of the crude distillates is less unpleasant than that of many of the commercial oils; and even higher boiling fractions show remarkably little colour or evidence of cracking, the fraction boiling at 300°–360° being only light yellow in colour. The benzine and kerosene, however, burn with a smoky flame, so that the kerosene cannot be used in an ordinary kerosene lamp; this is due to the presence of benzenoid and similar hydrocarbons. The benzine fraction reacts but slowly with bromine, showing that olefines are practically absent. On the other hand, the contraction on shaking with fuming sulphuric acid is no less than 36 per cent. with the benzine and 30 per cent. in the case of the kerosene.

After this treatment the kerosene is water-white and burns without any trace of smokiness. The gravities of the benzine and kerosene thus treated are still high in comparison with Pennsylvanian oils of similar boiling point, indicating that the residues are rich in cycloparaffins, of which, indeed, they are chiefly composed. The oil is thus in general characters similar to that from the Koetei District of Burma, described by Jones and Wootton (*J.C.S.*, 1907, **91**, 1146), and the further examination of the actual constituents of the oil confirms this conclusion.

It is not without interest that the Taranaki oil field is within 20 miles of Mt. Egmont, an extinct volcano, suggesting that the benzenoid and cycloparaffin hydrocarbons owe their origin to thermal action.

The results of the examination of the oil are given below :—

1 Cycloparaffins

The benzine fraction, after shaking with fuming sulphuric acid until no further contraction occurred, was washed with alkali and water, dried, and then repeatedly fractionated through a column similar to that described by Dufton (*J.S.C.I.*, 1919, 45), when the following hydrocarbons were isolated :—

Fraction.	Boiling point	Sp. gr. 15·5° C.	Cycloparaffin	Constants given in literature	
i	69°–74°	0·7494	Methyl cyclopentane	B.p. 72°	Sp. gr. 0·7474 (21°) (Markownikoff)
ii	78°–83°	0·7790	Cyclohexane	B.p. 81°	Sp. gr. 0·7788 $\left(\frac{19^\circ}{5^\circ}\right)$ „
iii	100°–104°	0·7669	Methyl cyclohexane	B.p. 103°	Sp. gr. 0·7662 „
iv	115°–125°	0·7433	Probably a mixture of *n* octane (b.p. 125°, sp. gr. 0·719) and dimethyl cyclohexanes (b.p. 120°, 125°, sp. gr. 0·8)		
vi	160°–163°	0·7884	α-Decanaphthene	B.p. 159°–165° (Subkow)	Sp. gr. 0·783 at 15° (Markownikoff)
vii	179°–182°	0·7987	Undecanaphthene	B.p. 179°–181°	Sp. gr. 0·8119 „
viii	196°–198°	0·8042	Dodecanaphthene	B.p. 196°–197°	Sp. gr. 0·8055 (16°) „

From fraction v *n*-nonane was isolated, b.p. 146°–152° (mainly at 150°), sp. gr. 0·7243; the literature gives b.p. 149·5°; sp. gr. 0·7228 (13°), 0·7177 (20°).

2 Benzenoid Constituents

On careful fractionation of the original benzine, the following results were obtained :—

		Per cent.
i	Boiling below 90°	5·0
ii	„ between 90°–110°	30·0
iii	„ „ 110°–140°	47·4
iv	„ „ 140°–170°	17·6

In a preliminary experiment toluene was recognised in the second fraction by shaking with fuming sulphuric acid until no further contraction occurred, and diluting the separated acid, when a sulphonic acid crystallised out that proved to be *p*-toluenesulphonic acid of melting point 92° (Norten and Otten, *Amer. Chem. J.*, **10**, 140).

Benzene, toluene and xylene were identified in fraction ii by shaking with sulphuric acid, removing volatile hydrocarbons from the acid layer by means of a current of air, and then hydrolysing the sulphonic acids by steam distillation at a temperature above 160° (Armstrong and Miller, *J.C.S.*, 1884, **45**, 151). The regenerated hydrocarbons were then carefully fractionated :—

	Per cent.
Original contraction on shaking with sulphuric acid	23·7
Volume regenerated by steam distillation	19·6

The regenerated hydrocarbon gave :—

	Per cent.
Benzene, b.p. 80°–81°, sp. gr. 15·5°, 0·8802	9
Toluene, b.p. 111°, sp. gr. 15·5°, 0·8697..	68
Crude xylenes, b.p. 120°–145°	17
Residue boiling above 145°	5

The benzene was further identified by conversion into *m*-dinitrobenzene m.p. 89·5° ; the toluene by conversion to 2.4 dinitrotoluene m.p. 70·5°, and by oxidation to benzoic acid m.p. 121°.

The crude xylenes contained the *ortho*, *meta* and *para* isomers, as on oxidation the three benzene dicarboxylic acids were formed. The least soluble acid was identified as terephthalic acid by its dimethyl ester m.p. 140° ; isophthalic acid by its dimethyl ester melting at 64° ; phthalic acid by the fluoresceïn reaction.

Toluene and xylene were also found in the fraction of the benzine boiling at 110°–140° By fractionation of the hydrocarbon regenerated from the sulphuric acid extract of fraction iv (b.p. 140°–170°), mesitylene and pseudocumene were separated ; they were identified by conversion into trinitro derivatives melting respectively at 235° and 184°.

Naphthalene and methylnaphthalenes were isolated from the kerosene b.p. 150°–300°. On adding picric acid to the fraction boiling at 210°–220°, a dense precipitate of a bright yellow colour was formed. After recrystallisation it melted at 150°, the melting point of naphthalene picrate. Steam distillation after the addition of alkali yielded pure naphthalene melting at 80°. From the fraction 235°–245° picric acid precipitated a picrate of a deeper yellow colour ; after repeated crystallisation from alcohol it melted at 116°, the correct melting point for α-methylnaphthalene. The molecular weight found by titration was 146, calculated 142. The hydrocarbon generated from the picrate was liquid, thus confirming the view that it was the α compound.

1.4-Dimethylnaphthalene picrate was precipitated from the fraction boiling at 258°–265° in orange needles, which after recrystallisation melted at 139° ; the molecular weight found was 155, calculated 156.

A deep red picrate was precipitated from the fraction boiling at 280°–300° ; the quantity was too small for identification. It is not improbable that this was the picrate of the tetramethylnaphthalene boiling at 320° isolated by Tammann (Ger. Pat. 95,579 ; *Chem. Centralblatt*, 1898, **1**, 812).

3 The Paraffin Wax

A quantity of the paraffin wax was distilled at 6 mm. pressure, and boiled between 215° and 290°. The fractions thus obtained were repeatedly refractionated until heaping took place at certain temperatures. The fractions were finally distilled at 15 mm. and then recrystallised from alcohol, until the melting points were constant.

The following paraffins were thus shown to be present :—

	Boiling point at 15 mm.	Melting point		Paraffin
i	243°	50·9°–51·1°	$C_{24}H_{50}$	Tetracosane
ii	249°–251°	53·2°–53·4°	$C_{25}H_{52}$	Pentacosane
iii	258°–260°	56·7°	$C_{26}H_{54}$	Hexacosane
iv	272°–274°	61·5°	*$C_{28}H_{58}$	Octacosane
v	280°–282°	64·0°	$C_{29}H_{60}$	Nonacosane
vi	290°–292°	65·2°–65·4°	$C_{30}H_{62}$	Triacontane
vii	299°–303°	67·8°–68·2°	$C_{31}H_{64}$	Hentriacontane

* Heptacosane could not be detected.

The still residue boiling above 290° at 6 mm., after repeated crystallisation from alcohol and ether, melted at 72·7°–73·1° ; assuming that it contained only primary paraffins, it must have consisted chiefly of pentatriacontane m.p. 74·7°, or of still higher members of the series.

If the deductions of Francis and his coworkers (*J.C.S.*, 1922, **121**, 496, 1529, 2804), with regard to the non-identity of the hydrocarbons of paraffin wax with those obtained by synthesis, are correct, then the conclusions here arrived at may require modification.

To test the stability of paraffins at these comparatively high temperatures, paraffin wax, m.p. 57·2°–57·4°, was sealed up in an evacuated tube and heated for a week at a temperature of 350°–400°. The melting point of the wax was not altered by this treatment, showing that no decomposition had taken place.

Paraffins may therefore be slowly distilled in vacuo at the above temperatures of fractionation without fear of decomposition. Thorpe and Young (*Annalen*, 165, 1) have shown that paraffin wax distilled in closed tubes decomposes into a liquid mixture of paraffins and olefines.

The authors wish to express their thanks to Mr. G. Millar, formerly manager of the Taranaki Oil Wells, Ltd. ; to Mr. M. Ongley, N.Z. Geological Survey ; and to Mr. H. Hill, for the crude and refined oils used in the investigation ; and to Mr. P. G. Morgan, Director of the New Zealand Geological Survey, and to Mr. A. H. Kimball, Under Secretary for Mines, for supplying statistics made use of in this paper.

Cawthron Institute, Nelson, N.Z.
Victoria University College, Wellington, N.Z.

SUGAR-CANE FORECAST, BRITISH INDIA, 1923–24

The first general memorandum relating to 99 per cent. of the total area under sugarcane in British India, estimates the total area sown at 2,715,000 acres, as against 2,392,000 acres at the corresponding date last year, or an increase of 13 per cent. Weather conditions at the time of planting were generally favourable, and the present condition of the crop is, on the whole, good.

DINNER OF CHEMISTS,

October 31, 1923

This dinner is being held under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry at the Hotel Victoria, Northumberland Avenue, London, W.C. 2, on October 31, at 7 for 7.30 p.m.

The details are being arranged by a committee consisting of representatives of the three societies mentioned above and one or two other societies. The price of the tickets for ladies or gentlemen is 12s. 6d. each, not including wine.

Sir William Pope, K.B.E., F.R.S., will take the chair. There will be some speeches and some music ; it is thought that both these will be of interest, and that there will be in addition opportunities for informal talk.

No similar dinner for chemists has hitherto been organised on exactly these lines, and it is expected that such a gathering will be not only very pleasant, but will be useful in promoting that social acquaintance which is so valuable in connexion with prevailing ideas and hopes. Members of any of the societies concerned are invited to attend and to bring guests, but no rigid line need be drawn in the case of chemists who would like to attend and whose membership of one of the societies has not yet been attained.

Applications for tickets should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C.2.

PERSONALIA

The Railway (Engineering) Gold Medal for 1922-23 of the Institute of Transport has been awarded to Sir Robert Hadfield, D.Sc., F.R.S.

Mr. F. B. Gorin has been appointed chief of the heavy chemical section of the chemical division of the United States Bureau of Foreign and Domestic Commerce.

* * *

With regret we record the death of Mr. W. J. Leonard, senior partner in the firm of Carless Capel and Leonard, of the Hook Chemical Works, Hackney Wick. Mr. Leonard was a well-known member of the London Section of the Society of Chemical Industry.

With regret we announce the death of the eminent French physicist Violle, a member of the "Institut" since 1881. He will be remembered chiefly for his calorimetric pyrometer and his investigations on radiation at high temperatures and on the velocity of sound.

CORRESPONDENCE

THE ORIGIN OF SYMBOLS

Sir,—With reference to "Analyst's" query in your issue of September 7, I have dipped into some old chemistry books in my possession, and find that no symbols or formulæ are given in Davy's "Agricultural Chemistry" (1814) Accum's "Brewing" (1820), Gurney's "Chemical Science" (1823), or Christison's "Poisons" (1832). On the other hand, Ure's *Dictionary of Chemistry*, 4th ed. (1831), gives Berzelius's table of equivalents with formulæ, but no other formulæ or symbols in the text.

Daubeny's "Atomic Theory" (1850), Napier's "Art of Dyeing" (1853), and Noad's "Chemical Manipulation and Analysis" (1852) all give symbols and formulæ freely, whilst Glover's "Mineral Waters" (1857) quotes many analyses but gives no formulæ.

It would therefore appear that the use of symbols and formulæ arose gradually during the period 1833-1850.—I am, Sir, etc.,

A. O. Jones

Technical College, Huddersfield
September 17, 1923

FINISH OF CHEMICAL GLASSWARE

Sir,—I have noticed a letter from Mr. Jones in your issue of September 21, with respect to the finish of various pieces of chemical apparatus as being inefficient.

This undoubtedly is a fact, as much of this lampblown apparatus is made by workers entirely ignorant of the uses to which it is ultimately put, and the difference between cheap apparatus and that slightly more expensive is shown by this attention to details.

If your correspondent would purchase his apparatus from reputable *manufacturers* who understand and advertise in this Journal, he would have no cause to complain.—I am, Sir, etc.,

A. V. Hussey

Duroglass Works,
Walthamstow, E. 17
September 21, 1923

THE STREAM-LINE FILTER

Sir,—Has Mr. Watts carried his explanation of this filter to a logical conclusion in his letter of the 18th inst. ?

Solutions of common salt, etc. after passing through the filter, are found to be more dilute than before, because "the tendency of a liquid is always to diminish its surface energy."

Where the surface tension of a solution is lower than that of the solvent, this may appear reasonable as one of the factors, but the surface tension of a 5 N NaCl solution is 83·5 dynes per cm. at 18° C., that of water being 73·6, hence one would surely expect the brine to be concentrated by the "filtration" !

Have the facts in this case been conclusively established ? Commencing with a damp pack the early runnings may include displaced moisture for some time, but is the affluent constantly different, and how is the $NaCl$ content of the solution in the inlet tubes affected ?—I am, Sir, etc.,

William C. Reynolds

"Wharfedale,"
Engayne Gardens, Upminster
September 24, 1923

FORTHCOMING EVENTS

Oct. 1. The Society of Engineers, The Geological Society, Burlington House, Piccadilly, W. 1, at 5.30 p.m. "Improved Method for Mass Production of Tank Glass Bottles, Jars, &c.," by A. Ferguson.

Oct. 3. Society of Public Analysts, Chemical Society's Rooms, Burlington House, W. 1, at 8 p.m. "The Sampling of Coal," by J. H. Coste, E. R. Andrews and W. E. Powney; "A New Test for Distinguishing Castor Oil," by H. G. Stocks; "The Volumetric Estimation of Vanadium in Steel," by A. E. Etheridge, B.Sc.; "The Iodimetric Determination of Sugars," by C. L. Hinton and T. Macara.

Oct. 4. Society of Chemical Industry, *Bristol Section*, The Chemical Department of the University, Woodland Road, at 7.30 p.m. "An Outline of Rubber Manufacture," by J. F. Reid.

Oct. 4. The Chemical Society, Burlington House, Piccadilly, W. 1, at 8 p.m. (1) "A Revision of the Dissociation Constants of Weak Inorganic Acids. Part I—Boric Acid," E. B. R. Prideaux and A. T. Ward; (2) "A Revision of the Dissociation Constant of Weak Inorganic Acids. Part II—Phosphoric Acid," E. B. R. Prideaux and A. T. Ward; (3) "Two Heterogeneous Gas Reactions," C. N. Hinshelwood and C. R. Prichard; (4) "A Homogeneous Gas Reaction. The Thermal Decomposition of Chlorine Monoxide. Part I," C. N. Hinshelwood and C. R. Prichard; (5) "The Direct Union of Oxygen and Sulphur," R. G. W. Norrish and E. K. Rideal; (6) "Note on Aqueous Formaldehyde Solution," W. R. Ormandy and E. C. Craven; (7) "The Interaction of Potassium Tetroxide with Ice and with Dilute Sulphuric Acid," H. Hawley and H. J. S. Sand.

Oct. 4–5. The Ceramic Society, *Refractory Materials Section*, October 4, at The Library, Grosvenor Museum, Chester. "General Sketch of the Geology of the Chester District, by T. A. Acton; "The Zenith Temperature," by J. W. Mellor; "Glass House Pots," by W. J. Rees. October 5, at 10 a.m., General Meeting. "Notes on the Proctor Dryer," by A. H. Middleton; Methods of Producing Gas for Industrial Operations," by R. Maclaurin; "The Effect of Salty Coal upon Refractory Materials," by L. M. Wilson; "Carbonisation of Clays," by W. Smith.

NEWS AND NOTES

BRITISH INDIA

First Forecast of the Sesamum Crop, 1923-24

A memorandum based on reports received from provinces which contained an average of 99·6 per cent. of the entire area under sesamum, states that the area under the crop, so far reported, is 2,100,000 acres, as compared with 2,367,000 acres (revised) at this time last year. Sowings still continue in many places. The weather at sowing time was favourable, except in Bengal and Madras, where early rains failed. The present condition of the crop is, on the whole, fair.

SOUTH AFRICA

Prospects for a Shale-Oil Industry

An article on the oil-bearing rocks in the Union of South Africa is contributed by T. G. Trevor to the July issue of the *S. African Journal of Industries.* After discussing the chief oil-yielding beds, the author describes the nature of the crude oil obtained from them, and concludes by stating that although South Africa appears to possess extensive deposits of shale oils of good quality, the question whether exploration is economically possible is very difficult. The capital required would be relatively great and mining risks considerable, so that it would be necessary not only to work out development and assay plans similar to those required for gold mines, but to consider the cost of refining, distribution and other factors, a question now being investigated by the Oil Fuel Committee appointed by the Union Government.

CANADA

The Chemical Industry in 1921

A summary report issued by the Dominion Bureau of Statistics' Mining, Metallurgical and Chemical Branch states that owing to the general depression and the fall in prices, the value of the Canadian output of chemicals and allied products reached only $87,184,000 in 1921, compared with $121,686,000 in 1920 (*cf. J.*, 1922, 557 R). Altogether the capital of the 459 firms engaged in the industry was $116,712,000, wages and salaries paid amounting to $12,330 and $15,950,000, respectively, and the cost of raw materials was $42,440,000, so that the value added by manufacture totalled only $44,745,000 ($61,616,000 in 1921). The acid, alkali, salt and compressed gases industries had the largest capital ($34,164,000) of any of the chief groups of manufactures, and were followed by paint, pigments and varnish ($20,331,000), soap, washing compounds and toilet preparations ($16,115,000) and explosives, ammunition, fireworks and matches ($13,642,000). At the close of 1921, although prices were lower than at the beginning of the year, conditions in the chemical industry showed much improvement, and prospects were better than at any time since the close of the war.

Mineral Production, 1922-23

According to the Dominion Bureau of Statistics, the Canadian production and value of certain minerals and allied products in 1922 was as follows :—Cement, 6,447,696 barrels ($14,324,715) ; copper, 42,879,818 lb. ($5,738,177) ; gold, 1,263,364 fine oz. ($26,116,050) ; gypsum, 484,629 t. ; nickel, 17,597,123 lb. ($6,158,993) ; platinum, 469 fine oz. ($45,783) ; palladium, 724 fine oz. ($47,060) ; osmium group, 392 fine oz. ($31,360) ; and salt, 183,438 t. All show a decrease compared with 1921, except gold and salt.

The mineral production during the first six months of 1923 shows that the mining industry of Canada has recovered from the slump of the last few years. The total value of products amounted to $87,152,248, being an increase of 44 per cent. over the corresponding period last year. The gold output amounted to 530,402 fine oz., valued at $10,964,382, and the production of silver totalled 8,336,946 oz., valued at $5,506,489. The other metals all show increases in production, and increased production of non-metallic minerals, especially of asbestos, is general.

FRANCE

A New Compound Fertiliser

In the August issue of *Chimie et Industrie*, Prof. C. Matignon describes a new compound fertiliser, "Superam," prepared by utilising the acidity of superphosphate to neutralise ammonia, thereby reducing the quantity required of sulphuric acid and obtaining a well-balanced fertiliser in the form of a dry, neutral powder. Previous attempts to utilise this method have failed on account of the reversion of the superphosphate, owing to the formation of the basic phosphate in presence of ammonia and free calcium sulphate. This difficulty has been overcome by the Cie. de St. Gobain, which utilises *dilute* gaseous ammonia (3 to 5 per cent.), which combines partly with the free phosphoric acid and partly with the phosphoric acid of the monocalcium phosphate (but without affecting its assimilability) according to the equations :—

$$H_3PO_4+2NH_3=(NH_4)_2HPO_4$$

$$CaH_4(PO_4)_2+2NH_3=CaHPO_4+(NH_4)_2HPO_4.$$

Thus, if 100 kg. of superphosphate (16–18 per cent.) is acidified with 10 kg. of sulphuric acid (60°), then treated with gaseous ammonia (diluted with air, 110 kg. of "Superam" is obtained containing 4·10 per cent. N and 15·77 per cent. total P_2O_5, of which 97 per cent. is assimilable, and 76 per cent. soluble in water. In this way only 48 per cent. of the sulphuric acid is used that would be required in preparing the material for a mixture of ammonium sulphate and superphosphate. In addition the water is partly eliminated owing to the heat evolved. It is, however, essential to regulate the temperature of the reaction very carefully, for if it takes place too rapidly, the calcium sulphate will begin to cause reversion, which is easily detected by the fact that the product becomes moist, owing to the liberation of the water combined with the calcium sulphate, present partly in the form of gypsum in superphosphates.

JAPAN

The Recent Disaster and Chemical Industry

Although definite information is lacking, it appears probable (*Chem. and Met. Eng.*, Sept. 10, 1923) that the Japanese chemical industry has suffered heavy loss through the earthquake and its aftermath, as several of the largest chemical factories, producing soda, acids, potassium chlorate and quinine, are situated in the devastated area. The important arsenic and graphite industries, are, however, located in the interior and will probably be affected only by the deranged transport facilities, whilst the dyestuffs, iron and steel, copper and galvanising industries, in the Osaka and Kobe districts, are unharmed. As Kobe is the chief port of Japan, the loss of chemicals in transit and storage will be insufficient to have much influence, the main loss having probably fallen on the large stocks of silk stored in Yokohama. No estimate can be made of the effect of the disaster on the foreign chemical trade, but if there is a shortage of silk, this may stimulate the artificial fibre industries and reduce the demand for weighting salts and dyestuffs. That reconstruction is to begin at once is shown by large inquiries for iron and steel.

GERMANY

The Salt Industry in Germany

Almost inexhaustible supplies of rock salt are to be found in Germany in the district round Stassfurt and in the "salt-mines province" of Bavaria. The Stassfurt salt contains 98 to 99 per cent. of sodium chloride, whereas rock salt obtained from other German mines is of 90 per cent. purity. The Bavarian salt is obtained by flooding the mines and concentrating the brine thus formed. The works at Schoenebeck in the Magdeberg district has an average annual production of 60,000 tons and constitutes the largest single enterprise of this kind in the continent of Europe. Other important mines are situated at Egestorf, Lueneburg, Stade, Heilbronn-am-Neckar and Salzungen. For inland consumption, the salt is sold directly to the trade, but for export it is sold exclusively by the Salz-Ausfuhr Gesellschaft, Berlin. The production in 1921 comprised : rock salt, 1,876,540 metric tons ; brine salt, 317,060 t. ; panstone and waste, 6920 t. ; salt by-products, 81,780 t. ; figures which compare with 1,332,180 t., 678,770 t., 107,110 t., and 105,560 t., respectively, in 1913. The decline in the production of by-products and brine salt is ascribed to the shortage of coal. Since April 1, 1923, the rock salt producers in Germany been combined to form the Steinsalz-Syndikat G.m.b.H., Berlin, which replaces the former convention.

REVIEWS

QUALITATIVE ORGANIC ANALYSIS. AN ELEMENTARY COURSE IN THE IDENTIFICATION OF ORGANIC COMPOUNDS. *By* OLIVER KAMM. *Pp. vii*+260. *New York*: *John Wiley and Sons, Inc.*; *London*: *Chapman and Hall, Ltd.*, 1923. *Price* 12*s*. 6*d*. *net*.

The systematised identification of organic compounds as a discipline is a comparatively new subject which has received more attention in America than in Europe. In Gattermann's well-known *Praxis des organischen Chemikers* the preparation of many representative compounds is followed by a description and discussion of their characteristic reactions, but the analytical part is confined to qualitative and quantitative elementary analysis. Cohen's *Practical Organic Chemistry*, an English textbook, deals briefly with the systematic identification of organic compounds, much useful information being crowded into the space of eight pages; the determination of molecular weight is also described.

In the book under review the author presents an analytical scheme developed by him whilst engaged in teaching the subject in the University of Illinois. The book is intended for college tuition; its tone is didactic throughout, and the text interspersed with problems and questions in small type. The text-matter comprises three sections :—(1) Theoretical part (106 pages) on solubility behaviour and classification reactions; (2) laboratory directions (79 pages) for the identification of compounds and the examination of mixtures; (3) classified tables of about 2000 compounds, including practically all those procurable on the market, with the exception chiefly of salts and dyes (54 pages). The classification is based on division into solubility groups and further division of each group into sub-groups of compounds of like chemical behaviour (*e.g.*, alcohols, ketones, amides, etc.); the liquid compounds are arranged in the order of increasing boiling-points, the solids in the order of increasing melting-points. The tables are intended for preliminary aid before proceeding to more advanced reference books.

The systematic identification procedure consists in physical examination, determination of constants, elementary analysis, solubility tests, homologous tests, consultation of literature, and preparation of derivatives. The preface states that "the most radical individual departure from other analytical schemes consists in the subdivision of organic compounds into seven solubility groups." It may be of interest here to give a list of these groups :—(*A*) Soluble in water: (1) soluble; (2) insoluble in ether. (*B*) Insoluble in water: (3) soluble in dilute hydrochloric acid; (4) soluble in dilute caustic soda; (5) soluble; (6) insoluble, in cold strong sulphuric acid; (7) other indifferent compounds containing nitrogen, sulphur, etc.

Not having put the book to the test of practical experience (by which alone any imperfections could be detected), the reviewer does not feel called upon to criticise a system of procedure so obviously the fruit of several years' patient experimental and tutorial work; but a careful perusal of the book leaves him with the conviction that it will prove a thoroughly reliable, as well as stimulating, guide to the student of organic analysis.

There are but few typographical errors in the text (*e.g.*, "biruet" for "biuret," in p. 91). "Affected" instead of "effected" (pp. 181, 182) is an irritating misspelling, peculiar to American technical literature.

W. R. SCHOELLER

VARNISHES: THEIR CHEMISTRY AND MANUFACTURE. *By* CH. COFFIGNIER. *English translation by* DR. A. H. J. KEANE. *Pp. viii*+547. *London*: *Scott Greenwood and Son*. 1923. *Price* 21*s*.

The original work (*Les Vernis*. By Ch. Coffignier. Preface by M. Haller. Encyclopédie de Chimie Industrielle. Pp. xviii+640. Paris: J. B. Baillière et Fils, 1921. Price 40 francs) was reviewed at length by the late Dr. Ingle (*cf*. *J*., 1921, 243R), who laid stress on its value compared with English or German books on the subject.

The publishers state that the book is a translation and not an English edition. The original has been faithfully followed, even where French practice in varnish-making differs from English methods. The book thus amplifies without supplanting the existing English literature on the subject. In accordance with the above statement the translation has been faithfully carried out, the index has been entirely rearranged and a table of contents inserted at the beginning, which is a great advantage. The preface by M. Haller is omitted in the English translation. The volume is a valuable addition to publications in English relating to the varnish industry, and the publishers are to be congratulated on a volume of smart appearance and of good type; moreover, at a very moderate price. Dr. Ingle has reviewed the book so fully that additional criticisms will be few. The translator might have used his discretion in correcting many obvious mistakes in the original work, especially where the names of English authors are concerned—*e.g.*, A. H. Salvay not M. H. Salvary, Wilkins for Wilking; even the error in the formula of linolenic acid ($C_{28}H_{32}O_2$) might have been eliminated. There are a number of errors in the letterpress which have been overlooked—*e.g.*, angolacopal resene cannot have the formula $C_{30}N_{54}O_6$, nor tetrachlorethane the name ethanium tetrachloride.

In the mass of detail presented in the volume it is exceedingly difficult to avoid errors, which remain even after careful proof-reading. It is occasionally apparent that the translator is not familiar with English trade terms. On pages 435-437 many of the French terms used to describe the defects of varnishes are translated literally, whereas it would have been better to have given the English equivalents. No mention is made of the common defect "bloom," which is rendered as "clouding." Often the translation from French to English is too literal, and although correct, is lacking in style and meaning. A great defect in the original work is the very inadequate reference to contributions by non-French authors to the knowledge of the subject. If the translator had inserted references to the Abstracts of the Society of Chemical Industry in addition to the French references, the English reader would have been grateful. It is much to be regretted that so little information is given of the manufacture and properties of wood oil varnishes. All interested in the industry will thank Ch. Coffignier for his valuable work and Messrs. Scott Greenwood and Son for publishing the English translation. It is to be hoped that the numerous small errors will disappear in the second edition and that the subject will then be treated fully from an international standpoint.

BY-PRODUCT COKING. *By the late* G. STANLEY COOPER, B.Sc. *Second edition revised by* E. M. MYERS. *Pp. xv* + 188. *London: Benn Bros., Ltd.*, 1923. *Price* 12*s.* 6*d.*

The volume is intended as a guide to those connected with the practice of coke-oven and by-product recovery plants. It is a very concise manual, including, as far as space will allow, detailed descriptions of the various processes and plant involved. The industry, being yet in its infancy, has made great advances within the past few years, and a revision of the earlier edition is assured of a cordial reception. The first three chapters deal with the evolution of the industry, and the classification and preparation of coals for carbonisation, the brevity of which is very marked. Much of our present knowledge of coking and non-coking coals, and their classification has been obtained within the past nine years, and it is regrettable that no mention is made of the recent valuable work of Lessing, Beilby, Illingworth, Stopes, Wheeler, Sinnatt and others on this subject. Chapter IV is essentially practical, dealing with the manipulation of the ovens, and concludes with a list of valuable hints for the practical worker. The following two chapters consist of detailed descriptions of the more modern types of ovens, and coal and coke handling machinery, forming a valuable collection of the descriptive pamphlets issued by all the most important makers of such plant, the whole having been carefully edited and modified by suggestions based upon the author's own experience. In the chapter dealing with the formation and recovery of tar and ammonia, one would have expected to find reference to the recent valuable work of Hodsman and Foxwell on the formation and dissociation of ammonia in the oven, but this has obviously been overlooked. Mention is made of the modern tendency to neutralise, dry, and crush the sulphate of ammonia, but no description is given of the various methods in use. In describing the utilisation of surplus gas the following paragraph appears, as in the previous edition :—"The use of coke-oven gas for town lighting has not developed to any great extent in this country." Whilst this was true nine years ago, it is a very pessimistic view to take of the present practice, since most of our cities and towns, in the vicinity of coke-oven plants are now taking, or seriously contemplating taking the gas for this purpose, *e.g.*, Leeds, Sheffield, Middlesbrough, Birmingham, and many other smaller towns, some relying entirely upon this source for their supply. An excellent description is included of the fundamental considerations controlling the processes of benzol recovery and rectification, tar distillation and the working-up of the various fractions, and the various types of plant commonly met with. Chapter XII is devoted to chemical tests for the control of such processes, and chapter XIII to the future development of the industry. In the latter is found a brief paragraph describing the American tendency to make the ovens narrower, and mention is made of the Bury and Ollander process for the recovery of ethylene, and its conversion to ethyl alcohol, although it is not described. The reviewer fully appreciates the impossibility of describing in a volume of this size, every process and development of such an industry, but feels that two such important points should have received more than a mere passing remark. The book is undoubtedly invaluable to the student, and is essentially practical, great attention having been paid to detailed description of processes and plant; also it is exceptionally well illustrated, containing in all 131 illustrations. Greater care, however, might have been taken in revising, in which case many irregularities, such as the following example, would have been avoided. On page 184 is found "A plant to work the Cobb process on the large scale dealing with Mond gas, is being erected." This passage also appears in the previous edition of 1916, and it would appear that the erection was unduly prolonged. It is no easy task to mould one's thoughts to fit the grooves made by a predecessor, and Mr. Myers would undoubtedly have done greater justice to himself if he had written a new book on the subject, in his own way, and it is to be hoped that in the near future we shall have the pleasure of reading such a book.

THOS. BIDDULPH SMITH

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Sept.* 20)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Tiles, paint, builders' wares	412/7/1/1/154
,, ..	Leather	412/7/1/1/158
Canada ..	Tarred and asphalt felts, roofing materials	*
Egypt ..	Cast iron tubing ..	315
Italy ..	Pitch	20579/F.W./M.C.2
Netherland E. Indies	Tinware, enamelware	316
Rumania ..	Bronze (tender) ..	11508/F.E./E.C./2
South Africa	Brass (tender) ..	12162/E.D./E.C./2
,,	Traction lamps (tender)	12161/E.D./C.C./2
United States	Leather	320
Uruguay ..	Fuses (tender) ..	8686/F.L/.C.C./2

* Canadian Government Trade Commissioner's Office, Portland House, 73 Basinghall Street, E.C. 2.

TARIFF CUSTOMS EXCISE

British Empire.—The current issue includes an abbreviated form of invoice and certificate for use of colonies assessing duties on "invoice price."

British North Borneo.—The duty on petrol, benzine, gasoline and similar oils and spirits has been fixed at 25 cents per gall.

Germany.—An increase has been made in the rate of the internal tax on sugar.

Japan.—Until the end of March, 1924, the import duties are suspended on many goods, including certain acids and chemicals, paper, cement plate, and sheet glass, iron and steel, and electric wire.

Mexico.—The import duty on soap has been raised to 0·15 pesos per kg.

Norway.—A statement regarding the basis of assessment for goods dutiable *ad valorem* is given in the current issue of the *Board of Trade Journal.*

COMPANY NEWS

NOBEL INDUSTRIES, LTD.

Presiding over the annual general meeting on September 21, the Chairman, Sir H. McGowan, said that the company's factories were kept well occupied during the year and there was a ready sale for most of their products. Efficiency had been improved, owing to concentration of manufacture, and prices of explosives had been reduced. The export trade showed encouraging improvement, particularly in South Africa. Factories had been erected in Chile and Czechoslovakia, and others were being erected in Hungary and Rumania. There was an improvement in the metal business of the company, the holdings in the Dunlop Rubber Co. and the General Motors Corporation had not been altered, and the prospects of the British Cellulose and Chemical Manufacturing Co were much better than they were a year ago. The future was uncertain, and it could not be foreseen when conditions would become normal. Business so far this year had been promising, and it was anticipated that results this year would not be below those of 1922.

The gross profits for the year ended December 31 last were £1,157,137, compared with £809,242 in 1921. After providing £176,999 for interest (less tax) paid and accrued to December 31, 1922, upon the 8 per cent. seven-year secured notes, the balance was £980,138; £37,236 was written off the cost of note issue, leaving a net profit of £942,901 (against £604,264). The balance brought forward was £463,349. After allowing for the preference dividend for the year it is proposed to pay a dividend of 7 per cent. on the ordinary shares (against 5 per cent.) less tax, to write off the balance of "cost of eight per cent. note issue," the notes having been repaid in May, 1923, £148,945, and to carry to reserve £50,000 (against £350,000). The carry forward is £509,018.

CALICO PRINTERS' ASSOCIATION, LTD.

After providing £597,305 for maintenance, depreciation, repairs, renewals and upkeep, and £128,000 for debenture interest, the profits for the year to June 30 last are £800,208, to which £237,371 brought forward is added, making a total of £1,037,579. It is proposed to devote this balance to payment of a dividend of 5 per cent. per annum on the preference shares for the year ended June 30, against which the directors have declared and distributed an interim dividend on March 31 for the six months ended December 31, 1922, £150,805; to payment of a 10 per cent. dividend on the ordinary shares for the year ended June 30, £201,073; to payment of a bonus on the ordinary shares for the year ended June 30, at the rate of 2½ per cent., £50,268; to reserve account, £150,000; to reserve for equalisation of dividends, £150,000; to employees' benefit fund, £100,000; leaving a balance to be carried forward of £235,432.

MARKET REPORT

This Market Report is compiled from special information received by the Secretary from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Business is slightly better, but still much below normal. Orders remain small in bulk. Prices are steady and even firmer where stocks are slight.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d. per carboy makers' works.
Acid Nitric 80° Tw.	£22 per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 65s. f.o.r. makers' works, with slight variations up and down due to local considerations.
Acid Sulphuric, 94% Arsenical	£6 per ton makers' works.
Ammonia Alkali	£7 12s. 6d.—£8 per ton. General export demand good, particularly from the Continent.
Arsenic (White)	£72—£73 per ton. Not much doing.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Copper Sulphate	£25 per ton. Dull.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	5¾d.—6d. per lb. d/d.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Carload lots 9¼d. per lb. Less quantities 10½d. per lb. ex wharf London. Ample supplies.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d. Regular demand and short supply.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£10 per ton, according to grade. Market quiet owing to slack demand for non-ferrous metals.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d.—6s. 4d. per gall. 60% O.P. Steady market.
Solvent	6s. per gall. 40% O.P. Good demand.
Wood Tar	£5—£6 10s. per ton, according to grade. More inquiry for forward delivery.
Brown Sugar of Lead	£41—£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d.—1s. 2½d. per lb. Good demand. Market firmer.
Crude 60's	3s. 3d.—3s. 6d. per gall. Good demand for spot delivery.
Acid Cresylic—97/99	2s.—2s. 5½d. per gall. Fair demand.
Pale 95%	1s. 10d.—2s. 5d. per gall. Market quiet.
Dark	1s. 10d.—2s. 0½d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price.
Anthracene Oil—	
Strained	8¾d.—10d. per gall. Supply short.
Unstrained	8½d. per gall.

Benzole—	Fair enquiry.
Crude 65's	1s. 1½d. per gall.
Standard Motor	1s. 6½d. per gall. delivered buyer's works.
Pure	2s.—2s. 1d. per gall. d/d. buyer's works.
Toluole—90%	1s. 7d.—1s. 9d. per gall. Little business passing.
Pure	1s. 11d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8¼d.—9¾d. per gall. Steady demand.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 3d.—1s. 6d. per gall.
Solvent 90/190	1s. 3d.—1s. 4d. per gall.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Supply short, demand increasing.
Whizzed or hot pressed	£11—£12 per ton.
Naphthalene—	
Crystals	£20 per ton.
Flaked	£20 10s. per ton.
Pitch, medium soft	125s. to 130s. per ton. Market quiet. Few sellers.
Pyridine—90/140	21s.—21s. 6d. per gall. Market very strong. Price still advancing.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 10d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	6s. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 7d.—1s. 8d. per lb. Market weaker.
Acid Sulphanilic	1s. 1¼d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d.—10d. per lb.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	5s. 0d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	6d.—6½d. per lb. Prices firm with a good steady demand.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/24° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
d-Dichlorbenzol	£75 per ton.
Diethylaniline	4s. 6d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£90 per ton d/d.
Dinitrotoluene—48/50	8d.—9d. per lb. naked at works.
66/68	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 6d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 6d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	5s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	3s. 3d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	4s. 10d. per lb. d/d.
m-Toluylene Diamine	4s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Business is still quiet, but prices remain steady, Continental quotations being increasingly firm.

Acid, Acetic 80% B.P.	£52 10s. per ton.
Acid, Acetyl Salicylic	3s. 1d.—3s. 2d. per lb. Good demand. Firm market.
Acid, Benzoic	2s. 3d.—2s. 6d. per lb. Firmly held. Some German makers are stated to be out of stock.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Citric	1s. 5½d.—1s. 6d. per lb., less 5%. Supply exceeds demand.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	5s. 9d.—6s. per lb., according to quantity.
Acid, Salicylic	2s. 2d.—2s. 3d. per lb. Firm market. Good inquiry. Supplies not heavy.
Acid, Tannic	3s. 3d. per lb. for B.P. quality.
Acid, Tartaric	1s. 2d. per lb. less 5%. Market continues weak.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 6d. per lb. for English manufacture. Imported higher. Market very quiet.
Amidopyrin	12s. 6d. per lb. Demand still very poor.
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz. for English make.
Barbitone	17s. per lb. for quantity.
Benzonaphthol	4s. 6d.—4s. 9d. per lb. Slight advance in price.
Bismuth Salts	A steady market.
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	
Potassium	6½d. per lb. Foreign market appears a little more stable. Not much inquiry.
Ammonium	7d. ,, ,,
Sodium	7½d. ,, ,,
Calcium Lactate	2s. 6d. per lb. for best makes. Better enquiry.
Chloral Hydrate	3s. 9d.—4s. per lb. Somewhat firmer. English makers are oversold.

Chloroform	2s. 2d. per lb. for cwt. lots. Demand is poor.
Creosote Carbonate	8s. lb. Demand negligible.
Formaldehyde 40%	75s. per cwt. ex wharf London.
Guaiacol Carbonate	8s. 6d. per lb.
Hexamine	3s. 6d.—3s. 9d. per lb. Spot parcels have been cleared, and forward prices are higher.
Homatropine Hydrobromide	30s. per oz.
Hydroquinone	3s.—3s. 3d. per lb. Now asked, according to quantity and holder.
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.
Magnesium Carbonate— Light Commercial	£37 per ton net.
Magnesium Oxide—	
Light Commercial	£82 10s. per ton, less 2½%.
Heavy Commercial	£28 per ton, less 2½%.
Heavy Pure	65s.—75s. per cwt., according to quality & quantity.
Menthol	A.B.R. recryst. B.P. 65s. per lb.
Mercurials	Very much weaker. Reduced 6d. lb. all round. Quicksilver reduced to £8 15s. per bottle.
Methyl Salicylate	2s. 4d. per lb. Distinctly firmer for English or imported, in view of normal increasing demand.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Metol	8s. 9d. per lb.
Morphine and Salts	Prices advanced about 6d. per oz., due to higher price of opium. Alkaloid : Cryst. 11s. 6d., Precip. 11s. 3d., Acetate 9d., Hydrochlor. 9s., Sulphate 9s. per oz.
Paraformaldehyde	3s. 5d. per lb.
Paraldehyde	1s. 5d. per lb. Demand slow.
Phenacetin	6s. per lb. Steady.
Phenazone	7s. per lb. Firm.
Phenolphthalein	6s. 6d.—6s. 9d. per lb., according to quantity and holder.
Potass. Bitartrate— 99/100% (Cream of Tartar)	88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	2s. 8d. per lb. English makes are meeting foreign competition.
Potass. Iodide	15s. 8d.—16s. 2d. per lb. Good demand.
Potass. Metabisulphite	8d. per lb.
Potass. Permanganate	10d. per lb. for B.P. crystal.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	5s. 6d. per lb.
Salol	3s. per lb. Limited demand.
Silver Proteinate	10s. per lb. A weaker market.
Sod. Benzoate	2s. 6d. per lb. Improved demand would lead to higher prices as present stocks cannot be replaced at current figures.
Sod. Citrate, B.P.C. 1923	2s. 3d. per lb.
Sod. Hyposulphite— Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—87s. 6d. per cwt. Fairly good demand.
Sod. Salicylate	Powder 2s. 6d.—2s. 7d. per lb., and Crystal at 2s. 8d. per lb. Distinctly firmer. Demand more active, and supplies not excessive.
Sod. Sulphite, anhydrous	£25—£26 10s. per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	14s. per lb.
Tartar Emetic	1s. 2d.—1s. 4d. per lb.
Thymol	14s. per lb. for best white crystal.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 6d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate	3s. ,, ,,
Cinnamic Aldehyde Natural	18s. 6d. ,, ,,
Coumarin	18s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	10s. ,, ,,
Geraniol (Palmarosa)	35s. ,, ,,
Geraniol	5s. 6d.—12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. per lb.
Linalol ex Bois de Rose	18s. 6d. ,, ,,
Linalyl Acetate	21s. ,, ,,
Methyl Anthranilate	8s. 6d. ,, ,, Cheaper.
Methyl Benzoate	6s. ,, ,,
Musk Xylol	11s. ,, ,,
Nerolin	3s. 3d. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	16s. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	2s. ,, ,,
Terpineol	3s. ,, ,,
Vanillin	24s. ,, ,,

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	30s. ,, ,,
Camphor Oil	80s. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4½d. per oz.

Cassia Oil 80/85%	12s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 2d. ,, ,,
Ceylon	3s. 10d. ,, ,,
Clove Oil	8s. 6d. ,, ,,
Eucalyptus Oil 70/75%	2s. 8d. ,, ,,
Lavender Oil	18s. 6d. ,, ,,
Lemon Oil	2s. 10d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	12s. 6d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	24s. per oz.
Palma Rosa Oil	23s. 6d. per lb.
Peppermint Oil—	
Wayne County	15s. 9d. ,, ,, Market very unsteady.
Japanese	12s. per lb. Market very unsteady.
Petitgrain Oil	7s. 6d. per lb.

TRADE NOTES

Trinidad and Tobago, 1921

The staple agricultural products of the colony are cacao, coconut and sugar. Heavy rain reduced the sugar crop by 3500 tons to 54,933 t., and the export comprised 46,149 t. of sugar and 6792 galls. of molasses. Much attention is being paid to the elimination of disease in the sugar-cane plantations. The exports were over 20,000,000 nuts and 4,196,703 lbs. of copra, valued at £108,725 and £61,989 respectively. Rubber is grown on a small area, but tapping has been stopped for the present owing to the low price. The lime industry is considerably hampered by general prevalence of disease. At the end of 1921 twenty companies were producing petroleum from an area of 100,000 acres, the total number of wells drilled in the colony being 607. Petroleum production amounted to 82,395,595 imperial gallons, an increase of 9,489,648 galls. over the previous year; in addition 119,729 t. of asphalt and 227,244 t. of road-building material were produced during the year. Imports were valued at £6,903,694, of which 25·37 per cent. came from the United Kingdom, 20·99 per cent. from other British Possessions, and 36·11 per cent. from the United States. Of exports valued at £683,988, the United Kingdom took 40·54 per cent., Canada and other British Possessions 12·99 per cent., and the United States 28·53 per cent.—(*Col. Rep.-Ann.*, No. 1135, 1922.)

French Company News

It is reported that the Société Pathé Cinéma intends to establish a factory in England for the manufacture of sensitive kinematograph films.

A new company entitled "Soie de Compiègne" has been established for the manufacture of artificial silk.

The St. Gobain glass and chemical company intends to add a department for the manufacture of superphosphate to its works at Wasquehal.

The Société Industrielle du Celluloid now controls the Société l'Agatine, which manufactures a non-inflammable plastic material from phenol and formaldehyde.

Market News

There is a certain tension in the market for resins and turpentine, as most of the factories have paid high prices for raw materials and prefer to stock their products rather than sell. On the other hand, consumers are not buying, and as a result prices are fluctuating widely. The price of turpentine has risen from 465 francs on September 11 to 505 francs on the 19th. Prices for dry products are well maintained, viz., tar, 82 francs, colophonies 86 to 87 francs. Tars are in good demand, especially from Italy and Northern Europe. It is not known what stocks of turpentine are in hand in the Landes, but it is supposed that stocks unsold at the works are fairly high, although those in warehouses are smaller.

PUBLICATIONS RECEIVED

PHOTOGRAPHY AS A SCIENTIFIC IMPLEMENT. *A collective work by* A. E. CONRADY, C. R. DAVIDSON, C. R. GIBSON, W. B. HISLOP, F. C. V. LAWS, J. H. G. MONYPENNY, H. MOSS, A. S. NEWMAN, G. H. RODMAN, S. E. SHEPPARD, W. L. F. WASTELL, W. M. WEBB, *and* COL. H. S. L. WINTERBOTHAM. *Pp* viii+549. *London: Blackie and Son, Ltd.*, 1923. *Price* 30s.

THE CULTIVATION OF THE SUGAR CANE IN JAVA. *An elementary treatise on the agriculture of the sugar cane in Java, and more especially on its cultivation on the Krian Sugar Estate. By* R. A. QUINTUS. *Pp. xi*+164. *London: Norman Rodger*, 1923. *Price* 12*s*.

THE PROPERTIES OF MATTER. *By* B. C. MCEWEN, M.C., B.Sc. *Pp. vi*+316. *London: Longmans, Green and Co.*, 1923. *Price* 10s. 6*d*.

PUBLICATIONS OF THE DEPARTMENT OF THE INTERIOR, UNITED STATES GEOLOGICAL SURVEY. *Washington: Government Printing Office*, 1923:—

ANTIMONY IN 1922. *By* F. C. SCHRADER. *Mineral Resources of the United States, Part I.* No. I: 9. *Pp.* 97—105.

ASPHALT AND RELATED BITUMENS IN 1922. *By* K. W. COTTRELL. *Mineral Resources of the United States, Part II.* No. II: 3. *Pp.* 7—13.

BAUXITE IN ALUMINIUM IN 1922. *By* J. M. HILL. *Mineral Resources of the United States, Part I.* No. I: 8. *Pp.* 87—96.

BISMUTH, SELENIUM AND TELLURIUM IN 1922. *By* V. C. HEIKES. *Mineral Resources of the United States, Part I.* No. I: 3. *Pp.* 15—25.

LEAD AND ZINC PIGMENTS AND SALTS IN 1922. *By* C. E. SIEBENTHAL *and* A. STOLL. *Mineral Resources of the United States, Part I.* No. I: 7. *Pp.* 77—85.

SALT, BROMINE AND CALCIUM CHLORIDE IN 1922. *By* K. W. COTTRELL. *Mineral Resources of the United States, Part II.* No. II: 5. *Pp.* 23—29.

INSTITUTION OF CHEMICAL ENGINEERS

Owing to great public demand, a limited number of copies of the paper on "Industrial Oxygen," read by Mr. T. Campbell Finlayson (Associate-Member), B.Sc., before the Institution of Chemical Engineers in June last have been published, and are issued to the public at the price of 10s. 6d. each.

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EDITORIAL

EVERY manufacturer, whether of chemicals or any other products, is interested in the efforts made by Governments to promote trade. Here such efforts may be placed in two categories, first, the participation of the Government directly in some species of manufacture as in the construction of ships or by investment in some company, instances of which will readily occur to our readers, second, some legislative action intended to foster a particular industry. The investment of money in an industrial undertaking is due either to a desire to make a profit or to a sentimental feeling of benevolence in favour of some person other than the investor. Government investment is usually of the latter variety; a business may be so lucrative or so well-organised as to appeal successfully to those who are willing to invest twenty pounds in the sure hope that these will speedily be converted into five and twenty. Such a business needs no Government aid in raising its capital. On the other hand, the sentimental investor has no right to expect profits. The making of money is a legitimate occupation, but it must be pursued with that intention and every other consideration which influences the business will be at the expense of the profits. Legislative measures for the benefit of an industry usually involve a prohibition to import or manufacture certain goods unless some penalty is paid. It is obvious that the arguments in favour of such a course, and those against it, will be very prominently brought before us in the near future. With such arguments and their relative merits we are not and shall not be concerned, but it is a matter of common interest to notice here and there the signs of greater stability or prosperity in the world. In this country our national finances have, from the point of view of currency, been rectified very speedily. Our French and Italian friends admit this but direct our attention to the fact that our deflation of currency and high taxation have caused an army of unemployed. It is all very well for the man who owes more than he can pay to deny himself every luxury, but if he knocks off his bread and meat as well, he will die of starvation before his balance is a credit one.

* * *

The French have avoided this rapid deflation or, rather, have postponed it, for they have only put off that evil day. Perhaps they will carry out this operation so slowly as to cause little temporary inconvenience, if so, it will be a long while before their national finances are sound. We have compressed our trouble into so short a time that the remedy can hardly be endured, but we are nearer than any other European country to a sound financial condition. Whether we are wise or foolish depends not on our study of the problem but on our political faith. The balancing of probabilities and weighing the advantages against the disadvantages of any course are far too difficult questions for the decision of those who will have to make the choice. Meanwhile, there is consolation to be derived from the fact that a certain measure of stability has been reached in some countries, Austria is one, for instance. If we compare the present state of the world with its state two or three years ago there are signs of progress; even Russia seems to have risen a little from the very low position she recently occupied as a trading concern. Desperate as is the condition of Germany, and extraordinary as are her currency problems, there seems to be a feeling in many quarters that she has reached a crisis in her currency and financial problems from which a recovery seems almost certain. Even if this particular crisis is successfully weathered, she will have other, but less severe ones, for her shortage of the necessary basis for a stable currency will be an important factor for a long time to come. We wish some means could be found for hastening the golden age, but catalysts for this process are yet to be discovered and we much fear that patience and determination will be the conditions most necessary for our comfort.

Nothing short of a well-known Americanism would be sufficient to describe adequately a consulting chemist's practice in which the work ranged from the examination of quinine, matches, dyes, beer, soap and condensed milk to analyses of sheep-dip, cocaine, tea, paint, cheese, radioactive materials, tobacco and alloys. Yet such a laboratory is in existence in Clement's Inn, where the Government Chemist and his staff are quietly engaged in work of great national importance, Everyone who has had experience of analytical work will feel in sympathy with Sir R. Robertson, when he writes in his report, referring to work done in connexion with the Safeguarding of Industries Act, that the analysis of many of the samples such as medicines, perfumery and proprietary articles, is of an intricate nature, especially as in some cases no information is available as to the composition of the goods. Those who are pessimistic about the state of chemical education in this country should note that in all the samples examined under the Fertilisers and Feeding Stuffs Act, there was substantial agreement between the results obtained in the Laboratory and those of the agricultural analysts who had first examined the samples. And in another part of the report it is stated that similarly efficient work is being performed by the chemical stations established in the chief seaports. Curiously enough, search in various books of reference failed to reveal any information about the Laboratory. A cynic would perhaps say that this silence explained certain peculiarities of the schedules to the Safeguarding of Industries Act.

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This week it has been our privilege to receive officially from the Chemical Society, abstracts of the papers to be read at their meeting on the 4th inst., to prepare for the distribution of advance proofs and to arrange for the publication of these and the discussions following the papers in our next issue. The Chemical Society and the Society of Chemical Industry have much in common, many of the distinguished Presidents of the senior society have also presided over the junior one. The Chemical Society has given to the Society of Chemical Industry the privilege of using its library and its lecture hall; there has always been the bond that each Society existed, not for the gratification or profit of any individuals, but for the advancement of science. Each Society has contributed a number of zealous workers to the Federal Council whose influence is probably greater than its publicly announced achievements. To the support of the Chemical Society this journal already owes much and, with that gratitude which consists of a sense of favours to come, we welcome their help in enabling us to publish so rapidly and with such authority, an account of the communications submitted to the oldest chemical society in the world.

ENZYMES

At a meeting of Section B (Chemistry) of the British Association at Liverpool University on Monday, September 17, a discussion upon Enzymes was opened by Dr. E. F. Armstrong, F.R.S.

Dr. Armstrong said that the study of enzyme action now resolved itself very largely into the study of surface effects. Indeed, he ventured to predict that the subject of surface effects would be one of the most important matters discussed by chemists during the next few years. He was gratified to find that the President of the Section had devoted so much attention to it in his Presidential Address. Sir Ernest Rutherford and his colleagues were dealing with what might be termed the innermost centre of matter—the atom. Surface action was what was taking place right at the outside of the aggregates of molecules which make up matter as we know it.

Enzymes are catalysts found in plants and animals which apparently enable the plant and animal very easily, at comparatively low temperatures, to bring about reactions which in the test tube require high temperatures and strong chemical agents. They belonged to the class of substance known as colloids, and their action was largely a question of surface action. The reactions brought about by enzymes were, in the main, hydrolytic—*i.e.*, they concerned active hydrolysis when water was split into HO—H, or alternatively, they involved oxidation and reduction, which were only two phases of the same thing; in that case water was split into H_2—O, so that the study of enzyme action was virtually a study of changes in water.

As to the preparation of an enzyme, animal or vegetable tissues—yeast was a good example—were taken and the cell wall ruptured in some way; in the case of yeast, by drying it. Then an aqueous extract was made of the enzyme and the filtrate—an opalescent liquid—possessed properties which were attributed to the presence of an enzyme. Yeast extract, for example, would hydrolise cane sugar. It used to be considered that the enzyme was truly in solution, and it was spoken of as a soluble enzyme, but he believed the view to-day was that we are dealing not with a true solution, but with a colloid gel. If we were dealing with a material of that kind, then we were justified in imagining that the action is taking place at the surface of the molecule—the molecule being a big one—and going a little farther in the study of the enzyme we had discovered numerous cases in which all the action required could be obtained without dissolving the enzyme, all of which action took place at the surface of insoluble material, the hydrolysed substance acted upon being in true solution. Therefore, it was quite clear that enzyme action was a surface action.

The next stage in the investigation of the enzymes over a period of years was the rate of their activity. Physical chemistry, in its application to natural problems, had the advantage of bringing in exact science in the sense that it enabled us to make measurements. It was, perhaps, however, necessary to add a word of warning with regard to the use of these methods of measuring the rate of action, viz., that it was necessary to be quite sure that we were really measuring what we think we are. As a matter of fact, very nearly half the experiments on record with regard to enzyme action were not measuring the rate of activity of the enzyme at all; they were measuring something quite different, in many cases the rate of accumulation of impurities in the solution, the rate of destruction of the enzyme and not the rate of action of the enzyme.

As a result of work done in all parts of the world during the last twenty-five years, many people were agreed that, as with other active catalysts, if the enzyme were really active and the solution such that plenty of material was brought to the surface all the time, then the rate of action was such that equal quantities of material were attacked—hydrolysis or oxidation, as the case may be—in successive equal intervals of time. If this were accepted, then all idea of mysticism was removed from the action of enzymes, because it was incredible to think that such simple actions as digestion, which went on in a body, or the recovery of muscular tissue after work, should be governed by very complex mathematical laws.

It would, perhaps, be worth while adding a word of caution as the result of experience, and to say that for enzyme work considerable training was necessary. Enzymes, as active catalysts, by virtue of their surface, were naturally rather sensitive to outside influences. Traces of alkali in particular, and acids to a less extent, affected their activity enormously. It was therefore necessary that all work should be carried out in hard glass beakers and flasks and that all solutions should be kept in hard glass bottles, and also that hard glass pipettes and burettes should be used, and it was neglect of such precautions which had led to the anomalous and complicated results to be found in the literature.

If enzymes were regarded as colloids, then we could bring to our assistance all that was known about other colloids and catalysts, particularly the fact that as a colloid aggregate was active in virtue of its surface, every possible means must be taken to keep that surface clean. It was quite obvious that if the surfaces were allowed to be attacked by chemical acids and alcohols, the surface would be harmed in some way. A great deal of evidence to this effect was brought forward by the Colloid Committee of the Section.

Referring again to the yeast extract, the best way to make a strong enzyme from yeast was to take ordinary brewer's yeast and put some in a bottle with a little toluene on the top, and place this in an incubator at a temperature of 36° for a week or more until the whole of the yeast melted down to a dark brown liquor which, after filtering from impurities, was a thick, opalescent, though very dark solution. This could be precipitated by the cautious addition of alcohol, to a brownish whitish slime, a sort of colloidal substance which, after washing by alcohol, could quickly be re-dissolved in water, and gave a much cleaner solution, slightly active. If that process was repeated with care a dozen or more times there would be less and less material and the activity increased. They would then begin to test with ordinary organic groups and would find, as the purification was carried farther and farther, that the reaction with sugars grew fainter; the reaction with amino-acids and protein bodies, and, in fact, nearly all the reactions would grow fainter. Generally, in any one series of experiments, most of the reactions disappear except one, and the investigator might think he had made a discovery as to the destruction of enzymes and might publish a paper upon it. But if the investigator had more experience he would do it all over again, and would find that the reaction, which did not disappear at first, disappeared the second time and that one of the others persisted; and after this had been done several times, the investigator would no doubt decide not to publish a paper.

From his point of view, he was quite clear that we could never hope to purify the enzyme, because there was no such thing as an enzyme in the sense that there was a molecule, say of cellulose; considering the molecule of cellulose we were pretty clear—at any rate, Prof. Irvine was—as to what it should be like. So far as the enzyme was concerned he thought it was highly improbable that there was such a thing at all; we have a big colloid surface, and one part of it contains a certain grouping which, with the proper physical conditions, is built up as a catalyst and possesses the activity with which we associate the name enzyme. Therefore, he hoped that his physical-chemical colleagues would devote much attention to the study of the peculiar particular surface condition which brings about this high state of activity. What chemists wanted was to get some evidence as to the particular groups for each specific enzyme action. Actually we had no means at our disposal at present to allow of any proof being put forward. The hypothesis was there and some day he hoped we should be able to test it. We were certain that there was a definite relationship between the activity of the enzyme and the substance on which it acts. Each particular enzyme restricts its activity to nearly one subject. Fischer had studied the action of these enzymes and showed that there is the closest relation between the structure of glucose and the activity of the enzyme. Moreover, Fischer suggested the analogy of a lock and key to show how to fit an enzyme on to sugar and that idea had prevailed in the minds of most of those who had studied the subject ever since, but it was rather an unfortunate analogy from our present day point of view because it did not correlate itself with the idea of surface at all. He himself had been very much helped by Langmuir's conception of the state of affairs in the case of a drop of fatty acid on a water surface. Langmuir imagined that when there is fatty acid on water the carboxyl group is on the surface of the water and that the rest of the molecule rears itself proudly in the air with a CH_3 group sticking out at the top. Hardy had stated that when two pieces of glass with an organic liquid between them were rubbed together, there was a great tendency for the chemical molecules to arrange themselves in a definite orientation, and all our space lattice theory of the structure of metals fits in with this new conception. Now we are able to take the sugar molecule and arrange it at the surface of the colloid, not with the lock and key idea, but in some such way that it completes an electrochemical circuit while the action takes place.

After referring to the paper read by Professor G. Hopkins at the recent meeting at Cambridge, he turned to the nature of the first phase of the reaction between the substance attacked and the enzyme. There were two rival theories at the moment. The first is that some kind of complex is formed between the enzyme and the substance which it attacks, and that the forces which bring about the formation of that complex are chemical forces. This is suggested as some loose form of complex, but nevertheless it is formed by chemical forces. The physicists, however, have the idea that this active layer of colloid is able to adsorb or absorb the substances, the forces holding it being physical. The work of Hardy and others has shown that this adsorbed layer is generally a molecule thick, or not very much more. He thought there was very little doubt that both the physicists and the chemists meant the same thing although they were expressing it differently. It was not possible at the moment to offer proof of the formation of these complexes in the case of enzymes, but it was possible to offer it in the study of other catalysts, particularly the nickel catalyst. If they had a fatty acid; $CH_3— \cdot \cdot — CH : CH — \cdot \cdot \cdot —CO_2H$, the complete substance containing 18 or 20 or even more carbon atoms, and also a nickel catalyst, the theory is that a loose complex is formed by the two substances, and the point of attachment of the complex is the CH : CH part of the above expression. Chemists knew that if in their test tubes that compound was formed and broken down again, it will break down not only to the original substance but in every other possible way. The substance selected could break down in more ways than one. There was the syn form and the anti form, and if this theory is correct we could expect amongst the products of reaction both the syn and the anti form. For instance, in the case of oleic acid, if the reaction with hydrogen was stopped when it had gone, perhaps, half way, in addition to stearic acid there would be obtained an isomer of oleic acid. In fact, a considerable quantity of elaïdic acid was obtained. That seemed to him to afford convincing proof that such a complex is formed. If to that proof were added the extraordinary effect of the structure of the sugar, then he thought the evidence was absolutely in favour of the formation of a definite chemical complex between the enzyme and the substance which it acts upon.

It seemed as if the formation of the complex is necessary for the formation of an electrochemical circuit where the energy was provided by radiations or by the ultra-violet light with which Prof. Baly was working. If we once solve this problem, then we have a clear idea of the manner in which changes are brought about in the living organism. The plant or the animal actually controls what happens inside it because its active agents are such that they only come into operation when an organic compound of a particularly complex structure is present. We had got a glimmering, which in a few years might become a certainty, of the actual groups in the enzyme which possess the power of initiating these far reaching changes.

Prof. E. C. C. **Baly** believed, on the energy quantum theory, it was possible to found an explanation of the supply of energy by means of a catalyst to the substance which has been catalysed, which he would call a catalyte for want of a better word. There were two ways by means of which the addition compound between two molecules could be stabilised. If they had two molecules, which he would call A and B, the complexity of which did not matter, to form a complex between the two there were two possibilities. The first was one with which we are familiar—viz., that the energy content of the resulting complex is less than that of the two components. In other words, both of them lose energy, and a stable complex was formed which could not be resolved back again into its two free components A and B until the amount of energy lost in the formation of the complex had been restored. There were many complexes of that type, and a typical example was aniline hydrochloride. But there was another possibility—viz., that the complex is stabilised by a definite transference of energy from one component to the other, and then such a complex cannot be resolved back into its components until or unless the energy goes back again from one component to the other. In the case of the two molecules A and B, the transference of energy from one to the other must be considered as a purely isothermal reaction, and the amount of energy transferred on the energy quantum theory must be one, two or three energy quanta per molecule, and, if that were so, it must be capable of experimental proof. It was possible to determine, by physical methods, energy changes of that type—*i.e.*, where a molecule loses one quantum of energy or gains it. He had made a series of investigations in which a particular substance A had been examined spectroscopically, together with B and finally the complex A B had been examined, and he felt he could say that there was a certain amount of definite proof that a change had actually taken place between the two; A had lost energy and B had gained it, the whole change being accompanied by no transference of energy to or from the surroundings.

Dr. **George Tate** asked whether the reaction brought about by an enzyme was reversible.

Professor **Robinson** said an idea which had been running through his mind for some time, which he had never published for lack of experimental evidence, was in regard to the nature of polymerisation in all classes of organic compounds. A large class of polymerides was derived from reactive groups at both ends of the molecule which could combine with one another, and there were two possible theories as to such polymerides, although only one had been suggested hitherto. The theory that had been suggested was that these polymerides were principally chemical polymerides, and consisted of enormously large molecules. Another possible theory which had occurred to him, however, was that the unit of the polymeride was a fairly large ring, and that these rings were interlocked and unable to separate one from the other. The evidence on which that was based was very slender, but there was a certain amount. Dr. Armstrong had mentioned cellulose. Principal Irvine's idea, however, he did not think was sufficient to explain the character of cellulose. In fact, the unit of cellulose must be regarded as a polymeride, and under the possible idea of polymerisation which he had just put forward there would be a large number of interlocked rings, each of which would be the Irvine cellulose unit. The question, of course, arose as to what experimental evidence there was, and he thought it was to be found simply in the complete absence of the end member of the chain in the cellulose unit.

Prof. H. S. **Raper**, speaking as a physiologist, said we needed an explanation of where the energy came from in an enzymic action. We had not a satisfactory explanation of how the catalyst was regenerated—*i.e.*, how it replaced the energy it had lost.

Prof. H. E. **Fierz** said that ultra-violet rays had no effect at all in the chlorination of toluene. He had not been able to come to a conclusion with regard to this, but it would be interesting to know whether Prof. Baly had ever absorbed completely the heat waves. It was quite possible that if the heat waves were taken away and there was absolutely cold ultra-violet light, there might be no reaction.

Prof. **Baly**, in reply, said that one could realise how it was that these reactions of enzymes could be so easily carried out by means of an enzyme, and yet were exceedingly difficult to carry out by the action of heat. With regard to the chlorination of toluene mentioned by Prof. Fierz, he would assume that for the particular reaction only one quantum is necessary—*i.e.*, energy has to be absorbed so that the total amount is of the order of 3000 calories per gramme molecule, which corresponded to the absorption band in the infra red, about $3{\cdot}5\mu$. It followed that it should be possible to carry out reactions by means of infra-red light which was absorbed at the characteristic intensity of the toluene or chlorine in the infra red. Chlorine had no absorption band, as a matter of fact, but toluene had, and, assuming that one quantum per molecule was just sufficient to carry out the reaction, that explained why Prof. Fierz had found no reaction with the ultra-violet light, and that point was an extraordinary contribution to the radiation theory of chemical reaction, which he was sure Prof. Lewis would be very much interested in. If energy was absorbed at the ultra-violet absorption band of toluene, instead of just one quantum of energy being absorbed, he believed that twenty-five times that quantum would be absorbed, and the result of the absorption of that larger amount of energy was quite different from the changes produced with one quantum. If twenty-five times the quantum were used, the toluene would be in such a condition that it would not react with chlorine. There was a definite condition for each particular reaction, and for each specific reaction there must be the corresponding condition.

Dr. **Armstrong**, replying to the discussion, said it had been asked whether enzymes synthesised the same material as they hydrolysed. His answer to that was that he wished he knew. Sir Wm. Bayliss said they did, and the French people said they did, but personally he had never been able to get any evidence in the affirmative, although he had tried over and over again for twenty years. In the test tube we were unable to realise the conditions which took place in Nature. Probably in nature the enzyme could act reversibly, but in the test tube there was no favouritism. Every possible reaction took place, and there would be synthesis of both forms; but the balance would lie in favour of the one which was ordinarily not destroyed, and we should tend to get not the natural, but the isomeric form synthesised.

SOME BIOCHEMICAL EFFECTS OF POLARISED LIGHT*

By ELISABETH SIDNEY SEMMENS
(Amy, Lady Tate Research Scholar)

Starch is formed in the leaves of a plant to about 6 p.m., and after that time sugar becomes more evident. As the vertical light from the evening sky is polarised, it seemed possible that the above change, like many other facts in plant and animal life, may be due to a specific action of polarised light.

About eighteen months ago some experiments were undertaken to determine whether plane-polarised light has any effect on the various stages of plant growth. Plane-polarised light was found to cause a definite acceleration of germination and of flower production, but apparently not to influence the vegetative growth of the stem and leaves. Since these results might be explained as being due to an acceleration of the breaking-down of the reserve stores of starch, etc., an explanation which would also satisfy the appearance of sugar in the growing leaf in the evening, the following observations were made :—

Equal amounts of ground and sifted mustard seed were placed in three glass dishes and to each was added the same quantity of water. One of these dishes was exposed to plane-polarised light, one was exposed to ordinary light, and the third was kept in the dark. After definite periods the contents of the dishes were boiled and filtered, and the amount of sugar formed was estimated by Fehling's solution or by potassium permanganate. The results distinctly indicated that an increased hydrolysis is caused by polarised light.

The difficulty of eliminating the non-coagulable proteid and other reasons led the author to investigate the hydrolysis of starch grains under conditions which were under greater control. Washed and centrifuged starch grains were shaken up with diastase and water, and a few drops of the suspension were placed on each of three microscope slides. These three slides were then mounted on three microscopes, and in one case the slide was illuminated by a beam of plane-polarised light, in the second by a beam of ordinary light, while the third was completely covered. The three instruments were placed close together so as to secure equality of temperature, and this was checked by means of a delicate thermocouple. The progress of hydrolysis was observed through the microscopes, and after intervals of from one to four hours, depending on the intensity of the light and the strength of the diastase, the starch grains broke up on the slide exposed to polarised light, there being slight erosion in ordinary light and practically no effect on the control in the dark. Altogether 23 separate experiments were carried out, using daylight from a north window or artificial light from an Osram lamp, the polarising apparatus being either a Nicol prism or reflecting surfaces of ferrotype, covered with glass, set at the polarising angle. In 17 experiments evidence was obtained of the accelerating influence of the polarised light on the breaking-up of the starch grains, and it should be mentioned that the difference between the effects of polarised and ordinary light decreased as the strength of the diastase was increased.

With shorter exposures the presence of dextrin in the hydrolysed products was proved by iodine, and after longer exposures the formation of reducing sugars was detected by warming the slides after the addition of a few drops of Fehling's solution.

The starch was obtained from potato, maize and wheat. Diastase was added to the first two, but as the wheat was freshly grown, the wheat starch was hydrolysed by its own diastase. On the slides carrying the wheat-starch preparation some proteid was present, and this was also hydrolysed under the influence of polarised light. This phenomenon is at present under investigation.

Some attempts were made to compare the relative rates of breaking-up of starch grains under the following conditions : (*a*) In light polarised by a Nicol prism ; (*b*) In light polarised less strongly by reflection ; (*c*) In ordinary light ; (*d*) In darkness ; and it was found that the rate was in decreasing order *a*, *b*, *c*, *d*, the hydrolysis being much more rapid with the strongly polarised light given by the Nicol.

It was also found possible, provided that the intensity of the light was sufficiently great, to hydrolyse starch grains in water without the use of any diastase, and here again the maximum effect was obtained with polarised light. This result is of some interest in view of the fact that even when diastase is present, chemical changes sometimes appear to commence within the grain under polarised light, before the outer membrane breaks. After a short exposure grains, apparently intact, are coloured brown by iodine and occasionally sugar crystals are seen to form as the grains break down.

Investigations of the relative rate of hydrolysis of boiled starch in polarised light and ordinary light are now in progress. Results of considerable promise have already been obtained. Although no accurate experiments have as yet been carried out on the region of the spectrum which is most effective in causing the hydrolysis, it may be recorded that the reaction is more rapid with a red glass screen interposed than with a blue glass screen.

It would seem from the above results that the evidence is decidedly in favour of the acceleration of the hydrolysis of starch by polarised light as compared with ordinary light of the same intensity.

The University of Liverpool

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* Abstract of paper read before Section B, British Association Meeting, at Liverpool, September 18, 1923.

MEMBRANE POTENTIALS CONSIDERED AS DIFFUSION POTENTIALS*

By **E. B. R. PRIDEAUX**, D.Sc., and
W. E. CROOKS, B.Sc.

The potential differences set up at most ordinary membranes, through which a slow diffusion of electrolytes can take place, are not of the same type as those formulated and to some extent realised experimentally by Haber, Loeb, Beutner, Baur and others. The latter refer to systems which are in equilibrium on account of the complete impermeability to one or the other ion. On the other hand, there is no equilibrium in the case of the ordinary parchment, agar or gelatin membrane, swelled with aqueous liquids and not wholly impermeable to any ion. Such a membrane would appear to present a closer analogy with most living tissues.

It seems more natural to ascribe such potentials, as in the older theories of Ostwald, Höber and others to a selective ion permeability; they are non-equilibrium potentials analogous to diffusion potentials. They are, as shown by the work of Cumming and others, higher than the diffusion potentials which arise between the same two solutions. If these consist of the sodium or potassium salts of organic acids, the potentials may be of a magnitude comparable with those found in living organisms.

In the earlier work by one of the authors, it was shown that sodium benzoate solutions, with a parchment membrane, gave steady and reproducible potentials, which were simply related to the log ionic-concentration ratios of the solutions by the diffusion potential formula:

$$E_a = 0{\cdot}058\ (1-2n_A)\log\frac{a_1C_1}{a_2C_2}\ \text{volts at } 25°.$$

This formula, however, contained a value for the transport number of the anion "n_A," which was smaller than that found at freely diffusing concentration gradients, *i.e.*, the mobility of the anion was diminished relatively to that of the kation. The investigation has now been extended to potassium benzoate and salicylate. One of the objects has been to ascertain whether the benzoic ion has a definite (diminished) mobility in the parchment, which is the same in potassium as in sodium salts. Measurements of conductivities, viscosities, diffusion and membrane potentials have been made in these solutions at 25° C.

Special apparatus was designed in order to obtain a flowing junction in the case of diffusion potentials and to run the two solutions past each side of the membrane at varying speeds.

The results were treated by the method of least squares in order to obtain the average values of n_A. The total concentrations C were used instead of the ionic concentrations corrected for viscosity (for reasons mentioned in the full paper). The values of the transport number of the anion in respect of the sodium and potassium salts, respectively, were found to agree with the assumption that, given an unaltered mobility of the kations, the mobility of the benzoic anion is diminished in a nearly constant ratio, 0·725 and 0·745. That of the salicylic anion is diminished in a different ratio, i.e., 0·66. The treatment of these potentials, as modified diffusion potentials, is so far justified.

The fact that alkali chlorides, etc. diffuse quite readily through this material supports the idea that the increase in the diffusion potential is due to the retardation of the organic anion. It also shows that the diffusion potentials of such salts, even when modified by a simple parchment-like membrane, are insufficient to account for the potentials observed in living organisms. But it has been supposed by Loeb that double decomposition occurs between inorganic salts and the material of plant membranes. This might produce a concentration gradient of alkali salts of organic acids in the membrane similar to that which is supposed to be formed by the alkali benzoates in the parchment.

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* Paper read before the joint meetings of sections (B) Chemistry and I (Physiology) at the meeting of the British Association in Liverpool on September 14.

SALT, BROMINE AND CALCIUM CHLORIDE IN THE UNITED STATES IN 1921–22

Production of salt in the United States in 1922 increased by 36 per cent. in quantity and 12 per cent. in value, to 6,792,849 short tons valued at $27,464,838, compared with 4,981,154 t. valued at $24,557,966 in 1921. In 1922 the number of operating plants was 104, a gain of 14. Sales of rock salt in 1921 and 1922 were 1,472,576 short tons ($6,693,923) and 1,947,124 t. ($7,489,644) respectively; of evaporated salt 1,931,243 t. ($16,846,963) and 2,276,683 t. ($18,472,759); pressed salt blocks 117,739 t. in 1921 ($1,275,483), and 172,682 ($1,554,429) in 1922. Imports in 1921 and 1922 amounted to 93,095 t. and 111,710 t. respectively, compared with exports during the same years totalling 109,563 t. and 134,989 t. respectively.

The output of bromine was 711,953 lb. in 1921 and 1,005,174 lb. in 1922, an increase of 41 per cent. in quantity but a decrease of 13 per cent. in value compared with the previous year. The wholesale price of bulk bromine in 1922 was 20 to 21 cents per lb. from February until about the middle of March, then increased to 27 to 28 cents until the end of the year. Bromine had not been imported into the United States for several years prior to 1921, when imports of 300 lb., valued at $84, were reported. In 1922 imports were 1094 lb., valued at $339.

The output of calcium chloride was 23,672 t. ($510,723) in 1921 and 33,067 t. ($571,326) in 1922.

THE CHEMIST AND INDUSTRY

By H. H. GRAY, B.Sc.

It is the firm belief of the writer that the British peoples have it in their power to be second to none in the world's chemical industry. Further, he is one of the many who ardently wish the British to (legitimately) lead the way ; but, and it is a considerable but, it is not quite clear that this desirable state of affairs will come about as rapidly as it might, and in the following mixture of criticism and grumbles he would like to make it quite clear, from the outset, that any note of criticism is struck, not from a querulous carping attitude of mind, but solely with the idea of bringing into the fresh air of discussion anything which seems likely to stand in the way of victory

Thoughtful observers must have been disturbed by the dramatic departures of Messrs. Levinstein and Green from the important national organisation to which they but recently belonged. Both give the same discouraging reason, namely, that the technical policy of a technical business is not given the prominence which successful working demands. Now, whatever the merits of the two cases may be, and the writer is ignorant of these merits except for information to be gleaned from published statements, one cannot dismiss *two* such cases, *two* such severances ; one cannot dismiss these cases as the hasty actions of disgruntled chemists.

Granted that chemists are queer people (quite as queer as anybody else), it would still be an eccentric judgment which lumped Dr. Levinstein with Prof. Green as a hot-tempered, nay, impulsive, resignationist.

Even if one did, for the sake of argument, grant this point, could one apply the same description to Prof. R. Robinson, who, instead of working with a single eye to our dyeing supremacy (not dying, one hopes), is working, no doubt still harder, in the academic groves of Manchester ?

These cases are, to my mind, but further instances of the general neglect of industrialists to realise that the prime essential raw material of the chemical industry is the chemist. It is possible to run a chemical works without a chemist ; nay, it must be so, since it is done ; but it is not possible, either here or in Utopia, to compete with the Continental or American chemical industry without the services of the best obtainable chemists. Yet I maintain, without fear of successful contradiction, that practically any raw material ranks in the minds of many business and commercial men more highly than does the chemist. The whims, eccentricities, departures from the normal, properties, call them what you will, of any raw material are studied, neutralised or developed with meticulous care, but where is the disposition to make allowances for, to nurture and to foster that delicate and easily dwarfed product of nature, a brilliant technical chemist who, though brilliant, cannot quite extort his own conditions ? And there are many such.

Why is it ? Whose fault is it ? Naturally there are faults on both sides. For instance, the writer is quite clear in his own mind that the ordinary commercial man, who has so much power to-day, fails to realise the necessity for thought as well as for action. Yet it can be demonstrated that all action worthy of consideration is preceded by thought processes. It can also be demonstrated that action not preceded by efficient thinking is rather uneconomical. But when will it be realised by any but the best employers that it is neither possible nor desirable invariably to combine in the one man a reflective, fruitful turn of mind with "pep" or "push and go" ?

It is still vividly within the recollection of the writer that he attended at Burlington House a meeting addressed by Prof. Donnan (one of our prophets) on the subject of the "Chemical Engineer or the Engineering Chemist." It was an absorbing subject and an inspiring address, but the discussion, alas ! was lamentable in its flat cautiousness and its uninspiring platitudes. Only two points raised in the discussion (apart from a jingoistic reference to America) stuck in the memory of the writer. One was that an employer of labour preferred to have to deal with one man instead of two in cases of trouble, since he found that the chemist and the engineer between them shuffled out of responsibility. That is, of course, a sound argument for a chemical engineer, or else for making the engineer entirely responsible for running the works with the chemist counted out as an executive. Such an argument was comprehensible and no doubt justified by experience. But another speaker, old enough to know better, actually rose, and, with a seraphic smile, intimated that in his opinion no raw graduate of a University or College was worth more than 30s. a week in his first post for a considerable time. Now, whether the old gentleman was a graduate himself is not known to me. He might, for all I know, be one of those complacent individuals who, having privately absorbed, from printed sources, large stores of knowledge, describe themselves with unction as self-made men, forgetting in their glory that nearly all the books they read and the work they absorb can be traced to the Universities they so despise, mouthing the empty phrase "the World is my University," and the like. Is it not curious how affluent age recommends low living and high thinking for turbulent youth ? And what an unbusinesslike statement ! Contrast this myopic mental attitude with the well-known practice of firms who intend to extend when they put down the hard cash for an option on a block of land or property to be held in reserve for future extension, or intended to block a rival concern. Such a mind as that of the old gentleman can clearly grasp the value of a potential warehouse or future site, but refuses to speculate on its knowledge of human nature far enough to risk more than one bottle of champagne per week in securing the future services of that priceless thing, a trained mind. Of course, it was ineptitude exalted to a fetish that produced this gem of speech, but I am afraid many people are similarly afflicted, and value an option on a shed more highly than the services of a brain.

No wonder that Lord Haldane finds it advisable to point out repeatedly that wealth is less the creation of capital or labour than of mind. After all, only mind can transform the pence of coal tar into the sovereigns of fine chemicals. Capital can draw the dividends and labour can plume itself on its indispensability, but it is mind which performs the miracle.

Briefly, I believe that employers of labour have, in the past, lacked faith, imagination and insight in their treatment of chemists.

Now, what about the chemist ? Has he no contribution to the tale of blame, no room for improvement ? Well, it would be remarkable if that were so, and the writer believes that the time is overdue for a radical change in the training of chemists. That a good many other people think so, and have thought so for a long time, is evidenced by the founding of various departments of applied chemistry, chemical engineering, engineering chemistry, etc. But this is only dealing with the superstructure ; it is the foundations of our chemical training which have been weak in the past. However, that is a highly specialised and debatable subject better omitted here.

The writer has no wish to take sides very definitely on the question of the chemical engineer versus the rest. He does not consider that the chemical engineer will succeed in monopolising the sunny spots of the earth, nor that anybody who is not a chemical engineer will die of starvation. He is quite aware that there are volumes to be spoken on both sides of this question, which was pushed to the front by a sudden and unexpected demand being made on our national supply of chemists. Still, he does know from experience that the self-conferred title of chemical engineer has covered a multitude of sins and caused the commission of many more, and he is inclined to agree with a famous teacher of chemistry, who is reported to have said that for twenty-eight years or more he had tried unsuccessfully to teach chemistry to engineers, whereas on the other hand, chemists had acquired quite a useful knowledge of engineering. Since this statement is the fruit of experience, there must be something in it, and the writer believes that there is a fundamental difference between an engineer and a chemist, and that a really good man might fail at either subject, provided he was fitted for one and put to the other.

After all, in spite of conferences, laws, threats, systems, etc., there will always be conformists and non-conformists in the religious sphere, because the two attitudes of mind correspond with fundamentally differing mental types, and the difference between a chemist and an engineer is often quite as clearly marked.

There is no doubt that we shall get results of tremendous interest and value when the workings of the new Ramsay Memorial Chair of Chemical Engineering at University College come to be published. The relative rates of absorption of the engineer and of the chemist should provide one or two interesting diagrams when total useable knowledge comes to be plotted against time.

One really splendid way to use the new department would be for employers to extend to their technical staffs the advantages which undoubtedly accrue from adult education. I believe that results of extreme value to the firms, the individual, the industry, the nation and the Universities, would follow if employers would send selected members of their staff to some such place as this new department for a refresher course. I have no doubt at all that men so refreshed would go back to industry revitalised, full of new ideas, once more young in spirit and full of a new hope. There is hardly an active mind in industry to-day but would admit, if asked, that he often sighs for a chance to fill in gaps and strike out new paths. For the true and useful chemist is not a hewer of wood and a drawer of water by instinct ; he has an evergrowing and tremendously live subject to keep him fresh and vital if only conditions are right.

Some people profess to believe that in one and the same person an engineer and a chemist can be found or produced. Such a product they call a chemical engineer. Now, although I never really believed in my heart that the authorities of University College had such futile conceptions, I must confess to a sigh of relief when I read that the new professor was to be a chemist, and I was still further impressed when it was announced (recently) that it was the intention to appoint a second member of the staff with engineering qualifications. Here now is the ideal solution of this very thorny problem, namely, that the directing intelligence of chemical concerns should be of a chemical nature, and that the executive authority (the process of doing) should be vested in the engineer. Obviously, there is no pretension here that one and the same (young) man can be a capable research chemist and an experienced engineer. And we must all fervently hope that the future products of this department will never pretend to be at one and the same time good mechanical engineers and learned chemists.

However, this is pre-eminently a case of *solvitur ambulando*, and the writer has little doubt that the genuine chemical engineer will successfully oust that mixture of impudence and bounce which, during the war, seemed to spring out of the earth in a night, the self-styled chemical engineer. The rate of increase in "chemical engineers" during the war puzzled the writer to such an extent that he could only account for it by some new method of procreation akin to that of the aphis, where the only person concerned was the individual himself.

However, let there be no misunderstanding of the writer's point of view. Chemical engineers of the *right sort* will be invaluable in industry, but let us beware of thinking that the subject of chemical engineering is a panacea for all our ills. On the contrary, it is even likely to be dangerous, since, if it threatens the prosperity of the genuine and unadorned chemical department, a good deal of harm will be done. After all, analytical and research chemists will always be required in industry, and they may be described as "academic" by certain folk, but if they are crushed out of existence there will be a heavy reckoning to pay some day.

Hit and miss works' investigations under the supervision of the plant man and under actual working conditions, however valuable they may be, will never replace systematic research work carried out in the laboratory, and if industrialists of this country fail ultimately to appreciate and *foster* real research work, they will either go bankrupt or acquire another country's results at a very high price. Those are the alternatives.

If we could only get rid of the "non-productive" theory of the accountant, of the state of mind which refuses to believe that any man can be "working" if he is caught in a thinking posture, or that knowledge is production, what a difference there would be in our industrial intelligence departments! And on the other hand, what a poor milk-supply there will be when the "speed-merchants" limit excessive time devoted by our national cows to rumination!

Finally, let me quote the remark of Prof. E. H. Starling, in a recent number of *Nature*, where he says so truly that "in Science it is the question that matters; the solution can always be found." The writer believes that that is true of industry, even in repetition work, but most certainly in the ever-changing chemical industry, because from the point of view of the chemist there is really very little difference between real science and ideal industry. All this apprehensive and dreadful anxiety about costs, about which a chemist is alleged to know nothing, is seen to be beside the point, when it is once realised that the most scientific, the least complex, and the most beautiful plant is nearly always the cheapest to instal, and the most economical to run, and that this is precisely the type of plant that experience in research will provide.*

* These notes were written before the publication of Professor Donnan's plea for a rational education of scientists as opposed to the intensive training of disproportioned specialists.—H. H. G.

A CRITICAL EXAMINATION OF BERTHELOT'S WORK UPON ARABIC CHEMISTRY

By **E. J. HOLMYARD**

Part I

The notable interest in the work of mediæval Muhammadan chemists which has arisen in the last few years probably has its origin in a fuller appreciation of the fact that the numerous puzzling problems presented by European chemistry of the early middle ages cannot be solved until a thorough investigation has been made of the rise and development of chemistry in Islam, whence it was imported to Christendom during a long period beginning in the first half of the twelfth century.

Two of the earliest historians of chemistry to realise the importance of this study were Berthelot and Prof. Eilhard Wiedemann. Whilst the scholarly researches of the latter have been comparatively neglected in this country until recently—probably because they were generally published in somewhat obscure local German periodicals—Berthelot's monumental work in three volumes (*La Chimie au Moyen Age*, Paris, 1893) at once attracted attention, and has been used—for the most part quite uncritically—by all later writers. It seems, therefore, of fundamental importance that we should arrive at a clear knowledge of the length to which Berthelot may be safely followed, of the accuracy of his conclusions and of the relation which the ground he covered bears to the whole field.

There can be no doubt, to my mind, that Berthelot's work is deserving of the most generous praise. All those who since his time have studied Islamic chemistry owe him a great debt, acknowledged or unacknowledged, and von Lippmann's section on the subject, in his invaluable *Entstehung und Ausbreitung der Alchemie*, is based principally upon *La Chimie au Moyen Age*. That remarkable genius, Moritz Steinschneider, expresses his opinion of Berthelot's researches in the following words[1]: "Mit dem grossartigen Werke von Berthelot, *La Chimie au Moyen Age* (1893), dessen 3 Band die arabische Chemie, bez. Alchemie, behandelt und einige der ältesten arabischen Schriften mit französischer Uebersetzung von O. Houdas enthält, mögen Physiker, die sich für Geschichte ihrer Wissenschaft interessieren, den Gegenstand für erschöpft halten; ja auch diejenigen, welche die Kulturgeschichte der Araber und deren Bedeutung für die Geschichte des Mittelalters nicht unterschätzen, dürften die Resultate Berthelots als für ihren Zweck ausreichend ansehen und ohne weitere Forschungen verwerten."

Coming from such an eminent authority, this praise is high indeed, and although—however diffidently—we may protest against an Arabist expressing such a dogmatic opinion on what is primarily a matter for chemists to decide, it comes as somewhat of a shock to find that Prof. von Lippmann[2] passes extraordinarily severe strictures upon "Berthelot als Historiker." von Lippmann, of course, wrote his book during the late war, when feeling ran high, and would possibly have employed less scathing terms under normal circumstances; but the fact remains that Berthelot's reliability has been seriously impugned, and until the matter is satisfactorily cleared up no historian of chemistry can feel safe in accepting, or rejecting, Berthelot's conclusions. It is in the hope of throwing a little light upon this obscure situation that the present articles have been written. It will be convenient to arrange the discussion under three heads—(1) Berthelot's qualifications for his task; (2) his choice of material; (3) his treatment of the material chosen, and his conclusions.

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[1] Z. D. M. G., 58, 299 (1904).

(1) BERTHELOT'S QUALIFICATIONS FOR HIS TASK

It will, I think, be generally agreed that the historian of chemistry must primarily be a chemist, for otherwise he is fatally handicapped from the start. No one can dispute Berthelot's possession of this essential qualification. Secondly, it does not appear unreasonable to insist that a man who sets out to make *original* investigation of a hitherto unexplored region in the history of a science should have an adequate knowledge of the language and literature of the men whose works he proposes to study. Berthelot, however, as is well known, had not even a bowing acquaintance with Arabic, and was therefore forced to rely upon translations. These translations were made for him by Prof. O. Houdas, an excellent Arabic scholar famed especially for his translation of Bukhari's "Traditions of the Prophet." It would seem, at first sight, as though this solution of the difficulty was comparatively satisfactory, but further consideration will show us (*a*) that, even for the actual work of translation, some knowledge of chemistry is essential, and this Houdas did not possess, and (*b*) that to translate a technical work from any language presupposes in the translator an adequate understanding of the technical terms and phrases employed, and an acquaintance with cognate works in the same and other languages. This second point is of especial importance in a subject so obscure as alchemy and in a language of so rich a vocabulary as Arabic. I believe I am correct in saying that Prof. Houdas had no special knowledge of Arabic chemical treatises, and that he undertook the work of translation only at the special request of Berthelot, backed by the *Ministère de l'Instruction Publique.* My opinion, which I have less hesitation in setting down here in that it is supported by two eminent Arabists, namely, Prof. E. G. Browne and Monsieur E. Blochet, is that properly to understand an Arabic work on chemistry requires both intensive and extensive concentration, and that even the best Arabic scholar would not produce a satisfactory translation of such a work unless he was familiar with many others of the same *genre.* I may, perhaps, quote Prof. Browne's own words, taken from his admirable book on *Arabian Medicine*[3]: "I have been greatly hampered in my reading of Arabic medical books by the difficulty of determining the exact scientific signification of many words used in the ordinary literary language in a looser and less precise sense than that which they evidently bear in the technical works in question. Nor is much help to be derived from the mediæval translations of the "Latino-Barbari," who too often simply preserve in a distorted form the Arabic term which they pretend to translate." If one of the greatest living Arabists, himself a qualified physician, feels this difficulty in dealing with medical works, at what sort of disadvantage must an Arabist of purely literary training find himself when confronted with texts dealing with alchemy, a subject far more involved than medicine? Prof. Blochet remarks[4], "le sujet est extrêmement obscur et la traduction de M. Houdas souvent insuffisante."

In spite of the difficulties with which he had thus to contend, Prof. Houdas in point of fact made translations which under the circumstances must be regarded as extremely good, and they certainly are worthy of his scholarship. At the same time they often fail, as might be expected, in those very places in which accuracy is essential, namely, the technical words and phrases. To take a case in point: one of Jābir ibn Hayyān's books is entitled *Kitāb Abī Qalamūn.* Houdas translates[5] this as "un livre à Qalamoc," by reading *ilā* instead of *abī*, which is in itself an immaterial mistake; but he obviously was not aware of the fact that *Abu Qalamūn* was commonly employed by chemists as a name for the jasper, the correct translation of the title thus being "The Book on the Jasper." Similar mistakes are numerous; thus he treats the word *ustuqus* as a proper noun[6] and leaves it untranslated, whereas anyone acquainted with Jābir's writings knows that *ustuqus* signifies "the four elements" of Aristotelian philosophy; and in the same place he misreads *ās* (myrtle) for *'uss* (base or foundation), thus rendering his translation not merely unintelligible but ridiculous.

Houdas' translation thus inevitably suffers from his lack of technical knowledge, so that, even if this were all, we should be compelled to admit that Berthelot was beginning his work upon a doubtful basis. But when we read[7]

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[2] *Op. cit.*, pp. 647-659.

[3] Camb. Univ. Press, 1921, p. 3.

[4] Private communication to the author.

[5] *La Chimie au Moyen Age*, iii, 33.

[6] *Op. cit.*, pp. 32, 33 ("Estaqès").

[7] *Op. cit.*, p. 6.

Berthelot's statement, "*j'ai revisé avec soin cette traduction littérale*[8], de façon à tâcher de lui donner un sens intelligible, autant que le comporte ce genre de littérature," and remember that he knew no word of Arabic, we cannot deny that he is wilfully breaking one of the first canons of literary criticism and laying himself open to grave censure. It is, indeed, difficult to see what justification a man could possibly have for believing himself capable of revising a professedly literal translation from a language of which he was admittedly completely ignorant. Especially is this true in the case of a work which was the first of its kind to be translated into a modern European language, and of which the very atmosphere was strange.

There is, however, no need for us to make the uncharitable assumption of Prof. von Lippman,[9] and ascribe this lapse from sound scholarship to Berthelot's egoism and conceit. It is much more likely that he was inspired by an earnest desire to throw as much light as possible upon the subject, and succumbed to the fatal temptation of trying to *make* sense instead of adopting the more toilsome but only sure path of finding out *the* sense by a comparative study of the whole field, or of at least a much wider portion of it.

We have seen, therefore, that Berthelot's whole work on Arabic chemistry rests upon an insecure foundation, since—to use the words of Prof. Ruska—the translations of the Arabic texts upon which he relied suffer from "zahllosen Ungenauigkeiten und durch vorgefasste Meinungen bedingten, irrtümlichen Auslegungen." There are, however, some factors which tell in the opposite direction, and these must now be considered. It has long been known (*a*) that chemistry was introduced into Islam chiefly from the Greek school at Alexandria, and (*b*) that mediæval European chemistry was a direct legacy of Islam. If, therefore, a man were thoroughly cognisant of both the source and the fruit of Muhammadan chemistry he would have a very valuable qualification for dealing with the latter itself. So far as I am aware, no one has disputed Berthelot's comprehensive knowledge of European chemistry of the middle ages, and we need have no hesitation in saying that the disadvantage under which he lay from having to rely on translations was thus partially neutralised. Partially only, however; for on the one hand he could not be in a position to throw any light on those problems which had their origin in Islam and were often transported bodily and unintelligently into the Latin world, and on the other lay the pitfall of reading into the Arabic works meanings and conceptions which were, in fact, of spontaneous and later European birth. Berthelot has, indeed, not been successful in avoiding either of these dangers; on the contrary, he has often failed, in addition, to realise that numerous facts and theories which he believed to be definitely European are to be found in the writings of Muhammadan chemistry. In not a few cases the errors which he thus almost inevitably made are of capital importance.

In the other direction we have to gauge the extent of his knowledge of Greek alchemy. In 1888 he published his *Collection des Anciens Alchimistes Grecs*, in which for the first time texts of the writings of these authors were made available. Of the worth of this collection I am not in a position to judge, but it is to be noted that, as in the case of the Arabic works, the translation was not made by Berthelot himself, but by Prof. Ruelle, and that the latter's version was subjected to the same treatment by Berthelot as was undergone by that of Prof. Houdas. One therefore has the uneasy feeling that, here also, one may be on uncertain ground, and although Prof. Gaster has expressed a high opinion of the work, other scholars have not been slow to pass very unfavourable judgments upon it. I think we may, however, be fairly safe in assuming that Berthelot had a pretty good general idea of Greek alchemy, and may therefore admit that he was in a position to recognise Greek ideas and influence in Islamic chemistry, though perhaps in matters of detail he was liable to go astray.

To summarise the points made in this section before proceeding to a discussion of Berthelot's choice of material, it may be said :—

(*a*) Berthelot possessed the first essential of a historian of chemistry in that he was a chemist.

(*b*) He had, however, no knowledge of Arabic and was compelled to fall back upon translations.

(*c*) These translations are untrustworthy and inaccurate from a technical point of view—which, in this case, is the vital one.

(*d*) They are further vitiated by the fact that Berthelot subjected them to a "revision" which, from the very nature of things, was bound to be uncritical, in order "to make sense."

(*e*) He had an adequate knowledge of mediæval European chemistry, which would help him to understand much of the Arabic work but which would leave him helpless in those very points where help was most needed.

(*f*) He often ascribed to Europe knowledge which came from Islam.

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[8] Italics mine.—E. J. H.

[9] *Op. cit.*, p. 648. "Dieser grosse Mann besass eben auch grosse Schwächen und zu ihnen zählte vor allem eine übermässige Eitelkeit; sein Leitmotiv auf allen Gebieten, die er bearbeitete, war daher der Satz, den der einstige Schüler im zweiten Teile des 'Faust' mit den Worten ausspricht: 'Die Welt, sie war nicht, eh' ich sie erschuf."

(*g*) He had a better knowledge of Greek alchemy than anyone else, and was therefore able to appreciate Greek influence on Muhammadan chemical thought. But his ideas and scholarship as expressed in the *Collection des Anciens Alchimistes Grecs* have since been severely criticised by those qualified to judge.

(*h*) Finally, one may add that Berthelot possessed an inveterate habit of sweeping away as " incomprehensible " anything which he could not himself understand.

Perhaps I may be allowed to give my own experience, for what it is worth. Starting with an implicit faith in Berthelot—naïve perhaps, but natural at the sight of his imposing volumes, which give one the impression of finality—I have been gradually led to a profound and progressive distrust, until at the present moment I feel that it is quite unsafe to accept any of his conclusions without first referring to the original sources or without strong collateral evidence. This, of course, does not imply that all are wrong ; many are accurate, many others require only slight modification, and *La Chimie au Moyen Age* contains a vast amount of material of the greatest value ; but the whole is marred by the circumstance that every fact has to be checked, every statement verified, every identification investigated and every translated phrase compared with its original. It is only natural that historians of chemistry, who have for the most part accepted Berthelot's work as authoritative, should have drawn thence both the true and the false, and that thus there have crept into the literature errors which will probably prove extremely difficult to eradicate. Even the late Prof. Campbell Brown, whose excellent *History of Chemistry* has acquired a well-deserved reputation for insight and accuracy, relied entirely upon Berthelot for his account of oriental chemistry, with the result that his pages are disfigured by gross inaccuracies, ludicrous transliterations and seriously incorrect conclusions.

(II) BERTHELOT'S CHOICE OF MATERIAL

About 300—400 different Arabic treatises on chemistry are known, and it is probable that a great many more exist in private libraries in Muhammadan countries. The *Bibliothèque Nationale* contains some 30 distinct MSS., and there are several of importance in the library at Leyden. The richest European libraries in this connexion are, however, the British Museum and the National Library at Berlin. The Royal Library at Cairo contains a large number of alchemical MSS., and I have been told that the King of the Hijaz possesses a fine collection, although I cannot vouch for the accuracy of this statement.

The works vary considerably in both age and importance. The majority range from the eighth century to the fourteenth, though the MSS. themselves are in general much more modern. It is rare to find a MS. older than the fourteenth or fifteenth century, but this is a common feature in Islamic literature and there is good reason to suppose that, in the main, the writings have been accurately transmitted. This does not imply, of course, that instances of pseudepigraphy are rare ; what is meant is that, once a work was written, it was usually carefully copied, so that, although—for example—the earliest extant MS. of an eighth century book may be of the thirteenth century, we may with some confidence assume that it has not undergone serious change in the process of transmission.[10]

The problem which Berthelot wished to solve was two-fold : in the first place he desired to find the relation which existed between the alchemy of the Greeks and that of the early Muslims, and secondly he was anxious to discover whether certain of the Latin works of the early Middle Ages were really, as they professed to be, translations from the Arabic. He also incidentally wished to find whether the Arabic works of Jābir ibn Hayyān showed any resemblance to those of the Latin Geber. It is clear, therefore, that he intended to limit himself to a study of the earliest and latest periods in history of chemistry in Islam, and this is in fact exactly what he did, neglecting entirely the intervening period of three or four centuries. This limitation must be borne in mind when we come to criticise his choice of material, and it is necessary to point out that those historians of chemistry who have assumed that Berthelot investigated the whole period and gave merely the most important and interesting works in his book, have made a grave error for which the only excuse is that Berthelot himself is liable to give one that impression.

Berthelot's immediate objective, then, was (*a*) to have recourse " aux ouvrages arabes eux-mêmes et de les comparer avec les textes latins, réputés traduits d'après des œuvres congénères "[11]; and (*b*) to have translated from the Arabic those treatises or compilations " où il est particulièrement question des alchimistes grecs, et, de l'autre parte, les ouvrages qui portent le nom de [Jābir ibn Hayyān]. "

With regard to (*a*), we find that Berthelot did not succeed in discovering, or at least did not use, any work that is known in both Arabic original and Latin translation. It is true that up to the present very few of such works have been found, but one at least he had at his disposal in the *Liber Secretorum Bubacaris* (Paris MS. 6514, pp. 101-112), of which the Arabic text occurs in the two MSS., one at Leipzig and a second at Göttingen. He gives a summary of the Latin version at pp. 306-310 of volume 1 of *La Chimie au Moyen Age*, and recognises that it is undoubtedly an Arabic work. It is, therefore, strange to find that he omits to give the Arabic text, as he had here ready to hand an excellent piece of material for aiding him to arrive at a definite conclusion on one of the questions under consideration. If the reason for this omission is that he was unaware of the existence of the Arabic MSS., he cannot be acquitted of the charge of negligence, for the Leipzig MS. is very fully described in the catalogue of the City Library published in 1838. If, on the other hand, he knew of the Arabic version (which seems improbable), but considered it unimportant, he showed a serious lack of judgment, for this work of "Bubachar" (*i.e.*, Abu Bakr Muhammad ibn Zakariyya al-Razi, or Rhazes) is, as Prof. Ruska has pointed out, of the greatest value as a compendium of the practical chemical knowledge of Islam in the tenth century.

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[10] Needless to say, the necessity of a critical study of the internal evidence, etc., is not by any means precluded.

[11] *Chim. au M. Age*, iii. 6.

Of other Latin works which Berthelot considered to be, in all probability, translations from the Arabic, he was unable to find originals, and therefore was not in a position to arrive at trustworthy conclusions concerning them. We may therefore, I think, fairly say that as far as regards point (*a*), Berthelot left the matter in practically the same state as that in which he found it, and that the whole problem is still to be solved. It is for this reason that the appearance of Prof. Ruska's promised edition of the Leipzig and Göttingen MSS. of the above work is eagerly awaited.

To turn now to point (*b*). Berthelot gives the texts of the following works which bear unmistakable signs of Greek influence: "un livre attribué à Ostanes; un extrait du ms. 1074 (Bibl. Nat.) renfermant une série de citations des alchimistes grecs; le livre de Cratès; et le livre de El-Habîb." Of these, the last two are taken from the Leyden MS. 440, which Prof. Houdas was inclined to think "n'a pu être écrit postérieurement au VII^e siècle de l'hégire et date même plutôt du VI^e siècle," whilst the first is in the Bibl. Nat. MS. *Arabe* 2605, written partly in the year 1337 A.D. (738 of the Muhammadan era).

Of these it is sufficient here to say that the choice, though small, is quite sufficient for the purpose and on the whole satisfactory; the inclusion of the works by "Ostanes" is perhaps unfortunate, as the Ostanes question is almost as puzzling as that of Hermes himself, and at once introduces many side issues of a mystical and theosophical nature, thus further complicating a problem which is already quite difficult enough. Still, the works which Berthelot chose enabled him to prove conclusively what had before been a matter of conjecture (although there was not in reality much doubt about it), namely, that Arabic chemistry is very largely derived from neo-hellenic sources—as is, indeed, definitely stated by the Muslims themselves. Berthelot's work here, however, is of value not merely in that it proved this transmission but because it showed also the nature and extent of the ideas that were transmitted, the names that were honoured and some of the theories that were generally accepted. If the treatises of Ostanes and the others are to be taken as typical of the Greek alchemy which was the seed of chemistry in Islam, we can gain a good idea of the progress that was made by the Muslims, for as Berthelot remarks, "il y a peu de chose sans doute à tirer de [the books ascribed to Ostanes] pour la chimie positive."[12] The only criticism which need be made of Berthelot's choice in this connexion is that as Khālid ibn Yazīd is unanimously described as the first Muslim who had translations of Greek alchemical works made, and studied the subject himself with ardour, it would seem that an investigation of his writings might have afforded more definite information than do the works of the anonymous or mythical authors such as Crates and Ostanes. Much of Khālid's chemical verse is easily available, and I believe that his complete (?) *Dīwān* is preserved at Constantinople.

It is, perhaps, in his treatment of Jābir ibn Hayyān that Berthelot most signally failed. A proper appreciation of the work of a man who wrote some 500 books cannot be gained by a study of only nine, and these not the most important. I do not propose in this place to offer any comment on the vexed question of the possible identity of Jābir with Geber, but will confine myself to pointing out that some 80 works of Jābir are still extant, whole or fragmentary, and that a study of them enables one to see clearly the reasons which led later chemists to regard their author with an extraordinary reverence. The choice of Jābir's works made by Berthelot is entirely misleading and inadequate. The extent of his knowledge was amazing, and to regard him as a bombastic obscurantist, as Berthelot does, is to do him a grave injustice. I hope to show later the remarkable scientific knowledge he possessed, but meanwhile I may perhaps refer to a bibliography I have made of his extant works, now in the press,[13] where those who are interested may gain some idea of the negligible relation which exists between the works published by Berthelot and those which were available for his study if he had cared to make a search.

To sum up :—

(1) Berthelot made no attempt to study the whole field of Arabic chemistry—an important fact which has, as a rule, not been observed by historians.

(2) He neglected entirely the development of chemistry in Islam in its most flourishing period.

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[12] *Ibid.*, p. 15.

[13] *Proc. Roy. Soc. Medicine*, October, 1923.

(3) He confined his attention to three points, (*a*) Arabic originals of Latin works, (*b*) Greek influence, and (*c*) the works of Jābir and their relation to the Latin works of Geber.

(4) As regards (*a*), he made scarcely any addition to our knowledge. As regards (*b*), his choice of material was sufficient and he proved his point, although he did not exhaust the subject and his material might have been better chosen. As regards (*c*), he proved that the Latin works could not have been translated *from the Arabic works he published*, but he did not (α) prove that the Latin works were not based on Arabic originals, nor (β) did he give an adequate account of Jābir's knowledge, choosing only nine works out of some 80 available.

In the second article I shall deal with Berthelot's treatment of his material and with his conclusions, but meanwhile it has been made clear (1) that, as far as Arabic chemistry is concerned, he is not a safe guide, (2) that he touched only the fringes of the subject, (3) that his choice of material was extremely inadequate, and (4) that in the case of the one chemist of whom he made a professedly detailed study he gave a very inaccurate picture based upon a negligible fraction of the data which are available. This is a serious indictment, but I believe it to be made with justice and to be based, as I have tried to show, upon irrefragable evidence.

(*To be continued.*)

FORTHCOMING EVENTS

Oct. 10. UNIVERSITY OF LONDON, University College, Gower Street, W.C., at 5 p.m. "The Heating Equipment of a Small House." By A. H. Barker.

Oct. 12. INSTITUTE OF BREWING. Joint Dinner of the Gloucestershire Brewers' Association and the London and Midland Counties' Section of the Institute at the Royal Hotel, Bristol, at 7 p.m. Meeting at 8 p.m. (1) "The Quick-Chilling Process," by A. Hadley. (2) "The Slow-Chilling Process—Maturation and Chilling in Tanks," by P. K. Le May. (3) "The Slow-Chilling Process—Maturation and Chilling in Cask," by H. Abbot, M.A.

Oct. 12. INSTITUTE OF METALS, Sheffield Section, The Non-Ferrous Lecture Room, Sheffield University, St. George's Square, at 7.30 p.m. "Electric Resistance Furnaces," by A. G. Lobley, M.Sc.

Oct. 12. SOCIETY OF CHEMICAL INDUSTRY, South Wales Section, Technical College, Cathays Park, at 7.30 p.m. Discussion on the "Smoke Problem," to be opened by H. J. Bailey, O.B.E.

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS,

October 31, 1923

This dinner is being held under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry at the Hotel Victoria, Northumberland Avenue, London, W.C. 2, on October 31, at 7 for 7.30 p.m.

The details are being arranged by a committee consisting of representatives of the three societies mentioned above and one or two other societies. The price of the tickets for ladies or gentlemen is 12s. 6d. each, not including wine.

Sir William Pope, K.B.E., F.R.S., will take the chair. There will be some speeches and some music; it is thought that both these will be of interest, and that there will be in addition opportunities for informal talk.

No similar dinner for chemists has hitherto been organised on exactly these lines, and it is expected that such a gathering will be not only very pleasant, but will be useful in promoting that social acquaintance which is so valuable in connexion with prevailing ideas and hopes. Members of any of the societies concerned are invited to attend and to bring guests.

Applications for tickets should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C.2.

SOUTH WALES SECTION

The following are the arrangements for the coming Session, 1923-24:—On October 12, 1923, discussion on the "Smoke Problem," to be opened by H. J. Bailey, O.B.E.; Thursday, November 8, dinner and address by Dr. E. F. Armstrong on "The New Chemistry"; December 7, a paper on "Coke Ovens," by T. G. Watts, B.Sc.; January 11, 1924, kinematograph exhibition and paper on "Cocoa," by H. W. Bywaters, D.Sc.; February 8, discussion on the "Action of Acids on Metals," to be opened by H. W. Webb, M.Sc.; March 7, paper on "Metal Colouring," by E. A. Rudge, B.Sc. These meetings will be held at Cardiff in the Technical College, Cathays Park, at 7.30 p.m. The following meetings will be held at Swansea in the Technical College, Mount Pleasant, at 7.15 p.m.:—October 19, 1923, Joint meeting with South Wales Section of the Institute of Chemistry; discussion on "Short Cuts in Analysis." November 16, 1923, Paper by E. A. Tyler, M.A.; January 18, 1924, Papers will be read (1) "Routine Work in an Oil Refinery Laboratory," by T. D. Ambrose, B.Sc., (2) "Estimation of Sulphur in Petroleum," by Dr. H. B. Thompson; February 15, Paper by Messrs. L. Taverner and H. J. Williams; March 14, Joint Discussion with the Faraday

Society on "Slags and Fluxes in Melting and Refining," with reference to the problems of slag inclusions; March 28, Annual Meeting, address by the chairman, Capt. H. Vivian.

BIRMINGHAM AND MIDLAND SECTION

There was a very large attendance of industrial chemists and gas engineers at the joint meeting held with the Midland Junior Gas Association, on September 25, at the Conference Room of the National Gas Exhibition, then being held at Bingley Hall, Birmingham. Dr. E. B. Maxted presided.

Mr. G. Coles, B.Sc., of the Mining Research Laboratory, read a paper on "The Specific Heat of Coal and Relation to its Composition," in which he gave the specific heats of various British coals, in the dried and undried condition, and classified them according to the different types of coal investigated. It was concluded that the specific heats of coal generally lay between the values 0·2 and 0·4, according to the water content of the coal. The nature and general composition of the coal also influenced the value of the specific heat, and, when the latter was reduced to an ash-free dry basis, coals of the same class possessed values of the same order for their specific heat. Anthracites and fusains agreed fairly well with Kopp's law, but bituminous coals diverged from this by about 11 per cent.

A new gas combustion-furnace was described by J. Hedley, who pointed out that existing types of furnaces represented little or no advance in design or efficiency over those in use over half a century ago, and were usually expensive, heavy and very wasteful. The new furnace was readily portable by one person, cost considerably less than any other furnace, was economical of gas, and could be operated with precision and comfort. The essential features were a multiple flame burner with separate control of each flame, gas being admitted at each end of the burner (which was partitioned at the centre) by a series of jet holes, the number in use being controlled by a screw plunger. The burner was self-regulating, the air intake by induced draught being governed by the number of jets in use; by this means any type of flame could be obtained for any number of flames, the number of flame orifices open being varied from the front underneath the burner by simple heat-screened thumb-screw valves. Adequate provision was made for the protection of the operator, the bench and the bungs of the combustion tube, by suitable hinged and fixed refractory screens.

A third paper, entitled "A New Automatic Pressure and Temperature Corrector for Gas Volumes," was contributed by Mr. C. H. Beasley. The design of the Beasley Recorder manufactured by Messrs. Parkinson and W. & B. Cowan had been improved, particularly in the device for measuring gas. The meter water line was now kept to a constant level by a small storage tank holding enough water to keep the meter correctly lined for several days without attention, and a constant drip of water was supplied from the storage tank to the meter slightly in excess to that required to meet losses by evaporation and conditions of saturation of the gas passing. The gas control to the instrument was effected by a pendulum-controlled clock escapement to the meter drum, by which the volume passed was kept constant irrespective of temperature, barometric pressure or density changes. By means of a flat steel "brake" spring, the pendulum rate of oscillation could be automatically varied in direct proportion to the alteration of volume of the gas passing through the meter owing to temperature and pressure conditions. This mechanism was practically frictionless, the brake spring being carried at the end of an arm of a lever operated by a set of fluxing diaphragms, forming part of a vessel containing a locked amount of air in the presence of water. The vessel itself and also the diaphragms were in contact with the gas stream and took up the same temperature. The diaphragms and lever thus moved in accordance with changes of pressure in the air vessel or external atmospheric pressure changes. The volume of the air chamber being large in proportion to that of the fluxing capsules, the movements obtained by changes of pressure were closely proportioned to the magnitude of these changes so that the brake spring moved distances proportional to the pressure changes.

The stud at the end of the brake spring came in contact with the sides of a taper slot made in a thin metal plate, forming the upper part of the pendulum rod. The slot was a section of the arc of oscillation, and the end of the brake spring moved vertically up and down the slot, its position being determined by the movements of the capsules expanding or contracting with changes of volume of the trapped air and water vapour in the air vessel. Whatever part of the slot the spring was in the extent to which it was bent remained the same; consequently its opposing force was constant in amount, and by applying this opposing force the pendulum rates were proportional to the distances the brake moved to and from a given position. This given position was the zero, the point in the slot where the brake spring rested when temperature and pressure were normal. If the brake moved below this point, the pendulum rate was increased; if it went above this point, the rate was retarded by amounts proportional to the pressure and temperature changes.

For convenience of checking the position of the brake from its zero position a scale graduated in percentage of increase and decrease was fixed to the front of the meter, and the position of the index showed the amount to apply to the rate to get normal conditions.

CORRESPONDENCE

"THE DETERGENT ACTION OF SOAP"

Sir,—The results obtained by Prof. McBain and his colleagues on the "Detergent Action of Soap," published in the *Journal* recently, are of great interest, but there is no evidence in the paper that the materials used were pure, and if this was not ascertained the results will be doubtful to that extent.

It is mentioned that "Kaulbaum's Pure" materials were used, but recently I had occasion to use some pure oleic acid and obtained some of Kaulbaum's, which was far from pure (although charged at a high price) and useless for our purpose. A replacement was of similar inferior quality.

It would be interesting to know if the materials used by Prof. McBain were fully examined for purity before using.—I am, Sir, etc.,

London, "Raybell"
Sept. 22, 1923

THE FINISH OF CHEMICAL GLASSWARE

Sir,—In reference to a letter under the above heading in your issue of September 21, it may interest some of your readers to know that glass apparatus can be easily and rapidly ground down by hand on any suitable stone if only a solution of camphor in turpentine be used as a lubricant. Glass tubing, such as is used for bomb furnace work, can be cleanly cut through by pressing a sharp, triangular file, well lubricated with the camphor solution, against the tube and rotating the latter by hand. When the tube has been cut through at one point it readily breaks across the line of the groove.—I am, Sir, etc.,

H. V. Thompson
Chemistry Dept., Central School of Science
and Technology, Stoke-on-Trent
Sept. 25, 1923

THE ORIGIN OF SYMBOLS

Sir,—Your correspondents whose letters referring to the use and origin of symbols appeared in your issues of September 7 and 28, will probably find matter of considerable interest if they refer to the *Transactions* of the Chemical Society, 1923, pp. 939-946.

The reference quoted is to the Presidential Address of Sir James Walker, whose subject was "Symbols and Formulæ," and who traced the beginnings of the present system of elementary symbols back to the latter end of the eighteenth century. Should your correspondents wish to investigate the matter still further backward, they might consult a book entitled "Die Geheimsymbole der Chemie und Medizin des Mittelalters," published in 1900. A copy of this work is in the Library of the Chemical Society and may be borrowed under the usual regulations.—I am, Sir, etc.,

Chemical Society, F. W. Clifford
Burlington House, W.1.
September 29, 1923

PERSONALIA

At the meeting of the American Chemical Society in Milwaukee, the Priestley Medal was bestowed upon Prof. Ira Remsen, in recognition of his outstanding achievements in chemistry.

Recent promotions in the Legion of Honour are as follows: Monsieur Calmette (assistant director of the Institut Pasteur) to Grand Officier; Messieurs M. Borrel (Institute of Hygiene, Strasburg), Gayon (University of Bordeaux), L. Martin (Institut Pasteur), René Vallery Radot (son-in-law of Pasteur), to Commanders; and Messieurs Fernbach, Fourneau, Mesnil, and Marie (Institut Pasteur), to Officers. Monsieur Duclaux (Institut Pasteur) has been appointed Chevalier. These awards have been made to commemorate the centenary of Pasteur.

Dr. Edgar F. Smith, provost-emeritus of the University of Pennsylvania and past-president of the American Chemical Society, has been made an Officer of the Legion of Honour of France.

Prof. F. Gowland Hopkins is retiring from the Medical Research Council under the provisions of the Royal Charter governing the rotation of membership. The vacancy will be filled by Sir A. Garrod, professor of medicine at Oxford.

* * *

We regret to announce the death of Prof. H. McLeod, F.R.S., aged 82. After working under Hofmann and Frankland at the School of Mines, he held the chair of chemistry at Cooper's Hill for 30 years, and was president of Section B (chemistry) of the British Association in Edinburgh in 1892. He undertook the great labour of editing the Catalogue of Scientific Papers published by the Royal Society.

From Germany the deaths are announced of Prof. P. Friedländer, privat-dozent for organic chemistry and technical organic technology in the Technical Hochschule at Darmstadt, who was well known for his investigations on the chemistry of dyestuffs and for his work "Fortschritte der Teerfarbenfabrikation," in twelve volumes; of Dr. T. Kempi, formerly a director of the Chemischen Fabrik auf Aktien vorm. E. Schering, and a pupil of Landolt and Kolbe; of Prof. A. Stutzer, formerly professor of agricultural chemistry in the University of Konigsberg, who had carried out extensive researches on nitrifying and denitrifying bacteria, soil organisms, and sulphite-cellulose lyes; of K. Heidenreich, director of the Deutschen Verein von Gas- und Wasserfachmännern; of E. G. v. Höveling, founder of the Hamburg Schiffsbodenfarbenfabrik; of Dr. F. Evers; of Prof. B. Rathke, formerly hon. professor of chemistry in the University of Marburg; and of Prof. H. Geitel, who had devoted much time to work on radium.

NEWS AND NOTES

UNITED STATES

A New Ethylating Agent

For some time past the Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa., in connexion with the work of the Multiple Industrial Fellowship, sustained by the Carbide and Carbon Chemicals Corporation of New York, has been making a thorough investigation of the properties and uses of diethyl sulphate as a general ethylating agent. Mr. A. R. Cade, an Industrial Fellow of the Institute, under whom the greater part of the work on this subject has been carried out, has published recently in *Chemical and Metallurgical Engineering* a report on the investigation, which shows diethyl sulphate to be a most satisfactory general reagent for introducing ethyl groups into organic compounds. The Mellon Institute will be pleased to furnish samples of this material to anyone interested, and Mr. Cade will correspond gladly with anyone who desires further information upon this subject. Reprints of the article referred to above may be obtained by writing to Mr. Cade at the Institute.

Bauxite and Aluminium in 1921

Bauxite.—The quantity of this mineral marketed in the United States in 1921 was 889,800 long tons, a decline of 73 per cent. from that of 1920 and about one-fifth of the peak production of 1918. This decrease is due to the bauxite miners of the United States being compelled to curtail their operations in 1921 owing to the stagnation in the industries that use bauxite as a raw material; but it was reported that late in 1921 there was some revival of business, and that the bauxite mines were being put in shape for larger operations. A total of 91,700 t. of bauxite was used for making aluminium, 41,000 t. for chemicals and 6850 t. for abrasives. Imports amounted to 27,587 t., exports were 5942 t., and the apparent domestic consumption was 161,195 t.

The world's output of bauxite in 1921 was :—United States 141,790 metric tons, France 84,942 t. (unofficial), and Italy 49,100 t. (including Istria). The figures for the United Kingdom are not yet available.

Aluminium.—The production of aluminium in the United States in 1921 was valued at \$14,681,400, the imports at \$8,889,791, and the exports at \$3,108,857. The apparent consumption was \$20,462,300, a decrease of over 37 million dollars. It was not found necessary to change the domestic plants, except to limit the output, which was done. It is reported that the Aluminium Co. of America has plans for a new development of power near Long Sault Rapids, New York. Apparently no changes in the status of the British aluminium industry took place during 1921, except the formation of a mining company to develop deposits in British Guiana.

Aluminium Salts.—The production of aluminium chemicals decreased in 1921, as compared with 1920, though the decrease was not so great as in some of the products made from bauxite. The quantity of aluminium chemicals made and sold during 1921 was 184,820 short tons, valued at \$7,546,000 ; chloride, made at five plants, amounted to 5650 t., and sulphate, made at 19 plants, amounted to 154,920 t. ; 3060 t. of commercial aluminium sulphate was made at municipal waterworks in 1921.

GENERAL

Metal Statistics, 1919–1921

Following the series of pamphlets on the sources, production and consumption of metals and non-metallic minerals, the Imperial Mineral Resources Bureau has now issued through H.M. Stationery Office further publications, wholly statistical, dealing with the following metals during the period 1919-1921 : *Copper* (70 pp., price 3s. net), *Zinc* (60 pp., price 2s.), *Lead* (56 pp., 2s.), *Silver* (38 pp., 1s. 6d.), *Gold*, (42 pp., 1s. 6d.).

Each publication gives a table of average rates of exchange for the period, the world's production of the ore, details of the production of silver in the principal producing countries, summaries of exports and imports and monthly average prices.

The following figures show the world's smelter production of metal for the years covered by the publications :—

	1919	1920	1921
Copper, long tons	937,000	947,000	580,000
Zinc ,, ,, ..	645,000	705,000	432,000
Lead ,, ,, ..	829,000	886,000	849,000
Silver, fine oz. ..	89,328,000	87,037,000	85,172,000
Gold ,, ..	14,333,000	13,516,000	13,401,000

Mineral Production of Southern Rhodesia in 1922

The total value of minerals produced in Southern Rhodesia in 1922 was £4,474,583 (£4,720,375 in 1921), the principal item being gold, the output of which amounted to £652,791, valued at £3,111,468, an increase of 67,266 oz. over the output in 1921. There was a decrease in value of £105,807, owing to the fall in the gold premium. The output of silver totalled 172,209 oz. (£24,526), an increase of 19,220 oz. (£4685) over 1921. The following shows the amount and value of the output of various minerals, the figures in parentheses referring to 1921 :—Asbestos, 14,249 tons, £577,699 (decrease of 5280 t.) ; chrome, 93,475 t., £302,880 (increase of 43,287 t.) ; coal, 515,650 t., £225,345 (decrease of 59,103 t.) ; copper, 3388 t., £201,022 (3080 t.) ; mica, 66 t., £16,561 (decrease of 19 t.) ; arsenic from the Buluwayo and Umtali districts, 497 t., £11,774 (361 t. at £11,263) ; diamonds, 256 carats, £1643 (141 carats at £720). It is stated that the existence of a seam of good steam coal, averaging 28 feet thick, has been proved in borings put down over a large area around a new site.

REVIEWS

Physikalisch-Chemische Tabellen. *By* Landolt-Börnstein. *Fifth and enlarged edition, edited by* Profs. W. A. Roth and K. Scheel, *and numerous other collaborators. Vol. I. Pp. xv+784. Vol. II. Pp. 784-1695. Berlin: Julius Springer,* 1923. *Price* 187*s.* 6*d.*

Konstanten der Atomphysik. *Edited by* Prof. W. A. Roth, Prof. K. Scheel and Prof. E. Regener. *Pp.* 114. *Berlin: Julius Springer,* 1923. *Price* 8*s.* 4*d.*

Every worker in physics and chemistry will welcome this new edition of the famous Landolt-Börnstein Tables—except, perhaps, those who may have recently purchased the 1912 edition. For this fifth edition is not only the fourth brought up to date but in many respects the book is remarkably improved. The work is produced in two volumes of more handy size than the former bulky tome: the first volume is supposed to contain chiefly chemical data and the second physical, but no clear distinction can be made. The index at the end of Volume II could have been conveniently included in each volume. The present index is, however, a considerable improvement on that of the former edition, which was inadequate. Each section of the Tables appears to have been recast. Not only have the latest values been introduced, but unnecessary and less accurate data have in some cases been removed, thereby enhancing the critical value of the Tables and rendering them less cumbersome.

The arrangement and printing are improved and graphs are used as much as possible—for example, in the section on resistance of alloys. When graphs are given it would be an improvement if the special data illustrated, *e.g.*, eutectic points, were also always given numerically; this is done in many cases, but not universally. One notices that many of the freezing-point diagrams given in the last edition have been redrawn in view of later work.

The Tables are thoroughly up to date—there is even mention of element number 72. The inclusion of comprehensive data for X-ray spectra, crystal structure as elucidated by X-ray analysis, dimensions of molecules, radioactive constants, series spectra, ionisation data, etc. greatly increases the value of the Tables. Particularly important is the section dealing with radiation constants, in which the many recent determinations of Planck's, Wien's constants, etc., are brought together, the accepted value being printed in bolder type, full references being given, as well as notes as to the method and the corrections applied.

These new physical sections are also printed separately in a much smaller volume entitled, *Konstanten der Atomphysik,* and many will find the book useful.

The section on specific heat in the larger volume is considerably extended to include recent work, but a table of accepted values of characteristic temperatures (βv) and of the differences of specific heat for constant pressure and volume might well have been added.

The Tables have lost both the originators (Prof. Börnstein died in 1913), but Prof. Roth and Scheel are to be congratulated on the way in which they have carried on this monumental work.

One cannot conclude this review without inquiring for a moment into the whole position of the work of recording data relating to the chemical and physical sciences. First there is the publication of the work, then the hunting out of the new facts and data, and finally their record in suitable form for reference.

It is difficult enough to lay hands on original communications in any particular line of work, but somehow we contrive to make it unnecessarily troublesome. Journals multiply and the range of subjects which they accept increases. One year papers of a certain type will appear in the *Annalen der Physik,* the next year finds them in the *Zeitschrift fur Physik* and so on. It would be much more convenient if each country decided to publish a certain class of work in a certain journal. The hunting out of the data is a matter of organisation. In the case of the Annual Tables of Constants, the journals are searched for numerical data by an abstractor in each country, marked in subjects and sent to a central depot, from which each collection of similar subjects is sent to a specialist to edit the particular section. In the same way it would be possible to search the journals for any subject (*e.g.,* "methods of preparation"), and make a complete subject bibliography.

Finally, there is the record of the data so gathered. "The International Annual Tables" aim at producing a complete record of all numerical data as published from year to year, so that reference to the tables gives every measurement which has been published on the subject since a certain date, 1910. The Annual Tables become almost a reference library in themselves in this way, and the data so collected form a complete record of progress. "The Critical Tables," which are in course of being produced in America with the collaboration of other countries, under the auspices of the International Research Council, critically survey the data collected by the Annual Tables and provide authoritative figures for as many constants as possible. So far as one can judge, the Landolt-Börnstein Tables take their position between the forthcoming International Critical Tables and the complete Annual Tables. They do not include all data like the Annual Tables, but they include data previous to 1910 which the Annual Tables naturally are not intended to contain; neither are they strictly critical, nor do they include technological or biological data, which are published in the Annual Tables and will be contained in the Critical Tables.

B

One may remark in conclusion that it is a pity that international collaboration in these matters is no longer complete since the war. But we may apply to these books, the prophecy of Lionardo da Vinci: "Men shall speak with and touch and embrace each other while standing each in different hemispheres, and shall understand each other's language"—but, perhaps, the quotation applies better to the latest developments of wireless.

A. C. EGERTON

PRACTICAL BACTERIOLOGY FOR CHEMICAL STUDENTS. *By* D. ELLIS, Ph.D., D.Sc., F.R.S.E. *Pp. viii*+136. *London: Longmans, Green and Co.*, 1923. *Price* 4*s*. 6*d*.

In perusing this book we find that much useful space is occupied by illustrations of pieces of apparatus which require no pictorial representation. It should be unnecessary, in a text-book concerning bacteriology, to depict for chemical students Ehrlenmeyer flasks, the top of a dropping bottle, or a watch glass supported by a pipe-clay triangle on a tripod stand. Adequate representation might have been made, however, of some of the more common organisms in everyday work; and Figs. 36 and 37 appear to be missing.

The section dealing with the preparation of culture media is poor and lacking in finish. Thus, gelatin is given priority of place, but it is very rarely used in many bacteriological laboratories examining thousands of specimens a year. No mention is made of up-to-date methods of standardising media, or the optimum reactions for various organisms obtained by estimating the hydrogen-ion concentration of the media, and the preparation of the various sugar peptone media is wrongly described. In preparing the last-named media, broth should *not* be used as a basis since minute traces of glucose from the meat may upset the sugar reactions; only sugar-free peptone should be used.

Prof. Ellis is apparently of the opinion that low-power lenses can be used for bacteriology. In the section dealing with the examination of a wet preparation of bacteria we must confess to a feeling that Prof. Ellis is very much of an optimist if he is able to distinguish cocci with the microscope working at a magnification of 350 diameters.

More detailed reference to the use of oil-immersion objectives would have been desirable.

In an elementary text-book of bacteriology we do not want to know that the author "has found glycogen in *Cladothrix dichotoma* among the Iron bacteria," but we do require accurate information regarding technique. For instance, in regard to Gram's method of staining—the most important of all methods of staining in bacteriology—Prof. Ellis gives the routine method but entirely forgets to counterstain his film after decolorisation. What the student will see with a Gram-negative preparation is best left to the imagination.

Too much attention is given to *B. megatherium*, which is not of great consequence in routine bacteriological work, and by working with this organism the real difficulty of bacteriological technique is by no means met.

There is no reference—in the index, at all events—to ultra-microscopic methods of examination by dark-ground condensers, or to the bacteriological testing of disinfectants or antiseptics.

On the whole, the book leaves much to be desired, and we confess that we do not think it is likely to be of very great value to the chemist who desires to obtain a sound working knowledge of bacteriological methods.

ARNOLD RENSHAW

CHEMISCHE TECHNOLOGIE DES STEINKOHLENTEERS, MIT BERÜCKSICHTIGUNG DER KOKSBEREITUNG. *By* Dr. R. WEISSGERBER. *Pp. vii*+141. *Leipzig: Otto Spamer*, 1923. *Price, paper* 4*s*. 2*d*., *bound* 6*s*.

A very hearty welcome may be accorded to Dr. Weissgerber's clear and concise account of the chemical technology of coal-tar distillation, etc., contained in the book under review. Within the space of little more than 100 pages, the author has succeeded in giving an adequate account of the German coal-tar industry, so far as this relates to the manufacture of the ordinary commercial coal-tar products, and also of such pure or nearly pure products as are ordinarily made at the larger tar-works. Throughout the whole of the book, one is conscious of the author's intimate practical acquaintance with his subject, and it is difficult to see how, within the limits of the space allotted, a greater amount of information could be supplied. Naturally, with that limitation, only short and general descriptions of the actual plant employed can be given, but the essential points of these are indicated in a manner which will be clear to anyone familiar with chemical works plant in general.

Due consideration is given throughout to the commercial as well as the technical side of the industry, to the alterations in the character of the crude tar, to the changes in requirements for the products which have taken place during the past 50 years, and especially those due to war and post-war conditions. Some account is also given of the preparation of the various "substitutes" obtained from coal-tar during the latter period, such as the coumarone and indene resins, lubricating oils, etc.

The first 30 pages of the book are given up to a short description of the chemical properties of coal, and of the different carbonisation industries which lead to the production of crude coal-tar. These descriptions are in no way exhaustive, but are intended to bring out such points as are of especial importance from the standpoint of the subsequent working-up of the coal-tar produced. They include a summary of the present position of the low-temperature carbonisation of coal, as now practised in Germany for the primary purpose of increasing the "internal" production of crude oil.

From the point of view of those actually engaged in the coal-tar industry, probably the main regret felt will be that Dr. Weissgerber, owing to the limits of space set by himself, or by the publisher, was unable to go still further into manufacturing details, which, with the author's great knowledge, would have further enhanced the value of the book. But even without this, and allowing for the fact that present trade conditions here differ considerably from those prevailing in Germany, the book is one which should be in the hands of all concerned with the coal-tar industry, and for other chemists who wish to obtain an insight into the methods of the industry, the book as it stands will be invaluable.

H. G. Colman

Auskunftsbuch für die Chemische Industrie. *By* H. Blücher. *Vol. I. A-L. Pp. xiv*+840. *Vol. II. M-Z. Pp.* 841—1672. *Berlin: W. de Gruyter and Co.,* 1923. *Price* 11*s. each volume,* 22*s. the two volumes.*

The nature and scope of this work of reference were fully described in the notice of the 11th edition (*cf. J.*, 1922, 65 R). The present edition contains an additional 82 pages, and has been thoroughly revised and brought up to date. The work is primarily intended to be of service to German chemists and manufacturers, and the choice of material has been largely influenced by Germany's present necessity of utilising her internal resources to a much more exhaustive degree than formerly, owing to the prohibitive cost of imported products. Considerable progress, for example, is reported in the utilisation of slags and other hitherto despised wastes and by-products, and also in the economical distillation of coal.

In this edition, removed a little farther than the last from the war period, it has been possible to value more exactly a large number of "substitute products" in use during the war, and to indicate with greater certainty those which are likely to have any permanent value.

Although the author complains that the high price of foreign books and journals in Germany has rendered it necessary for him to draw in many cases from reviews and abstracts instead of the original sources, the information given is accurate and, for a book of reference, complete. That the work has met with the appreciation of those for whom it is intended is shown by the issue of twelve editions in twenty-one years.

Reginald Brown

REPORTS

Report of the Government Chemist upon the Work of the Government Laboratory for the Year Ending March 31, 1923. *Pp.* 31. *H.M. Stationery Office,* 1923. *Price* 1*s.* 6*d.*

As the chemical work of most of the Government departments is performed mainly in the Government Laboratories, it covers so wide a range as to preclude adequate notice. The following notes are given to indicate the main points of interest.

During the year 343,454 samples were examined at the Government Laboratory and at chemical stations, an increase of 40,891 compared with 1921–22. This increase was due to the larger number examined of samples of wines, beer, spirituous preparations, sugar, and to extra work due to the Safeguarding of Industries, the Dangerous Drugs, and the Dyestuffs (Import Regulation) Acts.

A small number of samples of imported butter and margarine was found to contain excess of water, but no butter was adulterated with foreign fat, and the margarine never contained excess of butter. The proportion of fat in cheese was found to vary from 20·2 to 54·4 per cent. of the dry matter; some of the cheese had thus been made from skimmed milk, but no exception could be taken, as there are no appropriate regulations to control composition. It was found that the composition of condensed full-cream or "whole milk" varied very greatly; all the samples of condensed milk were free from chemical preservatives. An inquiry was made into the proposed standards for condensed milk and the character of filled milk powder.

The investigations on the effect of drainage from tarred roads on fish life showed that bituminous dressings appeared to be reasonably free from danger (*cf. Chem. and Ind.*, p. 544, 1923). Many samples of river water, effluents, and sea-water were examined.

Work on fertilisers revealed that most of the mixed fertilisers tested contained less than the guaranteed amounts of nitrogen, phosphates and potash, and various deficiencies and impurities in feeding stuffs were detected.

An inquiry was made under the Merchandise Marks Act into the composition of various agricultural materials, and it was found that 53 out of 71 samples of crystallised copper sulphate were 98 per cent. pure, 12 were almost up to this standard, and 2, sold as "commercial blue vitriol," consisted of mixtures of equal proportions of copper sulphate and ferrous sulphate.

Altogether, 32,542 samples of beer were examined for assessment of duty; of 308 samples as retailed 256 had been diluted. Only 1361 samples of imported beer were submitted. Out of 462 samples of brewing materials tested, 66 contained arsenic in excess of the legal limit.

Samples numbering 105 were examined

under the Dangerous Drugs Act, 633 under the Dyestuffs (Import Regulation) Act, and 8000 under the Safeguarding of Industries Act.

Many samples of duty-free spirits and denaturants were examined and progress was made in the inquiry into the characteristics of denaturants and colouring substances used for industrial alcohol.

As marking the production of beet sugar in this country, it is of interest to note that 50 samples of refined sugar, molasses, beet juice, and exhausted beet pulp were examined.

Work carried out for the Department of Scientific and Industrial Research included investigations into the nature of the aqueous extracts of wood, the value of anti-rust preparations, and the helium content of natural gas from boreholes in this country; the content was found to vary from 0·005 to about 0·2 per cent. by volume. Much work on building materials and paints, and on the preservation of ancient monuments was done for the Office of Works.

Report on the Economic, Commercial and Industrial Situation of Sweden, Dated March, 1923. *By* H. Kershaw, *H.M. Commercial Secretary, Stockholm. Department of Overseas Trade. Pp.* 68. *H.M. Stationery Office*, 1923. *Price* 2*s*.

During 1922 there was considerable recovery in Sweden from the period of economic dislocation noted in the last report (*Cf. J.*, 1922, 296 R). Although the record harvest of 1921 gave rise to hopes of an immediate recovery, these had to be abandoned and conditions adjusted to the trade depression and to the rapid deflation which continued uninterruptedly. Deflation has achieved its object of bringing down prices, which now approximate to those ruling in Great Britain and America, and optimism is now more general, especially due to the rise in the sterling exchange. The tremendous decrease in the excess of imports over exports in 1922 was a great achievement, but the approach to stable economic conditions has not yet ended. The question of wages and labour is a serious problem, and the strikes at the beginning of this year, together with the continued economic chaos in Central Europe, checked the growth of confidence in commercial circles. Nevertheless, the present stability of prices is a great help to national prosperity. The severity of German competition in Swedish markets has diminished, though the effect is not so marked in some lines—for instance, chemicals and drugs. Sweden depends largely on imports for supplies of coal, and it is noteworthy that of the 2,635,845 t. imported in 1922, no less than 95·5 per cent. was obtained from Great Britain. In addition to about 500,000 t. of coal produced in the country, 70,000 t. was obtained from Spitzbergen. The timber and wood trade was satisfactory in 1922, and prospects for 1923 are encouraging. The chemical pulp trade yielded indifferent results, though by reducing prices, possibly unprofitably, large stocks were disposed of in the United States and Canada. The output of sulphite cellulose in 1922 is estimated at 757,000 t., of sulphate cellulose at 249,000 t., and of mechanical wood-pulp at 310,000 t. Reduced costs of raw materials helped the china and pottery industry, and the output was about 75 per cent. of that of pre-war years. The Grängesberg Co. exported 5,361,772 t. of iron ore in 1922, against 3,472,352 t. in 1921; the prospects for 1923 are better still. Newly discovered copper deposits are expected to become important. The iron and steel industry was depressed, though less than in the previous year, and only 259,700 t. of pig-iron was produced, compared with 314,400 t. in 1921. Though 1923 opened badly, bigger export demands are anticipated. The leather industry seems to have recovered, and the match industry has been doing well, 29,343 t. being exported in 1922 (20,000 t. in 1921). The agricultural situation is unsatisfactory, and the general fall in sugar prices makes beet-growing unprofitable. Hydro-electric power generated in 1922 reached 1,269,000 h.p., and further developments are in progress.

The following figures give the value in kronor of the foreign trade in 1922 in some important groups of merchandise:—Tallow, oils, etc.—imports 67,674,527, exports 10,775,529; dyes and colours—imports 13,913,526, exports 744,726; wood-pulp, cardboard and paper—imports 16,113,105, exports 317,507,100; minerals (raw)—imports 148,292,079, exports 87,513,537; finished mineral products—imports 22,876,577, exports 61,850,524; metals (unmanufactured)—imports 42,779,672, exports 51,105,801; metals (manufactured)—imports 52,189,195, exports 51,993,754. Other imports included coal tar, 6287 t.; vegetable fatty oils, 8511 t.; vegetable fats, 5874 t.; zinc white, lithopone, baryta, 5196 t.; linseed, 26,466 t.; oil cake, 64,163 t.; tanning materials, 5871 t.; Chile saltpetre, 20,179 t.; coke, 528,338 t.; salt, 32,603 t.; Glauber's salt and sodium bisulphate, 50,582 t.; raw phosphates, 71,290 t.; soda, 14,169 t.; Stassfurt salts, 77,653 t.; coal, 2,635,845 t.; pyrites, 78,067 t.; sulphur, 58,346 t.; iron and steel, 92,745 t. The exports included:—Cement, 82,900 t.; felspar, 22,045 t.; iron ore, 5,321,914 t.; superphosphate, 20,311 t.

Prof. E. Heuser, director of the Institute for the Chemistry of Cellulose of the Technical *Hochschule*, Darmstadt, has been appointed director of scientific research to the Vereinigten Glanzstoffabriken in Seehof near Berlin.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Sept.* 27)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Artificial silk yarns	353
Belgium	Paper	333
British India	Leather	323
Canada	Rubber sheeting	326
Italy	Edible soya-bean oil, oil seeds, sesame seeds, groundnuts	336
Netherlands	Tinplate, tyres	338, 339
Norway	Pig iron, paper	341
Poland	Fertilisers	342
Rumania	Scientific apparatus	344
South Africa	Glassware	329
United States	Tiles, firebricks, etc.	20547/F.W. /M.C./2 20143/F.W. /M.C./2

TARIFF CUSTOMS EXCISE

Ecuador.—The current issue describes recent regulations for the control of the opium trade.

Fiji.—The export duty on copra is abolished.

Japan.—Import duties have been suspended on oils, boric acid, bicarbonate of soda, salicylate of soda, hydrogen peroxide, chloroform, iodoform, antipyrin, santonin, chemicals, medicines, leather, indiarubber, paper, building materials, iron, glass, gum and resin. The suspension dates from September 17, and is effective until March 31, 1924.

Madagascar.—Anthraquinone is now duty-free.

Poland.—The duty on acetic acid has been increased from 6000 to 12,000 P. mks. per kg. of undiluted acid.

Sierra Leone.—The exportation of gum copal[1] has been prohibited.

South Africa.—A dumping duty is levied on cement imported into Basutoland, Bechuanaland and Swaziland.

United Kingdom – Czechoslovakia — The agreement respecting Commercial Travellers' Samples has been ratified.

United States.—Cresol, asphalt and asbestos are dutiable.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Although the volume of business is disappointing there is a slight improvement in the position compared with that ruling during the last month or two. Salt cake is decidedly scarce and more export inquiries are being received. Other heavy chemicals are in steady request. Prices are unchanged, but from Oct. 1 ammonia alkali is reduced by 2s. 6d. per ton to £7 10s. per ton.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d. per carboy makers' works.
Acid Nitric 80° Tw.	£22 per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 65s. f.o.r. makers' works, with slight variations up and down.
Acid Sulphuric, 94% Arsenical	£6 per ton makers' works.
Ammonia Alkali	£7 10s. per ton, spot delivery. General export demand good, particularly from the Continent.
Arsenic (White)	£72—£73 per ton. Not much doing.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Copper Sulphate	£25 per ton. Dull.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	5¾d.—6d. per lb. d/d.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£25 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.

Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Carload lots 9¼d. per lb. Less quantities 10½d. per lb. ex wharf London. Ample supplies.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb.
Lead Hyposulphite	8d. per lb.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur, finest	£10 10s. per ton.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

The volume of trade is small and, except in acetates, there is very little life. The tar market seems slightly weaker.

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d. Regular demand and short supply.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£10 per ton, according to grade. Market quiet owing to slack demand for non-ferrous metals.
Iron Liquor	1s. 7d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d.—6s. 4d. per gall. 60% O.P. Steady market.
Solvent	6s. per gall. 40% O.P. Good demand.
Wood Tar	£5—£6 10s. per ton, according to grade. Slightly weaker.
Brown Sugar of Lead	£41—£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 2d. per lb. Good demand. Market firmer. Limited quantities only available for prompt delivery.
Crude 60's	3s. 6d.—3s. 8d. per gall. Good demand for spot delivery.
Acid Cresylic—97/99	2s.—2s. 2d. per gall. Fair demand.
Pale 95%	1s. 10d.—2s. per gall. Market quiet.
Dark	1s. 7d.—1s. 10d. per gall. Fair parcels offered.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. Few inquiries but no business.
Anthracene Oil—	
Strained	10d.—11½d. per gall. Supply short.
Unstrained	8½d. per gall.
Benzole—	Fair enquiry.
Crude 65's	1s. 1½d. per gall.
Standard Motor	1s. 3d.—1s. 6½d. per gall. delivered buyer's works.
Pure	1s. 8d.—2s. 1d. per gall. d/d. buyer's works.
Toluole—90%	1s. 7d.—1s. 8d. per gall. Little business passing.
Pure	1s. 11d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8¼d.—10¼d. per gall. according to grade and district. Demand still good.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 3d.—1s. 6d. per gall. Market very quiet.
Solvent 90/190	1s. 3d.—1s. 4d. per gall. Market very quiet.
Naphthalene Crude—	
Drained Creosote Salts	£7 10s.—£8 per ton. More inquiry, difficult to meet demand.
Whizzed or hot pressed	£11—£12 per ton.
Naphthalene—	
Crystals	£19 10s. per ton.
Flaked	£19 10s. per ton.
Pitch, medium soft	120s.—130s. per ton, according to district and time of delivery. Several inquiries but sellers not anxious.
Pyridine—90/140	21s.—21s. 6d. per gall. Market very strong. Price still advancing.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

Business quiet and difficult. Buyers refuse to carry stock and buy from hand to mouth. Orders frequent but small. Textile trade slack and outlook not very promising.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 10d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 7d.—1s. 8d. per lb. Good demand.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 9d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/21° C.	5½d.—6d. per lb. Prices slightly reduced and a better demand is experienced.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/24° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.

Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£90 per ton d/d.
Dinitrotoluene—48/50	8d.—9d. per lb. naked at works.
66/68	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d
p-Nitro-o-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 8d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb, 100% basis d/d.
R. Salt	3s. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	4s. 10d. per lb. d/d.
m-Toluylene Diamine	5s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Business is still quiet, but prices remain steady, Continental quotations being increasingly firm.

The demand for tartaric acid still continues to be poor owing to accumulation of stocks by both consumers and speculators. This is due to the cold weather during the first six months of the year, which was disastrous to the home trade and, as a consequence, speculators in foreign acid who were unable to get rid of their stocks, are offering at prices which are considerably below the cost of production in this country. Hence, although the demand has been slightly better during the past week or so, the market continues to be weak. It is reported that one forced sale of German acid amounting to 50 tons has been done at 1s. less 5% delivered here. This figure is below the immediate pre-war price.

The imports of tartaric acid into this country for the month of August amounted to 56·15 tons, against 125·20 tons for the previous month. The export demand is still below normal and a price below the cost of production must be accepted for any business that is done. Italy is, at present, our principal competitor in both the home and export markets. We are of the opinion that the bottom has now been reached and this is confirmed by the fact that both consumers and distributors seem anxious to enter into contracts for forward delivery over next year at the low prices that are now prevailing.

Acid, Acetic 80% B.P.	£52 10s. per ton.	
Acid, Acetyl Salicylic	3s. 1d.—3s. 2d. per lb. Good demand. Firm market. Price likely to advance owing to increase in raw material.	
Acid, Benzoic	2s. 3d.—2s. 6d. per lb. Firmly held.	
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.	
Acid, Citric	1s. 6¼d. per lb., less 5%. Poor demand. Market dominated by weak holders and bad season.	
Acid, Gallic	3s. per lb. for pure crystal.	
Acid, Pyrogallic, Cryst.	5s. 9d.—6s. per lb., according to quantity.	
Acid, Salicylic	2s. 2d.—2s. 3d. per lb. for 5 cwt. lots. Firm market. Good inquiry. Supplies not heavy.	
Acid, Tannic	3s. 3d. per lb. for B.P. quality. Fair business. Price steady.	
Acid, Tartaric	1s. 1¾d. per lb. less 5%. Demand fair and likely to improve. Raw material dearer. Prices will probably advance. (*See introductory remarks.*)	
Amidol	9s. per lb. d/d.	
Acetanilide	1s. 6d. per lb. for English manufacture. Imported quoted at higher prices.	
Amidopyrin	12s. 6d. per lb. Demand still very poor.	
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.	
Ammon. Carbonate B.P.	£32 15s. per ton.	
Atropine Sulphate	12s. 6d. per oz. for English make.	
Barbitone	17s. per lb. for quantity. Demand limited.	
Benzonaphthol	4s. 6d.—4s. 9d. per lb. Slight advance in price.	
Bismuth Salts	A steady market. Prices unchanged.	
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.	
Bromides—		
Potassium	6½d. per lb.	Market unsettled. Poor demand. Potassium bromide easier in price; other salts unchanged.
Ammonium	7d. „ „	
Sodium	7½d. „ „	
Calcium Lactate	2s. 6d. per lb. for best makes. Better enquiry.	
Chloral Hydrate	3s. 9d.—4s. per lb. Somewhat firmer. English makers are oversold.	
Chloroform	2s. 2d. per lb. for cwt. lots. Demand is poor.	
Creosote Carbonate	8s. lb. Demand negligible.	
Formaldehyde 40%	75s. per cwt. ex wharf London. Slightly less for large orders.	
Guaiacol Carbonate	8s. 6d. per lb.	
Hexamine	3s. 6d.—3s. 9d. per lb. Spot parcels have been cleared, and forward prices are higher.	
Homatropine Hydrobromide	30s. per oz.	
Hydroquinone	3s. 3d.—3s. 6d. per lb. Now asked, according to quantity and holder. British make cheaper than imported.	
Iron Ammon. Citrate	2s. 5d. per lb. for cwt. lots. Better demand.	
Magnesium Carbonate—		
Light Commercial	£37 per ton net.	
Magnesium Oxide—		
Light Commercial	£82 10s. per ton, less 2½%.	
Heavy Commercial	£28 per ton, less 2½%.	
Heavy Pure	2s.—2s. 3d. per lb., according to quality and quantity. Steady market.	

Menthol	A.B.R. recryst. B.P. 65s. per lb.
Mercurials	Market somewhat easier owing to lower prices for mercury.
Methyl Salicylate	2s. 4d.—2s. 6d. per lb. Distinctly firmer for English or imported, in view of seasonal advance now in progress.
Methyl Sulphonal	14s. 6d. per lb. Easier.
Metol	8s. 9d. per lb.
Morphine and Salts	Prices advanced about 6d. per oz., due to higher price of opium. Alkaloid : Cryst. 11s. 6d., Precip. 11s. 3d., Acetate 9s., Hydrochlor. 9s., Sulphate 9s. per oz.
Paraformaldehyde	3s. 5d. per lb.
Paraldehyde	1s. 5d. per lb. Average price in 5 lb. bottles.
Phenacetin	6s.—6s. 3d. per lb. Demand and price steady.
Phenazone	7s.—7s. 3d. per lb. Firm.
Phenolphthalein	6s. 3d.—6s. 6d. per lb., according to quantity and holder. Rather more inquiry.
Potass. Bitartrate—99/100% (Cream of Tartar)	88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	2s. 8d. per lb. English makes are meeting foreign competition.
Potass. Iodide	15s. 8d.—16s. 2d. per lb. Good demand.
Potass. Metabisulphite	8d. per lb.
Potass. Permanganate	10d. per lb. for B.P. crystal. It is understood that English makers will soon resume operations.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	5s. 3d.—5s. 6d. per lb. Business moderately good.
Salol	3s. per lb. Limited demand. Price would be shaded for quantity.
Silver Proteinate	10s. per lb. A weaker market.
Sod. Benzoate	2s. 6d. per lb. Improved demand would lead to higher prices as present stocks cannot be replaced at current figures.
Sod. Citrate, B.P.C. 1923	2s. 3d. per lb.
Sod. Hyposulphite—Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—87s. 6d. per cwt. Fairly good demand.
Sod. Salicylate	Powder 2s. 6d.—2s. 7d. per lb., and Crystal at 2s. 8d. per lb. Firm, with tendency to rise.
Sod. Sulphite, anhydrous	£25—£26 10s. per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	14s. per lb.
Tartar Emetic	1s. lb. net. Fair demand.
Thymol	14s. per lb. for best white crystal.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 6d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,
Benzyl Alcohol free from Chlorine	3s. ,, ,,
Benzaldehyde free from Chlorine	3s. ,, ,,
Benzyl Benzoate	3s. ,, ,,
Cinnamic Aldehyde Natural	18s. 6d. ,, ,,
Coumarin	18s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	10s. ,, ,,
Geraniol (Palmarosa)	35s. ,, ,,
Geraniol	5s. 6d.—12s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. per lb.
Linalol ex Bois de Rose	18s. 6d. ,, ,,
Linalyl Acetate	21s. ,, ,,
Methyl Anthranilate	8s. 6d. ,, ,, Cheaper.
Methyl Benzoate	6s. ,, ,,
Musk Ketone	40s. ,, ,,
Musk Xylol	12s. 6d. ,, ,,
Nerolin	3s. 3d. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	16s. ,, ,,
Rhodinol	45s. ,, ,,
Safrol	2s. ,, ,,
Terpineol	3s. ,, ,,
Vanillin	22s. 6d.—23s. 6d. per lb. Fair and steady demand. Raw material dearer.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. ,, ,,
Bergamot Oil	12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	35s. ,, ,,
Camphor Oil	80s. ,, ,,
Cananga Oil, Java	9s. ,, ,,
Cinnamon Oil, Leaf	4½d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 2d. ,, ,,
Ceylon	4s. ,, ,,
Clove Oil	8s. 6d. ,, ,,
Eucalyptus Oil 70/75%	2s. 8d. ,, ,,
Lavender Oil	18s. 6d. ,, ,,
Lemon Oil	2s. 10d. ,, ,,
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	12s. 6d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	24s. per oz.
Palma Rosa Oil	23s. 6d. per lb.
Peppermint Oil—	
Wayne County	15s. per lb. Market very unsteady.
Japanese	12s. per lb. Market very unsteady.
Petitgrain Oil	7s. 6d. per lb.

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EDITORIAL

CHEMISTS are accustomed in the laboratory to study, not only the method of preparing a substance, but also the percentage of the theoretical yield which can be obtained under specified conditions, and in their writings we frequently meet with the phrases " optimum conditions " and " maximum output," which are useful ideas, though we are personally sometimes shy of a Latin adjective agreeing with an English noun. Probably every chemist is familiar with the conditions of manufacture on a larger scale than is practised in the laboratory, and he has no hesitation in stating that when a particular piece of plant, or a works, is fully employed so as to yield the greatest output which may be regularly expected, then the material may be manufactured more efficiently, or more economically, than in other circumstances. Those who motor know how many gallons of petrol ought to be required to drive their car or their cycle a hundred miles. Perhaps because such considerations are so familiar to them in their daily work, they sometimes ignore them in those leisure moments which they devote to the organisation of chemistry. But the essential principles are the same everywhere ; there is an ideal efficiency to be attained in a society, in a journal, or in so vague a conception as the organisation of a science such as chemistry. The relation between the expenditure of human energy, of time, or of money and the result, is as worthy of careful study as the percentage of the theoretical yield to be obtained in a new process for making potassium chlorate. To what extent has a thoroughly scientific investigation been made of this relation ? The whole question of chemical publications, books, abstracts, transactions and even ephemeral matter such as our own, requires close scrutiny, so that we can compare the actual achievements with the best standards to be obtained in practice. An even wider scrutiny might be made and a larger table of empirical constants collected, but the survey of the science as a whole is a thing imagination boggles at.

We are accustomed to the present circumstances ; either the institutions, with which we are most prominently identified, date back prior to our times, or we have ourselves taken an active part in their organisation and growth. In either case we have a pride in them, and an affection for them, and those who have been trained up in their methods and their mutual relations, will not gladly ignore the present and, instead, look at the whole available resources of chemistry, and see how the time, human ability and money now spent in rather a fortuitous manner, can be expended so as to produce the greatest result. Faraday wrote many years ago " a dislike to the trial arises ; but what is that except a proof, that whilst they trust themselves, they doubt themselves, and are not willing to proceed to the decision, lest the trust which they like should fail them, and the doubt which they dislike rise to the authority of truth." He was not thinking of such a broad view as we have mentioned, although such a man might " on the very border stand, of the blest promised land, and from the mountain top of his exalted wit," see it himself and show us it. But our times and circumstances are vastly different from what they were a few score of years or even ten years ago ; our predecessors were not troubled by our troubles, to them life was a simple art of duties to be done ; we have a set of burdens we shall not speedily shake off, black care perches on the back of the horseman's saddle. On the other hand, we have the chance of advancing pure and applied chemistry in a manner, and to a degree which was previously doubtful. Germany, once dominant in chemistry, is now distracted, and many of her great leaders are no longer living ; other countries have their problems as we have, but we have also a scientific opportunity which we dare not miss. The achievements of British chemists during the last generation have, as Dr. Levinstein has recently pointed out, been splendid, and those of the present generation will surpass them.

The circumstances which compelled the Society of Chemical Industry a year ago to consider the publication of their Journal weekly instead of twice a month are not circumstances which prevail in this country alone. Chemistry is not only vital to most of our industries, but the number of persons engaged in its study and its applications is so great that prompt circulation of items of news and fresh discoveries becomes more and more essential. Our American colleagues have this year circulated as a supplement to their journals a news sheet appearing at frequent intervals, and we are now interested to note that the Dutch Chemical Society has issued the first number of *Chemie en Industrie* as a supplement to its weekly journal, the *Chemisch Weekblad*. We wish the new enterprise every success and feel sure that the Dutch Chemical Society, which is already in many ways a model of efficient organisation, will achieve all that is possible. In the first number of *Chemie en Industrie* the following item appears :—"The Badische Aniline Co. in English Hands. It is rumoured that by large purchases of shares in German colour works by English and American financiers the majority of the Badische Aniline Co.'s shares have fallen into English hands." Such rumours must always be treated with caution ; the large German dyestuff companies have been managed by men of great talent who combined business ability with scientific knowledge. It is immaterial whether such men commenced with business or chemical training ; in middle life they were thoroughly well equipped in both.

In this country comparatively few men are both keen men of business and competent chemists. Those we have met have become prosperous, and it is singular how few have followed their example. Far too few of the wealthy, business, community have trained their children in chemistry, far too many men are educated as chemists with no ambition or no training to become important factors in the control of a business, where large sums of money are at stake. A man who has spent the most important twenty years of his life in the laboratory or the lecture room is not likely to have good judgment on matters of finance, on how to run a works, on questions of sales and purchases. But if suitable men are chosen in good time the desired result will be obtained. Dr. Duisberg said during the war "England talks not only of holding her own in the war, but of beating us in the organic chemical industry. She cannot do it because she is incapable of the necessary concentration, patience, and the faculty of fixing the eye on distant consequences, and not merely on monetary results." Everyone knows that we can do this if we make up our minds. Surely the prize is worth the struggle; the struggle is surely worth while irrespective of the value of the prize.

A CRITICAL EXAMINATION OF BERTHELOT'S WORK UPON ARABIC CHEMISTRY

By E. J. HOLMYARD

Part II

In the first article Berthelot's qualifications for the study of Arabic chemistry, and his choice of material, have been considered. It now remains for us to examine (1) his treatment of the material chosen and (2) the conclusions at which he arrived.

(I) Berthelot's Treatment of his Material

The manuscript material which Berthelot employed comprises 13 different works, of which nine are attributed to Jābir ibn Hayyān. The whole 13 occupy 205 pages of Arabic type and 180 in the French translation. In addition to the manuscripts, he had at his disposal (*a*) the catalogues of the chief European libraries, many of which contain valuable critical and bibliographical notes, (*b*) the *Kitāb al-Fihrist* in Fluegel's edition, (*c*) the Biographical Dictionary of Ibn Khallikan in English translation, (*d*) the *Prolegomena* of Ibn Khaldūn in French translation, (*e*) the *History of the Philosophers*, by Al-Qifti, (*f*) the *Classes of Physicians* by Ibn Abi Usaybiʿa, and (*g*) the celebrated bibliography, the *Kashfu'l-Zunun*, of Hajji Khalifa ; to name only those important sources to which one would naturally turn. Of the last six he claims to have used all except *e* and *f*, but it is clear from his book that whilst he has quoted the whole of the appropriate section of the *Fihrist* and much of the passage in Ibn Khaldun, he has not drawn very much from Hajji Khalifa, although a Latin translation of the *Kashfu'l-Zunun* was published by Fluegel many years previously (1838-1858). Of the catalogues of libraries he makes scarcely any mention and seems indeed to have neglected this valuable source of information.

The section of the *Kitāb al-Fihrist* (987 A.D.) dealing with alchemy was translated by Houdas and is given at pp. 26-40 of volume I. of *La Chimie au Moyen Age*. The *Fihrist* is of great value for the history of alchemy, as it gives a list of the early alchemists and the titles of many of their works, but Houdas' version is unprovided with notes or critical apparatus of any kind and contains several inaccuracies in translation and some very doubtful identifications. Thus *Afrāgasūs* is identified[1] with an uncertain *Africanus*, in spite of the fact that the latter name is in Arabic *al-Ifriqiyyu*, whilst the suggested identification[2] of *Arkaghanis*, as well, with *Africanus* has nothing whatever to recommend it.

In short, the data provided by the *Fihrist* have simply been thrust into the book without any attempt at digestion, and anyone who is carrying out research on the subject will get no assistance from Houdas' rendering. This, however, is perhaps beside the point, which is whether Berthelot himself found it useful. In so far as the passage had never been translated before, it was no doubt interesting and gave a bird's-eye view of the range of Arabic alchemy of the first three centuries of the Hijra, but its true value (which, as has been remarked above, is considerable) cannot be appreciated, nor can the passage itself be properly used, without a knowledge of a great many of the early alchemical works themselves. It is clear that Berthelot realised this, for he leaves the section entirely without comment.

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[1] *La Chimie au Moyen Age*, III, 28.

[2] *Ibid.*, p. 35.

The other authorities are treated in the same cursory fashion, no attempt being made to arrive at a general idea of the course of Arabic alchemy, even up to the time of the Crusades, which was the limit which Berthelot set himself. Twelve pages of heterogeneous facts are, indeed, all that he appears to have extracted from the rich bibliographical sources he had immediately available. Even these facts are often incorrectly given. Thus there is no excuse for assigning Ibn Sina (Avicenna) to the twelfth century,[3] when the dates of his birth and death are well known to have been 980 and 1037 respectively; the date of the death of Al-Tughra'i, definitely given as 1122,[4] is in reality uncertain; Ibn Amyal (or better Umail) al-Temimi lived not in the twelfth century A.D.[5] but about 900 A.D.; Abn Casba ibn Temmam al-Iraqi[6] should be Abu'l-Asba; Djeldeik (rather Jildaki), placed between Ibn Hasan Ali (*i.e.*, Burhan al-Din Abu'l-Hasan Ali ibn Musa ibn Arfaʿ Ra's), who died probably in 1197, and Al-Ghazzali (died 1111), lived in the fourteenth century and died at Cairo somewhere about 1360. The famous controversy as to the reality of alchemy arose not in the twelfth century,[7] but in the first half of the ninth, in which period Yaʿqub-al-Kindi lived. Khālid ibn Yazid died in 704, not 708,[8] whilst the date of the death of Maslama al-Majriti[9] is not definitely known, and there is good reason to suppose that he never wrote on alchemy at all. Instead of its being the fact that "la plupart de ces traités (of Arabic alchemy) ont disparu,"[10] at least two-thirds of those mentioned by Hajji Khalifa in his article on *Alkimia* are still extant, although of course a great number of the very early ones have been lost. Of the list of 22 works quoted by Berthelot on pp. 41 and 42, about 10 are known in MS.

In dealing with the Latin works on alchemy ascribed to Avicenna, he has made a great many identifications which are, to say the least, very improbable; thus King Galud of Babylon is definitely identified with Khalid[11] without any reason given; Zucrat, obviously Suqrat, or Socrates, is surprisingly called Zoroaster; Clarō is given as "Caton"; Zabaibar appears to be identified with Vergil, for reason not given[12]; whilst Alpharabi, who is clearly Abu Nasr al-Farabi, is not identified. The "Jahie Abendinon" of Avicenna's list is unknown, but it has occurred to me that he may have been a son (Yahya) of the Egyptian alchemist and Sufi Dhu'n-Nun, and that "Jahie Abendinon" may be a crude translation of Yahya ibn Dhi'n-Nun. I do not know, however, whether Dhu'n Nun ever had a son, and I can find no trace of such a person as an alchemist. Dhu'n-Nun himself died in 860 A.D., so that his son would have lived in the ninth century, a date not incompatible with his inclusion in a list of Avicenna's.

It will be seen that Berthelot's introductory matter is meagre, that it has not been properly dealt with, and that it contains numerous inaccuracies which might easily have been avoided, and many doubtful identifications. It is, therefore, of very little help to a study of the manuscript texts themselves, and is often misleading. In other words, the published texts stand practically by themselves and have to be considered on their own merits, except for the light which Greek alchemy throws upon them. The manuscripts employed, especially the Leyden MS. 440, were not in a very good state, that volume, indeed, having been "mouillé dans sa partie inférieure," so that "les trois ou quatre dernières lignes sont souvent à moitié effacées, et parfois certains mots ont été complètement rongés par l'humidité." This rendered decipherment in many places uncertain, and in many others impossible. The major portions of the texts were, however, in good condition and the readings "presque toujours" certain.

The MSS. were transcribed by Houdas and printed in Volume III of *La Chimie au Moyen Age*, accompanied by a French translation as revised by Berthelot according to the peculiar canon mentioned in the previous article, namely, with the object of "making sense." Pages 9-23 give short descriptions of the treatises, together with a few notes. The annotations which accompany the translations deal almost entirely with resemblances of certain passages to passages of Greek alchemists, and the references are usually to the *Collection des Anciens Alchimistes Grecs*. In other words, Berthelot did not attempt the task of a proper elucidation of the translations, but confined himself to one definite point. This, as has already been said, he sufficiently proved; nevertheless, on the main question of the nature and development of Arabic chemistry he is perforce silent, and the historian will not derive much help in this direction from a perusal of the book. The works of Crates, Al-Habib and Ostanes, given by Berthelot, are indeed remarkable, not as being typical of Arabic chemistry, but because they are exceptional. I know of only one other MS. of "Ostanes'" treatise, and I have never come across a reference to those of Crates or Al-Habib in Jābir, Al-Razi, Burhan ad-Din ibn Arfa'Ra's, Abu'l-Qasim al-Iraqi, Ibn Sina, the pseudo-Maslama al-Majriti, Aidamir al-Jildaki, or in fact, in any other Arabic chemical writer, so that I do not believe that they can have had any considerable influence. Many of the ideas and much of the phraseology in them are of course common, but the works themselves appear to have been almost completely neglected by Muhammadan chemists. On the other hand, most of the books of Jābir which are given by Berthelot are frequently quoted by later authors, and there is no reason to doubt their authenticity; they do not, however, give an adequate picture of their author.

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[3] *Ibid.*, p. 4.
[4] *Loc. cit.*
[5] *Loc. cit.*
[6] *Loc. cit.*
[7] *Loc. cit.*
[8] *Op. cit.*, p. 2.
[9] *Op. cit.*, p. 3.
[10] *Op. cit.*, p. 5
[11] *Op. cit.*, I, 301.
[12] It is improbable that Avicenna knew of Vergil.

In using the texts one finds at once the difficulty of referring to any particular passage, as the pages of the MSS. are not numbered, neither are any indications given in the Arabic of the corresponding pages in the translation. This would not be a drawback in the case of a work divided into numbered sections and subsections, but it is very aggravating in the long and rambling treatises chosen and causes a great waste of time. Moreover, the texts themselves cannot be said to be properly established, since they were made from single manuscripts, often imperfect. With the books of Crates and Al-Habib this was inevitable, since no other MSS. are known, but another MS. of the Ostanes is in the British Musuem, and MSS. of the "Book of Royalty" and "Little Book of Mercy" are fairly common. The "Books of Mercury" and the other books of Jābir are freely quoted by Al-Jildaki and others, and their texts could thus have been partially checked.

In the first volume of *La Chimie au Moyen Age*, Berthelot brings to bear his knowledge of mediæval Latin treatises supposed to have been translated from, or based on, Arabic originals, but, as has already been pointed out, he is here attempting to explain *ignotum per ignotius*. In the Latin works it is impossible to separate the indigenous from the foreign, whether in ideas or in facts, without a previous knowledge of the later developments of Arabic chemistry, especially in Spain; now it is of Spanish-Arabic alchemy that we know least. A work of capital importance here is the *Rutbatu'l-Hakim*, ascribed, probably falsely, to Maslama al-Majriti, who died in the early years of the eleventh century, and it is to be hoped that the task of editing, translating and annotating this valuable book will be undertaken at no distant date.

The *Liber de Septuaginta* is probably the most useful tool which Berthelot had at his disposal in this connexion, as it appears to be directly translated from the Arabic of Jābir ibn Hayyān. He deals with this in Chapter IX of Volume I, but it deserves a much fuller treatment. As an example of the superficiality of his work one may mention that, in comparing the list of titles of works of Jābir quoted in the *Liber LXX* with that given in the *Kitāb al-Fihrist*, he has overlooked the correspondence between the *Intentio Intentionum* of the former with the *Kitāb 'Ard al-'Irād* of the latter, and that between the *Albicalmon* and the *Kitāb Abi Qalamun*, the *Elementum yrci* and the *Kitāb Ustuqus al-'Uss al-Awwal*, the *Chapitre des luts* and the *Kitāb al-Tīn*, and others.[13]

We have seen therefore :—

(1) That Berthelot had no idea of the vast extent of Arabic chemical literature;
(2) That he used the bibliographical material only superficially;
(3) That even in this superficial examination he was often very inaccurate;
(4) That many of his identifications are unsupported by evidence, and that others are certainly incorrect;
(5) That he took no pains to check the dates assigned by him to various authors, even ascribing Avicenna, in one place, to the 12th century;
(6) That the texts he printed cannot be said to be properly established, since they were made from single MSS., even where other MSS. of the same works existed;
(7) That the works of "Crates" and "Al-Habib" appear to have been unknown to most of the chemists of Islam;
(8) That the works of Jābir chosen are not representative;
(9) That the absence of appropriate pagination in the texts and translation renders reference very difficult;
(10) That the annotations are few and chiefly concerned with one point only, namely, the relation between Greek and Arabic alchemy;
(11) That the use of mediæval Latin works to explain Arabic ones is very limited in its application, unless a previous knowledge of the latter has been obtained;
and (12) That the most important Latin work employed by Berthelot has received insufficient treatment.

The general impression conveyed by a study of Volumes I and III of *La Chimie au Moyen Age* is, indeed, that of a confused mass of undigested material, rendered still more confused by careless scholarship. It is not surprising, therefore, that the conclusions at which Berthelot arrived are frequently misleading and very often quite inaccurate, while many others require considerable modification. It is to an examination of these conclusions that we must now turn.

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[13] I have not seen Berthelot's more recent edition of the Liber LXX, in *Archæologie*, 1906.

II. BERTHELOT'S CONCLUSIONS ON ARABIC CHEMISTRY

Since Berthelot arrived at conclusions of the widest extent as to the nature of chemistry in Islam, one cannot hope here to deal with the whole matter fully, or even, indeed, with more than a fraction of it. To examine it fully would be to write a complete history of Muhammadan chemistry, for Berthelot has something to say about the earliest period and the latest, in spite of the fact that he did not know what was going on in the meanwhile. I propose, therefore, to state shortly some of the principal points which Berthelot believed himself to have made, and to examine these briefly in order to arrive at some estimate of their worth. This is all the more necessary since historians of chemistry have, up to quite recently, accepted Berthelot's work as authoritative.[14]

1. " Les Arabes, en effet, n'ont pas connu les Grecs directement, mais par l'intermédiaire des Syriens, qui avaient les premiers traduit les philosophes et les savants grecs dans une langue orientale." (Vol. I, p. iv.) Comment upon this conclusion may be confined to the remark that it is an over-statement of the case, and that, as Steinschneider has abundantly shown, numerous books were directly translated from the Greek into Arabic. One may also refer to the well-authenticated tradition that Khalid ibn Yazid had many Greek alchemical treatises translated into his mother-tongue. Whilst Berthelot has conclusively shown that much alchemy passed to Islam from the Greek *via* Syriac, he has under-rated the Persian contributions, which were, perhaps, as important as those of the Greeks themselves. Additional light on this subject is being provided by the masterly researches of Prof. Ruska.

2. " L'ensemble des ouvrages arabes que nous allons publier, joints aux traités syriaques contenus dans un autre volume, présente un grand intérêt pour l'histoire de la science, attendu qu'il fournit une connaissance solide de la véritable alchimie arabe, ignorée jusqu'à ce jour." (Vol. III, p. 25.) This passage requires the most careful examination, for it makes two definite claims, namely (*a*) that Berthelot's work was the first in the field, and (*b*) that it furnishes a sound knowledge of the real alchemy of the " Arabs," or rather Arabic-writing authors. The first of these two is merely a question of priority and of no particular importance, but it is necessary to point out that Prof. Wiedemann had been working at the subject for several years before Berthelot, and had published some of his researches, which appear to have been unknown to, or neglected by, the latter. Kopp also, although handicapped—like Berthelot himself—by lack of knowledge of Arabic, had investigated Muhammadan chemistry as far as possible in the circumstances, and had consulted Orientalists on several particular points. Kopp's work is still of the greatest value, and is characterised by its accuracy. Thus, while Berthelot was certainly the first to publish texts of Arabic chemical books, the work of the two men just mentioned should not be forgotten, especially as in many respects it reaches a much higher level of scholarship than does *La Chimie au Moyen Age*.

The second claim (*b*), however, is really the crucial question of the whole discussion. In the present articles much evidence has been adduced to enable us to arrive at a considered judgment on the matter, and the inadequacy of Berthelot's work has, I hope, been made clear. Nevertheless, in order to place the matter beyond doubt it may be advisable to consider more closely the proportion which exists between the fraction of the material used by Berthelot and the total field.

The period during which chemistry flourished in Islam covers some seven hundred years—from the time of Khalid ibn Yazid (seventh century) to that of Aidamir al-Jildaki (fourteenth century). The chief centres of study were Iraq and Spain, and in that order. Jābir ibn Hayyān (eighth century) was undoubtedly the most accomplished chemist of the early period, and about 80 of his works are extant, whole or in part. The largest and most important is the *Kitab al-Khawass*, or *Book of Properties*, preserved in two MSS. in the British Museum. It will be obvious that a great deal of work will have to be done before a just estimate of Jābir's chemical knowledge can be obtained, and it will not be denied that Berthelot certainly was not in a position to make such an estimate. Several of his conclusions on this particular subject have already been proved incorrect, notably his statement that Jābir does not mention the sulphur-mercury theory of metals, nor admit " arsenic " as a third constituent of metals.

As far as our information goes, Jābir's death cannot be placed later than the reign of Al-Ma'mun (813-833 A.D.), so that it is apparent that Berthelot has entirely neglected a period of no less than five hundred years, except for the short articles he has given upon Bubacar (Rhazes) and Avicenna, based on Latin MSS. and therefore not authoritative. His claim that his researches " furnish a sound knowledge of Arabic alchemy " is therefore absurd ; even if he had modified it by adding the words " as far as it affected European alchemy," he would still have been claiming far too much, for the works of Al-Razi and Ibn Sina exercised a great influence upon the future development of the science. Moreover, since it was chiefly in the tenth and twelfth centuries in Muslim Spain that the transmission to Europe flourished, it is undeniable that a study of this period of Islamic chemistry is absolutely essential; and this Berthelot wholly neglected. The important "Letters" of the "Brethren of Purity" (tenth century A.D.), which contain a large section dealing with chemistry, and which were one of the chief sources of chemical knowledge in Moorish Spain, are not even mentioned, in spite of the fact that their plain and straightforward style and notable freedom from mysticism bear the clearest witness to the fact that it was in Islam that chemistry first became a true science.

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[14] Even de Lacy O'Leary has implicitly relied upon him in his *Arabic Thought and Its Place in History* (1922, p. 120). It is, however, to be noted that Prof. Lynn Thorndike (*History of Magic and Experimental Science*, 1923, II, 217), whilst accusing Lippmann of belittling Berthelot " on petty pretexts," himself says " Berthelot is a poor guide in such matters (alchemical MSS. of the Middle Ages) since his pretentious volumes are based on the study of a comparatively small number of MSS. at Paris."

The numerous works of Aidamir al-Jildaki (died about 1360 A.D.), which form a sort of encyclopædia of chemistry and give one a more or less accurate picture of six hundred years of the rise and progress of the science in Islam, together with much biographical information and innumerable lengthy quotations, seem to have been quite unknown to Berthelot. Al-Jildaki had a better knowledge of the Muhammadan chemists than anyone else had possessed, and he frequently gives long extracts from books which have now disappeared; he is in fact an indispensable source for the study of "l'alchimie arabe." Fortunately, MSS. of his works are plentiful and copies may be found in all the great European libraries.

As a last source unused by Berthelot may be mentioned the large number of books on minerals and precious and semi-precious stones, which provide material of importance to both the chemist and the mineralogist. Further elaboration of this point seems unnecessary, but one may perhaps remark that, to look at the matter from a numerical standpoint, Berthelot employed less than 4 *per cent.* of the available material, dealt with only three important chemists (viz., Jābir, Al-Razi and Ibn Sina) out of, at least, two or three dozen who require study, and passed over in silence nearly half a millennium.

It is fitting that these articles, which have contained much criticism of Berthelot's work, should also draw attention to those features which are praiseworthy, and one may readily acknowledge that such features are many. Berthelot's courage in attacking a problem of so great a difficulty was amazing, and that he achieved some measure of success is not denied, even by those who have most strongly felt his deficiencies. After all, it must be remembered that the historical researches were only the product of the leisure of an extremely busy man, and as such they compel our admiration. It is a sufficient testimonial to the worth of the researches on Arabic chemistry, that every one who has worked at the subject since they were published has used them, and perhaps occasionally abused them, but has never been able to neglect them. I feel personally that their chief value lies in the stimulus they give, for no one can read them without realising that the history of the progress of chemistry in Islam is probably the most important question for the modern historian of science.

The proof of the debt which Islam owed to the Greeks, the elucidation of the great help rendered in this connexion by the Syrian translators, the publication of the *Liber LXX* and the nine works of Jābir ibn Hayyān, the translation of the passage from the *Fihrist*, the attention drawn to the important book of "Bubacar"—for all these valuable contributions to knowledge Berthelot deserves our warmest thanks. The magnitude of his services was great and should not be belittled on insignificant grounds; yet I think they were greatest not in accomplishment, but in indicating what was to be accomplished. "*Ce n'est que le premier pas qui coûte*," and this was taken for us by Berthelot.

COMPOSITION FLOORING

By RAYMOND RENARD BUTLER

The chief binding materials used in modern jointless flooring are portland cement, magnesite cement, bitumen, rubber, and hard-burnt plaster of Paris. Of these the last named is little used in this country, but finds more extensive application on the Continent under the name of Estrich gips.

The life of a jointless floor depends mainly on the ability of the binding material to resist wear and tear. From the standpoint of the chemist the influences at work upon such floors are both mechanical and chemical:—(*a*) Attack by iron tyres of trolleys, etc. (*b*) Attack of the flooring on rubber tyres. (*c*) Influence of oil. (*d*) Influence of water. (*e*) Influence of acid. (*f*) General foot traffic. The problems of fireproofing and sound-proofing are also important.

It will be convenient to deal with the subject sectionally.

PORTLAND CEMENT

Olive, whale, bone and wood oils, and tallow show a tendency to attack freshly laid concrete, but concrete one month old is immune. Mineral oils derived from the distillation of coal products are without action on the cement unless contaminated with acidic substances. Even weak acids such as vinegar, sulphurous acid and carbonic acid in large quantities have a destructive effect. Alkalis such as potash and soda have no action, but ammonium salts tend to disrupt the surface, with the liberation of small quantities of ammonia. Organic fertilisers and manures attack lean concrete (*i.e.*, concrete having a low percentage of cement) when freshly laid, but not concrete one month old.

Water is practically without action on the cement, which may be rendered impervious by such substances as bitumen or sodium silicate. Bitumen is frequently used to render cement acid-proof (see "Bituminous Materials and Cement," U.S. Bureau of Standards).

The use of sodium silicate as a top dressing will satisfactorily cure the "dusting" of Portland cement, but it should be noted that common viscous "waterglass" is not always satisfactory. Such solutions are usually cloudy and have a soda/silica ratio varying between 1 to 4 and 2 to 3. The most generally useful silicate for use on cement has a ratio Na_2O/SiO_2 of 1 to 3·3. The solution contains 3·3 mols of silica to one of soda and is usually clear. It is now possible to obtain a "neutral" silicate in the form of a white powder, soluble in hot water, and containing about 60 per cent. of silica and 20 per cent. of soda.

A report on "Service tests on Concrete Floors" has been published by the U.S. Bureau of Standards, (Oct. 1920).

MAGNESITE CEMENTS

Magnesium oxide, prepared by heating magnesite ($MgCO_3$) to 800° C., is mixed with a strong solution of magnesium chloride; and the mixture sets to a hard compact mass having the formula $5MgO.MgCl_2.XH_2O$, where X has the value of 17 approximately. The magnesia should contain between 85—90 per cent. MgO, and less than 4 per cent. CaO (lime). The specific gravity of the $MgCl_2$ solution usually lies between 28° and 30° Bé. The density of most magnesite floorings is about 1·1 (water=1). Such floors should not be washed too frequently. A preliminary dressing of linseed oil, followed by ordinary floor polish, is probably the best treatment.

BITUMEN

Bituminous substances, acid-proof and waterproof, are valuable as viscous binding materials, and are frequently mixed with finely-graded granite dust, limestone dust and cement, in order to increase the viscosity. (See D. C. Broome, *J.*, 1923 May, 192 T.) If V=the viscosity of the tar alone at any temperature between 60° F and 100° F and Vp=viscosity of the mixture at the same temperature, it is found that $Vp=V^x$, where the value of $X=kp+1$, p being the percentage of filler added and k a constant whose value is $8{\cdot}5\times10^{-3}$. The percentage p of filler added should be less than 15 per cent.

It is possible therefore to calculate with reasonable accuracy the amount of filler which must be added to a low-viscosity tar to raise the viscosity to a given value Vp, since from the equation, $Vp = V^{(Kp+1)}$ and therefore

$$p=\frac{\log\frac{Vp}{V}-1}{8{\cdot}5\times10^{-3}}.$$

The equation should not be used for tars of a consistency V of less than 10 seconds at the temperature of the experiment, and no particles larger in diameter than 0·01 inch should be added. Reference may be made to the "General Directions for Tar Treatment of Roads" (Ministry of Transport, Roads Dept., 1923).

RUBBER

Rubber is resistant to water and acid under general conditions, but is considerably affected by oil. With raw rubber at 8d. to 10d. per lb. it should be possible to put on the market a self-coloured rubber $\frac{1}{8}$ inch in thickness at 12s. per sq. yard. The present maximum width of such compositions is 48 inches. Sheet rubber can be readily trimmed with a wet knife, and joints can be fixed down on to a cement base with rubber solution, or on to wood with glue. The material is eminently suitable for hospitals and institutions where the floor surfaces are washed regularly.

CALCIUM-SULPHATE CEMENTS

Hard-burnt plaster of Paris, produced at temperatures above 400° C, sets only very slowly, but the finished product is extremely hard. Experiments made by Haddon (*cf. J.*, 1921, 122 T) show that the expansion of plaster of Paris on setting is least when accelerators such as K_2SO_4 or $FeSO_4$ are used, and greatest when retarders (*e.g.*, $CaCl_2$) are employed. The tensile strength of briquettes in which an expansion of 5 per cent. has occurred is considerably less than that of a plaster in which expansion is normal, say 0·1 per cent., and has not been influenced by retarders. It is found that mineral oils have no effect on the tensile strength. As flooring compositions, such cements have the disadvantage that they set very slowly.

MISCELLANEOUS CEMENTS

Many modern composition floors consist of mixtures of short fibre asbestos held in a binder of sodium silicate with or without the addition of other aggregates such as powdered serpentine; the colouring matter in such flooring is usually oxide of iron (rouge).

PATENT LITERATURE

One suggestion for sound-proof material (E.P. 110,194, 1916, *J.*, 1917, 1237) involves the production of a porous structure by suitable quantities of sand and Portland cement. A fireproof composition is described in E.P. No. 121,986, 1917, and an acid-proof mixture in 121,855, 1918; (*J.* 1919, 107 A.) Light concretes frequently contain cork dust or sawdust, and sometimes dilute sodium silicate is added : as examples of porous aggregates see E.P. Nos. 173,965, 1920, and 180,887, 1921.

Patent No. 13,075, 1915, describes a magnesite composition, in which magnesia is mixed with 15—25 per cent. of its weight of sawdust, and 50 per cent. of its weight of $MgCl_2$ solution (18° Bé), a facing of slagwool or asbestos being given.

A. A. Shively (*J. Ind. Eng. Chem.*, 1916, 8, 672) recommends the use of a mixture consisting of, per cent., magnesia 40, clay 20, venetian red 12, sawdust 10, terra alba 8, $MgCl_2$ 10, water being added as required ; compare also Nos. 15,038, 1914 ; 120,727, 1917 ; 162,514, 1920 (*J.*, 1921, 434 A) and 178,880, 1920. The use of various zinc oxychloride compounds has been patented, *e.g.*, No. 194,025, 1922 (*J.*, 1923, 403 A), in which the final hardened surface is formed by the action of formaldehyde on gelatin. In No. 112,196, 1917 (*J.*, 1918, 89 A) it is stated that the double oxychloride has the composition $Zn_2OCl_2.Ca_2OCl_2$.

The stability of bituminous substances is stated to be increased by the admixture of at least 2 per cent. of clay paste, the water being removed by evaporation (No. 9838, 1915). Reference may be made to a soundproof mixture covered by a German patent (329,410, 1918 ; *J.*, 1921, 220 A).

A plastic composition resembling natural asphalt is covered by No. 181,092, 1921, in which one of the constituents is rubber. The addition of 2 parts hydrated aluminium oxide to 1 part of rubber is suggested as a method of rendering rubber "non-flam" (159,014, 1919 ; *J.*, 1921, 269 A), and the same fireproofing effect is claimed for sodium tungstate in a mixture consisting of rubber solution, woody fibre, and sodium tungstate (No. 110,941, 1916). Reference may also be made to No. 107,107, 1916 (*J.*, 1917, 895), and to an American patent which claims that high fusing point and marked colloidal properties are obtained by incorporating 1—1·5 parts of rubber and 100 parts of bitumen.

Silicate floorings are represented by No. 183,753, 1921 (*J.*, 1923, 57 A), the mixture consisting of quartz 50 pts., shavings 40 pts., zinc oxide 5 pts., potassium silicate solution (30° Bé) 50 pts. In place of shavings, short fibre asbestos is frequently employed.

An acid proof composition is covered by No. 108,278, 1917 (*J.*, 1917, 965), which consists of such an admixture as quartz 90 pts., calcium phosphate 10 pts., and sodium silicate 30 pts., to be mixed in the usual way, and treated with an acid such as sulphuric acid either just before or just after it sets.

Northern Polytechnic
London, N. 7

FORTHCOMING EVENTS

Oct. 15. INSTITUTION OF RUBBER INDUSTRY, *Manchester Section*, Midland Hotel, at 7.30 p.m. "Rubber Machinery." Discussion to be opened by H. C. Young.

Oct. 16. ROYAL COLLEGE OF SCIENCE CHEMICAL SOCIETY, South Kensington, S.W. 7, at 4.45 p.m. "Water as a Catalyst," by Prof. H. B. Baker, C.B.E., M.A.

Oct. 16. THE UNIVERSITY OF LONDON, University College, Gower Street, W.C. 1, at 5.30 p.m. "The Present Tendencies and Future Compass of Physiological Science," by Prof. A. V. Hill, F.R.S.

Oct. 18. THE CHEMICAL SOCIETY. Ordinary Scientific Meeting, Burlington House, Piccadilly, W. 1. "Studies in Electrovalency. Part III. The Catalytic Activation of Molecules and the Reaction of Ethylene and Bromine," by R. G. W. Norrish.

Oct. 18. THE INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. Inaugural Address by the President, Dr. A. Russell.

Oct. 18. INSTITUTION OF MINING AND METALLURGY, Cleveland House, City Road, E.C. 1. General Meeting.

Oct. 18 to 20. INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND. Conference of Fellows and Associates with the Liverpool and N. Wales Section of the Institute in Liverpool.

Oct. 19. THE SOCIETY OF DYERS AND COLOURISTS, *Manchester Section*, 36, George Street, Manchester. "Some Aspects of the Theory of Quinones," by Prof. R. Robinson, D.Sc., F.R.S.

Oct. 19. SOCIETY OF CHEMICAL INDUSTRY, *Swansea Section*, Thomas's Café, Joint Meeting with the South Wales Section of the Institute of Chemistry, at 6.30 p.m. Discussion on "Short Cuts in Analysis."

Oct. 19. THE INSTITUTE OF METALS, Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, at 7.30 p.m. "Large Metallic Crystals and Some of their Properties," by Prof. H. C. H. Carpenter.

Oct. 18 and 19. THE TEXTILE INSTITUTE. Annual Autumn Conference at the Exhibition of Textile Machinery, etc., in the Junior Training Halls, Leicester. "Artificial Silks." P. E. King. "The Application of Dyes to Textile Fibres and Fabrics," Prof. J. Thorpe.

Oct. 19 THE INSTITUTION OF MECHANICAL ENGINEERS. General Meeting, Storey's Gate, St. James's Park, S.W. 1., at 6 p.m. Presidential Address by Sir J. Dewrance, K.B.E.

Oct. 22 THE INSTITUTE OF PHYSICS. The Institution of Electrical Engineers, Victoria Embankment, at 5.30 p.m. "Physics in Industry," by Dr. A. E. Oxley.

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS,

October 31, 1923

This Dinner is being arranged under the joint auspices of the Chemical Society, the Institute of Chemistry, and the Society of Chemical Industry, and will be held in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on Wednesday, October 31, at 7 for 7.30 p.m. The arrangements are being made by a Committee consisting of representatives of the Societies mentioned. and of one or two other Societies.

Sir William J. Pope, K.B.E., F.R.S., will take the chair. There will be some speeches and some music as well as opportunities for social intercourse.

No similar dinner for chemists has hitherto been organised on exactly the same lines, and it is expected that the gathering will be not only very pleasant, but will be useful in promoting that social acquaintance which is so valuable in connexion with prevailing ideas and hopes.

Members of any of the Societies concerned are invited to attend and bring guests. The price of tickets for ladies and gentlemen is 12s. 6d. each, not including wine. Applications for tickets (accompanied by the appropriate remittance) should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2, as soon as possible.

Applicants are invited to state names of any friends beside whom they wish to be seated, and the names of guests should be furnished at the same time.

DEATHS

Dickenson, F. M. (elected 1898), of Broken Hill Proprietary Co., 3, Great Winchester Street, London, E.C. 2. Secretary. On May 22, 1923.

Kuttroff, Fred (elected 1900), of 128, Duane Street, New York City, U.S.A. Merchant. On October 22, 1922.

Leonard, Wm. J. (elected 1884), of Lindfield Gardens, Hampstead, and Hope Chemical Works, Hackney Wick. Naphtha Distiller. On September 10, 1923.

Muspratt, Dr. Edmund K. (Original Member), of Seaforth Hall, near Liverpool. Alkali Manufacturer. On September 1, 1923.

Thomson, Wm. (Original Member), of the Royal Institution Laboratory, 79A, Princess Street, Manchester. Analytical and Consulting Chemist. (Former Chairman of the Manchester Section.) On October 4, 1923.

MANCHESTER SECTION

The first meeting of the Session was held on October 5, Dr. H. Levinstein being in the chair. The attendance numbered about 60, the president of the Society, Dr. E. F. Armstrong, F.R.S., being also present. In opening the proceedings the chairman referred to the death of Mr. William Thomson, an original member of the Society, and a member of the Committee of the Manchester Section from as far back as 1885, and the Honorary Secretary (Mr. L. Guy Radcliffe) was authorised to send a vote of condolence to the bereaved family. The chairman then read an address, entitled "Recent Progress in Chemistry."

He said that when he last addressed the Section in March he reviewed briefly the progress made in British chemical industry since 1914. The war gave the opportunity for English chemical manufacturers to supply products for which a demand had previously been created by the German "Interessengemeinschaft" ("I.G."), and which had become necessary for the conduct of our trade. Thus very large dyestuff and other factories were erected, and of their activities he had endeavoured to give some brief account.

They would not fall into the error of thinking that "Capturing the German trade" (he believed that was the correct catch-phrase) was quite so simple a matter as merely making in England things previously made in Germany. It was not always easy to copy a German dyestuff merely from a specification, but in the technology of the dyestuff and fine chemical industry one did not expect it to be. It was certainly necessary to do this so that you could supply the products which the consumers had been accustomed to get from Germany, but this was just ordinary business routine in a dyestuff factory. Consider the life history of such a substance. Discovered in a German dyestuff laboratory, it was picked out by a discerning German technologist as a likely commercial "winner," made on a large scale probably in existing plant, until a demand had been created for it by a German technical sales organisation satisfied of its merit and determined to make it a commercial success. We should have a false sense of values if we considered that we were catching up merely by copying German patents, and he regretted the publicity which was sometimes given to this aspect of the question. Surely no-one present would think it possible to battle successfully in the world's markets by copying other people's products after they had been proved commercially successful by enterprising competitors. Everybody knew that the dye industry was not static, but progressive. Frequently it was stated that we in this country were forty years behind the Germans in chemistry. This view was erroneous. In some branches of chemical science we led the world, and in none could we be said to lag conspicuously behind any other nation.

The British Chemical Industry would be very well represented at the British Empire Exhibition at Wembley, to be opened in April, 1924. The Industrial Exhibit would be a collective exhibit in the sense that every exhibit would form part of a homogeneous scheme. There would also be an exhibition of British Chemical Science, which would be placed close to the industrial section, and would add greatly to its value. This scientific exhibit was being organised by a thoroughly representative committee, including representatives of the Royal Society, the Chemical Society, the Institute of Chemistry, the Society of Dyers and Colourists, the Institute of Petroleum Technologists, the Society of Chemical Industry, and the Association of British Chemical Manufacturers and also of the Federal Council of Pure and Applied Chemistry. Further, it had the great advantage of being in consultation with, and represented on, the British Empire Exhibition Committee of the Royal Society.

Dr. Levinstein then dealt generally with the progress of chemical science since the time of John Dalton, mentioning the names of numerous British investigators and stating the results achieved by them. In conclusion, he said it was desirable that the intimate bearing of biochemistry on many of the circumstances of daily life should find an appropriate expression at the forthcoming British Empire Exhibition. The Scientific Sub-Committee of the Chemical Section had appointed a Biochemical Sub-Committee, comprising Messrs. J. L. Baker, Dudley, A. Harden, T. A. Henry, Gowland Hopkins and Schryver, and it had been suggested that the exhibits should be arranged under the groups: (1) Vitamins; (2) Insulin; (3) Standardisation of animal extracts; (4) Fermentation, including alcohol, acetone, glycerol, lactic and butyric acids, beer and cider; (5) Bread; (6) Tannins and leather; (7) Nutrition and protein decomposition; (8) Cotton; (9) Silk; (10) Sewage and water; (11) Respiration of plants and animals; (12) Plant constituents; (13) Therapeutics, ergot, digitalis, squill, etc.; (14) Glue and gelatin; (15) Photographic exhibit of English biochemical laboratories.

One or two investigators whose names were prominently associated with the respective groupings would be invited to make detailed suggestions as to the nature of the exhibits. Thus Profs. Harden and Drummond might deal with vitamins, Dr. Dudley with insulin and animal extracts, Dr. Henry with plant constituents, Prof. Schryver with glue and gelatin, etc. Prof. Gowland Hopkins would deal with muscle work, lactic acid, Bence Jones protein, accessory food factors, uric acid and its derivatives on butterflies' wings, tryptophan, etc. Other exhibits might be:—Structure of the atom, Sir Ernest Rutherford, F.R.S., spectroscopy, Sir Herbert Jackson, F.R.S., crystallography and molecular structure, Sir Henry Miers, F.R.S., valency and theories of chemical combination, Prof. Lapworth, F.R.S., photography, Dr. T. Slater Price, general physical chemistry, Prof. Donnan, F.R.S.

Dr. E. F. Armstrong proposed, and Dr. E. Ardern seconded, a vote of thanks to Dr. Levinstein for his address.

BRISTOL SECTION

The opening meeting was held in the University, Woodland Road, on October 4, when Mr. John F. Reid gave a paper entitled "An Outline of Rubber Manufacture," to an appreciative audience numbering 63. Mr. W. Jones was in the chair.

The author first described the coagulation of rubber latex and said that, with the exception of crêpe sole, the rubber thus obtained required further treatment. Various materials, usually fluids or fine powders, were added to produce hardness, change the colour, make manipulation in manufacture easier, and give lasting qualities, resistance to chemical action, and so forth. Of all these materials sulphur was the most important, as it caused a profound change when the mixture was vulcanised, or "cured." The raw rubber was made plastic by grinding between steam-heated steel rolls, one of which revolved faster than the other. After about half-an-hour the powders were slowly added to the churning mass, the sulphur being added last. The material might be made into sheets by running it through hot calenders, or might go direct to extruding or forcing machines. The chief varieties of forced rubber were gas-tubing, carriages and pram tyre, linings for hose and window glazing strip. These were vulcanised in a bed of French chalk for from anything between 30 minutes to 4 or 5 hours at temperatures between 260° and 300° F., obtained by steam pressure. Calendered rubber varied in thickness from 0·01 in. to about 0·1 in., and articles of any thickness could be built up by adding the required number of layers, which could then be cut approximately to shape and vulcanised in a steel mould, under hydraulic pressure. Rubber was not moulded like lead or steel, as open heating destroyed it. The most recent invention, however, employed a solution of rubber which was poured into a mould, the rubber rendered vulcanisable and the solvent dried off. The most outstanding physical property of finished rubber was its elasticity; it stretched under stress up to 900 per cent. or more of its original length before it broke. Its specific gravity varied from about 0·9 to 4·8; and it might possess any colour. Its tensile strength was surprising, specimens occasionally reaching a strength of 6000 lb. per sq. in. It was a non-conductor of heat and electricity, and could be obtained in a state which resists abrasive wear to a very marked degree. It could be made highly resistant to the action of dilate acids and alkalis, but was readily attacked by concentrated mineral acids.

An excellent discussion ensued, and the proceedings terminated with a vote of thanks to the lecturer.

It has been arranged for the members to visit the Melksham works of the Avon Rubber Co. on October 18.

CHEMICAL SOCIETY

The first ordinary meeting after the vacation was held on Thursday, October 4, 1923, at 8 p.m., the President, Prof. W. P. Wynne, F.R.S., occupying the Chair.

The President referred to the death of Prof. Herbert McLeod, F.R.S., paying a tribute to the eminent services he had rendered to the cause of Science, and in particular to the Chemical Society, both as a member of the Council and as a Vice-President.

Since the last meeting of the Society, new arrangements had been made regarding the *Journal*, which, as from January next, would be dissociated from the Abstracts, the two sections being issued separately. Abstracts of papers appearing in the *Journal* would, however, be included in future in the volume of Abstracts. Moreover, members who so desired would now be supplied in advance with *précis* of papers to be read before the Society.

Attention was also drawn by the President to the new arrangements, which materialise in January next, for the publication of the *Journal of Physical Chemistry*, under the joint auspices of the Chemical Society, the Faraday Society, and the American Chemical Society.

The following paper was read by Mr. E. C. Craven :—

Note on aqueous formaldehyde solution. W. R. Ormandy and E. C. Craven.

THE discrepancies in the published values for the densities of aqueous formaldehyde solutions probably arise from the presence of methyl alcohol. The densities of solutions prepared by refluxing with water are now found to agree excellently with the results of Auerbach and Barschall, who prepared solutions by volatilising paraform in a current of nitrogen and absorbing the gaseous formaldehyde in water. The density and the refractive index of a formaldehyde solution appear to be linear functions of the formaldehyde concentrations. Thus at 15° C.:

$d = \cdot 9992 + \cdot 00307\,C.$

$n_0 = 1\cdot 3334 + \cdot 001145\,C.$

where C = % weight of formaldehyde in solution.

The specific refractivity of the formaldehyde in the dilute aqueous solution appears to be ·205, which agrees well with the assumption that methylene glycol is formed and this assumption is also borne out by the density measurements.

Dr. W. R. Ormandy humorously suggested that since formaldehyde evidently did not exist as such in its aqueous solution, the problem whether or not it is a "synthetic organic chemical" would appear to admit of easy solution.

Dr. H. J. S. Sand read a paper entitled

The interaction of potassium tetroxide with ice, and with dilute sulphuric acid. H. Hawley and H. J. S. Sand.

EXPERIMENTS were carried out to determine whether any evidence could be found for the formation of an oxide of hydrogen higher than the dioxide when ice or dilute sulphuric acid is brought together with potassium tetroxide at or below 0°. For this purpose the oxygen evolved on bringing the reactants together was measured, and found to be slightly greater than that which would have quantitatively left a derivative of hydrogen dioxide in solution. The solutions remaining were also tested as regards their velocity of reaction with hydrogen iodide and found to agree accurately with corresponding ones made up from hydrogen dioxide. It is thus proved that only hydrogen dioxide results from the interaction of potassium tetroxide with ice or with dilute sulphuric acid.

Dr. Irvine Masson remarked that the authors' results appeared to be conclusive, and enquired whether any ozone was present in the evolved oxygen.

Dr. T. Slater Price said that by avoiding the use of permanganate the authors had eliminated uncertainty due to the possible formation of persulphuric acid; he suggested the use of colloidal platinum in identifying the product of the reaction by means of velocity-experiments.

In reply, Dr. Sand said that ozone had not been noticed in the oxygen; he had not used colloidal platinum, but was under the impression that its use would involve greater difficulty in reproducing the experimental conditions.

Mr. R. G. W. Norrish gave an account of experiments on

The direct union of oxygen and sulphur (being Part IV. of "The conditions of reaction of hydrogen and sulphur"). R. G. W. Norrish and E. K. Rideal.

THE reaction of oxygen and sulphur has been studied by a dynamic flow method, between the temperatures 235° and 385°. Below 305° it proceeds with a temperature coefficient of 1·63; above 305° this falls off rapidly, due to the secondary formation of sulphur trioxide. The reaction is limited to the surface of the sulphur and the walls of the vessel, and proceeds equally well on both, pointing to a liquid film covering the whole surface of the vessel. This film can be seen under certain conditions by the development of interference colours. The rate of reaction is proportional to the pressure of oxygen, but at 0·41 atm. pressure a break occurs in the pressure-velocity curves, indicating that the reaction on the surface is complex and is made up of the sum of two reactions, one of which—the A reaction—becomes independent of pressures above 0·41 atm., while the other—the B reaction—remains proportional to the oxygen pressure as high as at least 1 atm. The temperature coefficients are respectively, 1·48 and 1·77, and the critical increments 25,750 cals. and 37,450 cals. The figures for the A reaction fulfil a prediction of the hypothesis advanced in earlier papers of this series. In explanation of the facts the assumption is made that the sulphur surface contains two different kinds of sulphur molecules, with which the oxygen molecules striking the surface react differently, giving the A and B reactions. The fact that the A reaction finally becomes independent of pressure indicates that the rate of production of the second allotropic form of sulphur now limits the velocity of the reaction. The temperature coefficient of the interconversion of the two forms of sulphur is shown to be 1·48 as required by the hypothesis advanced. A table of seven different reactions of sulphur is given which shows that their critical increments are simple multiples of a constant quantity, which is considered to be the half value of the work required to create one free sulphur bond.

Dr. J. J. Fox said that whilst some S_2 was undoubtedly present, most of the sulphur vapour consisted of S_8 molecules, with which the oxygen reacted. It was necessary, therefore, to take into account the heat change involved in the reaction $S_8 = 4\,S_2$.

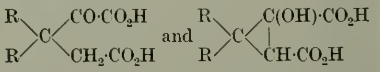
Mr. S. Sugden enquired whether the formation of sulphur trioxide above 305° appeared to be connected with the glowing of sulphur just below the boiling-point.

Mr. Norrish agreed that S_8 was present, but together with S_4, S_2, and S; the velocity of reaction, and likewise the temperature coefficient, were, however, determined by the slowest reaction, namely, $S_2 \rightarrow 2S$. He had observed that a glow generally preceded an explosion of the mixture of sulphur vapour and oxygen when the temperature was raised and the pressure increased. It was certain that no sulphur trioxide was formed at the lower temperatures employed.

Prof. J. F. Thorpe, F.R.S., described the following investigations :—

Ring-chain tautomerism. Part VII. The effect of the cyclohexane nucleus on the carbon tetrahedral angle. E. W. Lanfear and J. F. Thorpe.

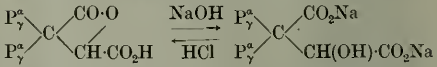
THE final proof that the directions of two valencies of a carbon atom are profoundly altered by the volumes of the groups attached to the two other valencies, or by the inclusion of these other valencies in a ring complex having known carbon to carbon angles is now supplied. Hitherto it has been shown that two substances



are tautomeric in strong potash solution when R, R = diethyl or di-*n*-propyl, but that when R, R = 2 hydrogen, 2 methyl, cyclopentane, or methyl ethyl, the keto-form is alone stable. Similarly, it has been shown that when R, R is a cyclohexane complex the hydroxy-ring form is alone stable. It is now proved that in the di-hydrogen, dimethyl, cyclopentane and methyl ethyl series the hydroxy-ring form is unstable, and that in the cyclohexane series the keto-form is unstable.

The formation of stable β-lactones. L. Bains and J. F. Thorpe.

HITHERTO the β-lactones which have been prepared have been found to be unstable to alkali; that is to say, they do not, under this treatment, behave like the γ-lactones and yield alkali salts of the hydroxy-acids from which the lactones can be regenerated. The alteration of the carbon tetrahedral angle by the di-*n*-propyl group causes, however, the four-membered heterocyclic nucleus to be so readily formed that the β-lactone behaves like a γ-lactone :—



The President remarked how fruitful had been the idea of the carbon tetrahedral angle in the hands of Prof. Thorpe, whom he thanked for speaking at very short notice.

ACADÉMIE DES SCIENCES

During the meeting held on September 17, Dr. Roux communicated a paper by Monsieur J. Regnier on "The measurement of the degree of anæsthesia produced by local anæsthetics," which indicated that novocaine was ten times less active than cocaine, and that stovaine, with an activity almost equal to that of cocaine, had a much less lasting action.

On October 1. Monsieur Molliard communicated a paper by M. Préaniniznikor, explaining that the inferiority of ammoniacal salts compared with nitrates as nitrogenous fertilisers, is due to the acid secretion that they induce in the plant. If this secondary effect is eliminated, ammonium compounds give a higher yield than nitrates, but it is still true that the larger the quantity of nitrate present the better the plants develop. In a second paper the author showed that the nature of the radiations selected by the plant for photochlorophyll assimilation depend on the species of the plant. Prof. Le Chatelier described a method, based on alterations in surface tension, for the estimation of very small quantities of alkali. Monsieur Hadamard criticised Helmholtz's explanation of several paradoxes of hydrostatics. claiming that the formation of discontinuous surfaces postulated by Helmholtz to explain the slipping of a mass on a liquid layer was incomprehensible. Recent experiments by Caemichel suggested that instead of discontinuous surfaces, vortices were formed, a view that was confirmed by Prof. Volterra. Monsieur Lumière communicated a note by Monsieur le Clerc, on an error in the interpretation of the point of view in photographic reproductions.

SOCIETY OF PUBLIC ANALYSTS

Four papers were read at the meeting held in Burlington House on October 3, with Mr. P. A. Ellis Richards in the chair :—

(1) "The Sampling of Coal; the General Problem and some Experiments," by J. H. Coste, F.I.C., E. R. Andrews, F.I.C., W. E. F. Powney, F.I.C. Attention is drawn to the difficulties encountered in sampling coal, which is often a heterogeneous mixture, so that the variations in composition of different "patches" are extremely wide. These variations are likely to be more extreme where the bulk is large and where it is impossible to sample throughout the dump. General considerations that should govern the sampling are suggested, and stress is laid upon the point that if, as often happens, different workers obtain different results from samples taken from the same bulk, the discrepancies are not due to mistakes in working, but indicate the variability in composition of the coal. Experiments are described in which it is shown (1) how difficult it is to obtain a homogeneous set of samples from so small a quantity of coal as 70-80 lb., and (2) the variation in composition of samples taken progressively from a bulk of about 400 lb.

(2) "New Test for Distinguishing Castor Oil from other Oils and Determining its Purity," by H. B. Stocks, F.I.C. The test is based on the following facts :—Ordinary soap solutions are alkaline to phenolphthalein. On titration with standard acid solution a point is reached at which a state of equilibrium exists and the pink colour disappears. The amount of acid required increases with the dilution up to about 1 part in 150 or higher, at which point it becomes practically constant. With soaps of oleic, palmitic, and stearic acids, and soaps from oils composed of these acids, the figures are equivalent to approximately half the total combined alkali. With castor oil soap it is only 3 to 11 per cent. of the total. Five grams of the oil to be examined are saponified with alcoholic potassium hydroxide, neutralised, evaporated to remove alcohol, made up to 100 c.c., 10 c.c. being diluted with 250 c.c. of neutral distilled water and titrated with hydrochloric acid in presence of phenolphthalein. Castor oil gave figures varying between 4·8 and 7·9, and figures are given in the paper for a number of fats and oils and rosin, in each case very much higher than for castor oil.

(3) "The Volumetric Estimation of Vanadium in Steel," by A. T. Etheridge, B.Sc., F.I.C., M.B.E. The estimation is carried out in the same solution in which chromium has already been estimated by treating the aqueous solution of the sulphates of the metals with permanganate, filtering, removing any colour due to iron, treating with standard ferrous-sulphate solution and titrating with permanganate. This gives the chromium figure. The solution is then adjusted so that it contains about 10 per cent. by volume of sulphuric acid, excess of ferrous sulphate is added, and the solution titrated with potassium bichromate, using as indicator 5 c.c. of diphenylcarbazide prepared by dissolving 0·5 g. in 1·2 c.c. glacial acetic acid, diluting to 500 c.c., and adding to each 5 c.c. 3 drops of 25 per cent. sulphuric acid and 1 drop of potassium-bichromate solution, resulting in the formation of a deep purple colour. About half the indicator should be added within 1 or 2 c.c. of the end of the titration, and the titration continued until the purple colour has practically disappeared. The remainder of the indicator solution is then added and the end point occurs within 1 or 2 drops, an apple-green tint being formed. A small amount of ferrous solution must be present when the indicator is added, the presence of 10 per cent. of sulphuric acid is necessary, and nitric acid, other than traces, should not be present.

(4) "The Iodimetric Determination of Sugars," by C. L. Hinton, F.I.C., and T. Macara, F.I.C. The aldoses, *e.g.*, dextrose and lactose, are quantitatively converted to the corresponding monobasic acids by iodine in alkaline solution at ordinary temperature, provided the proportions of alkali and iodine to sugar are suitably controlled. The slight oxidation of sucrose and levulose found by other observers is confirmed, the extent of this action depending considerably on time and temperature of reaction as well as on the proportions of iodine and alkali used. Using standard conditions, it is possible to determine sucrose accurately in mixtures by titration before and after inversion, but the determination of other sugars is liable to be affected by non-sugar reducing substances. The method is so convenient, however, that it recommends itself technically for approximate determination of invert sugar.

PERSONALIA

The "Medaille d'honneur de l'enseignement technique français" was recently presented to Mr. Stubbs, president of the Institute of British Foundrymen, by M. Vidal, under-secretary of State.

The following promotions have been made in the Legion of Honour on the occasion of the centenary of Pasteur: Messieurs Lacroix, A. Lumière to Commanders; Messieurs Cavalier, Hadamard, Radais, Blaise, Delépine, Lespian, Muller, Denigès, Guntz, Chavanne, Kayser, de Chardonnet, Simon, Le Bel and Victor Deschiens, to Officers; Messieurs Auger, Guerbet, Guérin, Tiffeneau, Maris, Marquis, Gault, Gedechot, Rivals, Jumelle, Bourion, Darmois, Mailhe, Nicloux, Wahl, Arsandaux, Abbé Senderens, to Chevaliers; Monsieur Vallée to Commander; and Messieurs A. Latapie and C. Levaditi, have been appointed Chevaliers.

Mr. A. A. Ramsay has been appointed chemist to the New South Wales department of agriculture, in succession to Mr. F. B. Guthrie.

CORRESPONDENCE

THE GOVERNMENT LABORATORY

Sir,—With reference to your editorial remarks about the Government Laboratory, some account (illustrated) of this Laboratory is given in Sir William Tilden's "Chemical Discovery and Invention," p. 60.—I am, Sir, etc.,

St. Helens, Lancs
October 6, 1923
A. Haywood

THE CHEMICAL ENGINEER

Sir,—Mr. Gray's article on "The Chemist and Industry" (*Chemistry and Industry*, October 6) raises again, *inter alia*, that age-old controversy about the chemical engineer, with the equally old axiom that "a man cannot be both a good chemist and a good engineer." You know the tale, "Chemistry is a science, Engineering is an art," and so on. The subject has been discussed till it is threadbare, with, I contend, one great omission.

Two important books have appeared recently. One is "A Handbook of Chemical Engineering," by D. M. Liddell; the other, "Principles of Chemical Engineering," by Walker, Lewis and McAdams. Both are likely to play a part in the development of the subject, and so I will draw an inference from them. The former is a practical book, containing a good deal of theory; the latter is a theoretical book, containing a good deal of practical matter. In neither book is there much chemistry. In both books there is a whole mass of *physics*. Flow of heat, flow of fluids, handling of solids, liquids, and gases, flotation, evaporation, gas-scrubbing—are these chemistry? Yet these are the domain of the chemical engineer. Even combustion belongs to physical chemistry. It is true that the chemical engineer must know some chemistry; the potter must know how to mix his clay. But I suggest that the name is a misnomer. His principal tools are *physics* and engineering, and he should be called a physical engineer. Whilst the man is exceptional who can be both a good chemist and a good engineer, I believe that there are plenty who are both good physicists and good engineers, and these are they who are called chemical engineers. Much of the argumentation on the subject arises from a failure to appreciate this point.

These remarks do not, of course, alter the fact that there are many self-styled chemical engineers who are nothing of the sort. That is another subject.—I am, Sir, etc.,

G. J. Greenfield

Templeton Coke Works,
Consett
Oct. 8, 1923

Sir,—I was extremely interested in Mr. H. H. Gray's article "The Chemist and Industry" in last week's issue of the Journal. I am sure he is to be complimented upon his literary abilities, but I do not find myself favourably impressed by his reference to the professional "Chemical Engineer." Mr. Gray would almost give us to understand that the "Chemical Engineer" cannot exist. "Some people," he says, "profess to believe that in one and the same person an engineer and a chemist can be found." Surely the inventors of some of the wonderful chemical plants which are at present on the market have a claim to the title, also I should be inclined to suggest that engineers who have specialised in the study of machinery and plant particularly adaptable to special chemical processes have the same claim. My opinion is that Mr. Gray's ideal solution of the problem, namely, that the directing intelligence of chemical concerns should be of a chemical nature and that the executive authority—the process of doing—should be vested in the engineer, is not a solution at all, and this is evidently the opinion of others, having regard to some appointments with which I am familiar. Something more is expected to-day of the one invested with these powers; a trained business mind is wanted in all matters of administration in addition to chemistry and engineering, the knowledge and power not only to advise his firm upon the purely chemical side of the business and his ability to give sound counsel as to the most suitable plant to employ for a specific purpose, but to be able to advise his firm accurately as to initial outlays, working costs (having regard to the important question of labour), the supplies of raw or crude materials, fuel, etc., their transit and handling, and possibly the selling markets of the manufactured product and estimated yields of profit. In my opinion, the controlling influence of a chemical firm must of necessity be the combined knowledge of a chemist, engineer, and business administrator, the last being the predominating qualification.—I am, Sir, etc.,

H. A. Wilson

Rugely, Stafford
October 8, 1923

TRADE INTELLIGENCE

Sir,—Being a member of the Society of Chemical Industry I have *Chemistry & Industry* posted to me weekly. There are two points upon which I desire to write to you.

First, are there ever any inquiries from overseas for such products as flour, feeding stuffs, etc., and if so, could you insert them in the paper under the weekly column "Openings for British Trade"? I notice in this week's issue an inquiry for fertilisers from Poland and think that it would be of use to those members who are interested in the manufacture of flour, foods and feeding stuffs if inquiries for these products could also be published.

The second point is—Could you publish weekly under your "Market Report" the prices of lubricating oils of standard quality, say the Anglo-American Oil Co.'s ·885 spindle oil, 900/7, Bayonne, and cylinder oils? This, I think, would be a guide to a large number of members of the Society who would be users of lubricating oils.

I make these two suggestions which perhaps you may consider would increase the usefulness of the paper to members.—I am, Sir, etc.,

N. Paice
Assoc. M.C.T.

Grimsby,
October 7, 1923

NEWS AND NOTES

FRANCE

First International Congress of Foundrymen

This Congress was held in Paris from September 12 to 15, contemporaneously with an exhibition. Amongst the papers presented were several by Messrs. Holmes, Adamson and Mayhey, who formed part of the British delegation. The paper by Mr. Mayhey on magnesium in foundry-work showed that the casting of magnesium alloys presented no great difficulties, provided that the metal was of suitable quality and that, apart from certain details of manipulation, standard foundry practice was followed. Mr. Adamson (Sheffield) spoke on the graphitisation of cast iron, M. Brizon suggested methods of avoiding the chief difficulties met in casting aluminium bronze, and the importance of the dilatometric method of investigating castings was dealt with by MM. Chevenard and Portevin. In conclusion the congress passed resolutions relating to the execution of mechanical tests on cast iron and decided to set up a mixed commission to establish methods of performing such tests.

Fuel

The total output of coal and lignite in France was 3,214,814 metric tons in July, against 3,325,778 t. in June. Imports were 2,472,728 t. including 1,624,867 t. from Great Britain, and exports totalled 177,071 t. The output of coke from the French coal mines in June was 178,427 t., imports were 301,998 t. and exports 4296 t. Production of compressed fuels reached 245,698 t.; 72,009 t. was imported and 13,349 t. exported.

Metallurgy

During the first seven months of 1923 France imported 40,214 t. of cast iron, 3817 t. of ferro alloys, 291,830 t. of iron and steel; altogether 318,012 t. of cast iron was exported. The output of iron ore reached 1,833,121 t. in July, a decrease of over 50,000 t. compared with June. The present stocks at the mines total 4,635,273 t.

It is reported that a large works is being opened at Beaumont le Roger (Eure) to work up large deposits of slag dating from Roman times. The slag is said to contain 60 per cent. of iron and nearly 20 per cent. of silica.

Potash and Salt

During July the French potash mines yielded 68,969 t. of potassium salts, equivalent to 16,876 t. of K_2O. Production of salt was 93,237 t. in the same month.

CANADA

Mineral Production, 1922

According to the Dominion Bureau of Statistics, the Canadian production and value of certain minerals and allied products in 1922 was as follows:—Asbestos, 158,023 tons ($5,552,723); iron ore, 17,971 short tons ($56,993); lead, 93,307,171 lb. ($5,817,702); silver, 18,581,439 fine oz. ($12,576,758); zinc, 56,290,000 lb. ($3,217,536). All show an increase compared with 1921 except iron ore.

UNITED STATES

A New Remedy for Diabetes

Diabetic patients cannot utilise starches and sugars, and can digest fats only partially, the objectionable acids, butyric, oxybutyric and acetoacetic acids, which contain 4 carbon atoms, being produced. These acids cause acidosis, which decreases the elimination of carbon dioxide and may result in death. Using as a basis Knoop's theory, that, in digestion, after the glycerin is split off from the fat the acid itself is oxidised by the removal of 2 carbon atoms at each step, Dr. M. Kahn argued that if, instead of a fat not containing an even number of carbon atoms (*e.g.*, $C_{18}H_{36}O_2$), one containing an odd number (*e.g.*, $C_{17}H_{34}O_2$) were used, digestion should not result in the production of an acid possessing 4 carbon atoms—*i.e.*, the objectionable acetoacetic acid. Trials with synthetic fats containing odd numbers of carbon atoms confirmed the theory, as the patients promptly lost the acidosis and improved in general health. The fat thus synthesised is glyceryl margarate $(C_{16}H_{33}COO)_3C_3H_5$, and unlike *all* fatty acids in natural fats contains an odd number of carbon atoms. It is known as "intarvin" (*i.e.*, "intermediate fat") and, according to *Industrial and Engineering Chemistry*, is now produced commercially at about $4 for 7 ounces.

GENERAL

Coal and Iron in Northern Ireland

During the past fifty years, many attempts to investigate the mineral resources of Northern Ireland, especially in regard to coal, have failed. A seam of coal, 32 feet thick, has, however, been discovered near Coalisland (Co. Tyrone), and it is hoped that production will be on a commercial basis by the beginning of February next. Two shafts have been sunk to a depth of 1080 ft., and twelve seams of coal located, ten of which are 3 ft. 6 in., and the others 1 ft. deep. It is estimated that the prospected area contains 4,000,000 tons of coal, so that assuming an annual output of 100,000 t., the mine should last forty years. It is proposed to sink a third shaft as soon as the first two are in full working order and raise the output to 3000 t. These will be the first local sales of coal, and with increased output, the selling area will be extended until it reaches Belfast, where the Corporation Gas Works alone uses 50,000 t. annually of a variety similar to the product of the Tyrone mine. Belfast imports about 1,250,000 t. of coal each year, but Coalisland is only thirty-five miles from the city and there are both rail and water facilities for the transport of the mineral.

The Antrim Iron Ore Co. of Northern Ireland operates half a dozen mines over an area of about sixty-five square miles, and produces about 60,000 t. per annum. The ore is being brought by rail to Belfast from around Glenravel, Parkmore and Broughshane, a distance of about forty miles, and is then shipped by the company's own vessels to ports on the east and west coasts of England and Scotland. The Antrim ore gives an average analysis of about 40 to 42 per cent. metallic iron, and possesses special binding qualities, which renders it of exceptional value in the manufacture of raw metal.—(*Ch. Comm. J., Sept.* 28, 1923.)

REPORTS

Fifty-ninth Annual Report on Alkali, etc., Works. *By the Chief Inspectors. Pp.* 38. *H.M. Stationery Office,* 1923. *Price* 1*s.* 6*d.*

The report on works in England and Wales states that although some sections of the heavy chemical trade show distinct improvement, conditions are not yet normal, but the introduction of new methods of manufacture is a hopeful sign. Complaints regarding registered works were few and these were promptly attended to: several works, however, had not been registered. (For technical details see *J.*, 1923, 885 A.)

Salt-cake is still made in quantity and the synthetic manufacture of hydrochloric acid promises to extend; the demand for hydrochloric acid was reduced by slackness in the fibre-separation trade. The chief feature in sulphuric-acid manufacture is the rapid increase in the use of sulphur. In ammonium sulphate and gas-liquor works the tendency is to produce neutral sulphate; haphazard methods are stated to prevail in many works that make ammonium sulphate and the whole treatment of ammoniacal liquor requires more attention. Consumers of chlorine are increasing as the old methods of making chlorine on the spot have been abolished, owing to the production of liquid chlorine.

Operations in Scotland continued to be restricted, but during later months there was increased activity in some branches. No salt was converted into alkali, and the production of salt-cake decreased, but a greater quantity of spent oxide was burned in sulphuric acid works. In some works it was thought advantageous to run gas liquor to waste rather than recover the content of ammonia.

Report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1923. *Pp.* 141. *H.M. Stationery Office,* 1923. *Cmd.* 1937. *Price* 4*s.*

The total expenditure of the Department of Scientific and Industrial Research during 1922-23 was £497,549, made up of £264,493 from the Exchequer, £48,103 from interest on the Million Fund, £95,345 from the capital of the Fund and £89,608 from fees for work for outside bodies. The chief items of the expenditure were: The National Physical Laboratory £164,906 (£90,358 received in fees should be deducted); Fuel Research Board £40,695; Geological Survey and Museum £55,935; Building Research Board £6975; Food Investigation Board £17,299; Forest Products Board £2876; grants to research associations £95,345; grants in aid of scientific investigations by other bodies £6244; grants to 304 students and research workers £50,000. Owing to restrictions in the programme of research work and to the automatic fall in wages, the net estimates for 1923-24 have been reduced to £276,863, compared with £297,437 in 1922-23.

Only one new research association for the flour-milling industry—has been established since 1921, but the formation of associations for research on adhesives, liquid fuels, pottery, paint, preserved foods, paper, china clay, mining and drugs has been discussed. It is gratifying to note that a grant is offered (*cf. Chem. and Ind.*, p. 782) to the British Photographic Research Association for a further period of four years.

The Fuel Research Board has begun work on low-temperature carbonisation, investigated the efficiency of water-gas plant, and carried out work on the combustion of coke, carbon-dioxide recorders, the Thomas calorimeter, on a tetralin-petrol mixture as motor fuel, and the carbonisation of peat. Other problems receiving attention are those of domestic heating, power alcohol, and the fermentation of cellulosic materials. Reports have been published on carbonisation in vertical retorts, water-gas plant, the air-drying of peat, an apparatus for measuring the specific gravity of gases in small quantities and the analysis of coal. Progress is being made with the physical and chemical survey of the national coal resources.

Researches ranging from investigations on alloys, illumination, radium, standard steel samples, to metrology, electric cables, lubrication, reinforced concrete, road surfaces, are in progress at the National Physical Laboratory; of great interest to chemists are the valuable researches on alloys.

The Low-Temperature Research Station at Cambridge is now at work under the Food Investigation Board and 35 research workers have now made use of it. Amongst work done under the auspices of the Board mention may be made of the isolation of pure hæmoglobin, the storage of fruit and fish, the production of succinic acid in meat during storage, and work on insulating materials, the chemistry of fats, and the chemistry of canned fish. Progress has been made in the investigations of the Forests' Products Research Board on the relations of water to wood and on the testing and preservation of timber. Under the Building Research Board, fundamental researches have been initiated on the setting and hardening of cements, the decay and preservation of stone, paint technology, and a wide series of problems of practical importance is being attacked.

Investigations on behalf of the Chemistry Co-ordinating Research Board were continued at the Royal Naval Cordite Factory on the oxidation of hydrocarbons to produce formaldehyde (*cf. J.*, 1922, 41., 303 T, 331 T, 42, 81 T, 260 T), and at the Research Department, Woolwich Arsenal, on the catalytic production of formaldehyde by the interaction of hydrogen and carbon monoxide. Other experiments related to a substitute for formaldehyde, the chlorination of methane, luminous radium compounds, the Oppau explosion (*cf. J.*, 1922, 10 R, 451 R), "permitted" explosives for coal mines, accumulators, and the corrosion of aluminium and its alloys. Metals have largely occupied the attention of the Engineering Co-ordinating Research Board, particularly in respect of "fatigue," electro-deposition and light alloys. The deterioration and strength of fabrics have been investigated under the Fabrics Co-ordinating Committee, and the Adhesives Research Committee has continued to work on glue and gelatin. Mention may be made of investigations, by other Committees, on the commercial handling of liquid oxygen and liquid air, gas cylinders, liquefiable gases, lubrication and current meters, amongst the many activities under the ægis of the Department.

During the past year, Sir G. Beilby, F.R.S., has resigned from the directorship of Fuel Research, but remains on the Advisory Council. It is pointed out that the Million Fund has now largely been hypothecated, so that it will be necessary for proposals to be begun at any early date for the formation of any more research associations. In the appendices to the report, an account is given of the new organisation for State research in France.

REPORT ON THE INDUSTRIES AND COMMERCE OF SPAIN, MARCH, 1923. *By* CAPT. M. DE B. CHARLES, *H.M. Commercial Secretary, Madrid. Pp.* 60. *Department of Overseas Trade. H.M. Stationery Office,* 1923. *Price* 2*s.*

The financial position of Spain in 1922 showed very little change compared with the previous year (*cf. J.*, 1922, 203 R.). New customs tariffs were introduced, and a commercial treaty was entered into with Great Britain; agreements were also made with France, Switzerland and Norway. Trade declined during the first half of the year, largely owing to commercial strife with France, though the position improved after the two countries had come to an agreement.

The year brought little improvement to the mining and metallurgical industries. In the coal industry the tendency to eliminate the small mines is more marked owing to their lack of capital for development. Several installations of British plant have been made for the extraction of fine coal, which forms a large proportion of the output of some mines. Though many mines closed in 1921 the output of the remainder, 2,993,099 tons, showed an increase on the total for 1920. Exports of iron ore in 1922 from Bilbao, 1,040,264 t., were more than double those of 1921, but much ore was disposed of at a loss to decrease stocks and keep the mines working. In the first nine months of 1922 1,419,255 t. of copper pyrites were exported (961,334 t. in the same period of 1921), but prices were probably barely remunerative even to the large producers. Lead mining changed but little, exports of lead bars being 56,800 t. in the first eight months of 1922; some development by French and German companies has taken place. A discovery of mica has been reported in the neighbourhood of Garrucha, and platinum is also said to have been found near Ronda. Some oil prospecting has been carried out and several companies have been formed. Progress has been made with hydro-electric works, and an increase of 80,000 h.p. has brought the available developed total to 800,000 h.p., about one-tenth of the capacity of the Peninsula. A factory to produce 6000 t. yearly of esparto cellulose has been working in Granada with a power installation of 4400 h.p., part of which will be used in the production of the soda required.

Trade in 1922 was stagnant, and imports amounted to 2787·6 million pesetas and exports to 1449·2 mill. pes.; trade items, including minerals, etc., imports, 340·7 mill. pes., exports, 157·2 mill. pes.; metals and manufactures, imports, 213·4 mill. pes., exports, 162·6 mill. pes.; chemical products, etc., imports, 253·0 mill. pes., exports, 111·9 mill. pes. Foreign competition has been serious; Germany, however, lost a large part of her trade with Spain during the year. It is hoped that the commercial treaty with Great Britain will lead to improved business.

REVIEWS

Die Elektrometrische Massanalyse. *By* Dr. E. Müller. *Pp. vii* + 159. *Dresden and Leipzig: Theodor Steinkopff*, 1923. *Price* 3*s*. 5*d*.

The possibility of electrometric titrations depends upon the facts that at the end-points of the ordinary complete reactions used in volumetric analysis the concentrations of an ion which has been diminishing steadily in proportion to the addition of the titrant, suddenly diminishes in a very high ratio, with the last few drops at the end-point, and that the potentials of electrodes reversible with respect to these ions show a great jump at these points. A silver electrode in normal ionic $AgNO_3$ when titrated with KCl solution begins at the normal potential $O^EAg = +0{\cdot}80$ volts and at the end-point reaches a potential given by $E_u = E_o + 0{\cdot}058 \log. (Ag^{\cdot})$, and $(Ag^{\cdot}) = LAgCl = 1 \times 10^{-5}$ approximately, so that $E_u = 0{\cdot}80 - 0{\cdot}29 = +0{\cdot}51$. This is the simplest case, but the potentials of suitable electrodes in many titrations can be thus defined in terms of normal potentials and the equilibrium constants at the end-points. All oxidation-reduction reactions can be expressed by the general equations :— $aA_h + bB_n = a_lA_n + b_lB_h$ in which " h " is the higher state of oxidation and " n " the lower. Of the theoretical part of Dr. Müller's book, which is both full and careful, the chief criticism which can be made is that the symbols for various kinds of potential with their subscripts are unnecessarily numerous and not always in accord with current usage.

In the practical part sufficient details of the physical measuring apparatus (*i.e.*, the potentiometer outfit) are given, as well as many valuable hints, which are not to be found collected in any other book on the procedure in different cases. All the ordinary volumetric titrations can be undertaken, mainly with the aid of the silver, platinum, hydrogen, platinum iodine, platinum oxidation reduction (*e.g.*, Fe‴, Fe″) electrodes, and also new powers are conferred on the analytical chemist: *e.g.*, the titration of cyanide, iodide, and sum of other halogenides successively in the same solution. Silver halides in gelatin emulsions can easily be determined and the method is constantly being extended, *e.g.*, to the determination of silver in protargol, etc. (*cf. J.*, 1923, 806 A).

The book lacks an index, which is particularly needed because the wealth of theory is such that the analyst before becoming thoroughly conversant with the fundamental ideas may have some difficulty in " seeing the wood for the trees." Enough has been said to commend the book both as an interesting application of electrochemical theory and as an exposition of highly ingenious and powerful analytical methods which once installed can hardly fail to save much valuable time.

E. B. R. Prideaux

(1) Radioactivity. *By* K. Fajans. *English translation by* T. S. Wheeler *and* G. E. King. *Pp. xiv* + 138. *London: Methuen & Co., Ltd.*, 1923. *Price* 8*s*. 6*d*.

(2) The Structure of the Atom. *By* Dr. E. N. da C. Andrade. *Pp. xiv*+314. *London: G. Bell & Sons, Ltd.*, 1923. *Price* 16*s*.

Radioactivity has thrown so much light on the structure of the atom that the two subjects will for a long time remain closely connected. These two books are both excellent, and any one who wishes to be acquainted with modern theories should purchase and read both.

(1) Professor Fajans has himself made important contributions to his subject, and his account of radioactivity is lucid and up-to-date. The translation has been well done and the book deals fully with the chemical side of the subject, and gives an accurate and readable account of such part of the physical side as is suited to non-mathematical readers. Isotopes and the structure, or speculations as to the structure, of the atomic nucleus, are treated adequately. The book is well written, well translated and well printed.

(2) Part of the charm of Professor Fajans' book is that he has omitted the difficult mathematical problems and calculations. Professor Andrade has included these and his book is less suited for arm-chair reading, but he has not made it dull or unreadable, and it is not his fault if some of the topics he deals with are inherently difficult. A fair amount of knowledge of the subject is assumed, and consequently he has been able in a book of moderate size to give a very complete account of most of the recent work and hypotheses dealing with the structure of the atom. He explains clearly the γ rays and the disruption of the nucleus; positive rays and Aston's work are well described. The account of X-ray spectra and their connexion with optical spectra is fuller and more intelligible than in any other book the reviewer has come across. There is an excellent account of Bohr's theory of atomic structure and a sufficient account of the octet theory of Lewis and Langmuir. Lewis' conception of electron-sharing has been applied to organic chemistry in various articles which Professor Lowry has contributed to this Journal, and Professor Andrade has briefly dealt with this and some other quite recent pieces of work. The book is as lightly written as is possible for such a grave subject, and shows signs here and there that the author is a human being; he obviously enjoyed writing in an old-fashioned style a dedication to Sir Ernest Rutherford, and in many places the reviewer found simple phrases where ponderous statements would have been possible. The reviewer has been much pleased by these books, either of which may be taken as a model of scientific writing, the one by chemists, the other by physicists.

MODERN GAS PRODUCERS. *By* N. E. RAMBUSH. *Pp. xix*+545. *London: Benn Brothers, Ltd.*, 1923. *Price* 55*s*.

For a long time there has been an increasing demand for a comprehensive book on the subject of "Modern Gas Producers." This has been supplied in no slipshod manner by Mr. N. E. Rambush. Those of us who are working for the complete elimination of solid fuel in all heating processes wherever possible, not only for the purpose of attaining higher thermal efficiencies and better control of heating conditions, but also for the purpose of eliminating altogether the smoke nuisance, are now labouring under a deep debt of gratitude to the author of this voluminous book for the excellent way in which he has treated his subject.

Producer gas has an enormous range of application, and as it can be made at a much lower cost per therm than town's gas can be bought, owing very largely to the cost of distribution, the problems connected with producer-gas production and use should receive as much attention at the hands of our technicians as those connected with the production of town's gas.

This book deals with the general subject of fuel utilisation, the theory of the production of producer gas, practical considerations in the working of gas producers, various types of producers for special purposes, the cleaning and distribution of producer gas, the technical control of producer-gas working, and a useful outline of the methods of utilisation of producer gas. One of the most valuable sections is that containing the conversion tables of particular application to this subject, and the excellence of the "References" still further enhances the value of the book.

The book can be recommended as being thoroughly sound, and the result of a wide introspective experience in the construction and running of producers of all types.

It is inevitable that differences of opinion will exist between technicians on such a wide subject. On page 2 the author states that only 20 to 25 per cent. of the total heat content of the solid fuel is obtained in a gaseous state when coal is carbonised in gas works or in coke ovens, when it is general knowledge that efficiencies of up to 33 per cent. are obtainable in high-temperature carbonisation processes. On the same page, paragraph B, blue water gas is stated to have a normal heating value of 300 B.Th.U. *nett* per cb. ft., whereas normal water gas is usually about 300 B.Th.U. *gross* per cb. ft.

The discussion on the correct definition of "producer" efficiency is very timely, but one regrets, for comparison's sake, that the author has not dropped the "gas" efficiency definition, and wholly gone out for an "overall" efficiency. It should not be forgotten, however, that as producers are particularly suitable for working with low-grade fuels as regards size and quality, efficiency is not always of prime importance. Special mention is made of the importance of grading of fuels for producer work.

Much valuable information is also given relating to liquid slag producers. There is likely to be a big development in this direction in English practice, but no mention is made of the Wollaston producer.

In discussing firebrick materials, the only one to which the fusion test is attached is that of Stourbridge material. Surely there is ample information available from which the author could have included fusion tests for the other materials mentioned?

The results of tests with steam-jet blowers have not been obtainable in this collated form, so far as the reviewer's knowledge goes, from any other source.

The chemical control and testing of gas producers is well handled, but one would have liked more detailed information of methods of sampling solid fuels, these being of much more importance than the actual tests themselves. The author suggests that the water used in gas sampling bulbs should be acidified in order to *prevent* the absorption of carbon dioxide. Acid does not prevent the absorption of carbon dioxide by water. It simply reduces the amount of absorption.

The section dealing with the question of the utilisation of producer gas, though comparatively short, is perhaps one of the most useful parts of the book. It is acknowledged that producer gas, because of its low flame temperature, cannot give as good results at high temperatures as either blue water gas or coal gas, but its range of usefulness still remains very great.

This book should be found on the shelves of all fuel engineers and others interested in the better utilisation of solid fuel.

E. W. SMITH

CHEMICAL INDUSTRY CLUB

The annual dinner of the Chemical Industry Club will be held in the Connaught Rooms, Great Queen Street, W.C. 2, on Monday, November 26. Several men prominent in the chemical world will be present. Tickets, price 15s. each, may be had from members or the secretary of the club.

With great regret we learn of the death of Mr. William Thomson, F.I.C., an original member of the Society of Chemical Industry who had served many times on the Committee of the Manchester Section. An obituary notice will appear in a later issue.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Oct.* 4)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Paper (tender)	8740/F.L./P.N.
,,	Oils, rubber (tender) ..	8495/F.L./G.P.
Australia	Steel pipes (tender) ..	12250/E.D./E.C./2
British India	Iron, tyres (tender) ..	*
South Africa	Scientific instruments ..	918/6/F.G./C.C./2
,,	Copper tubing (tender)	12225/E.D./E.C.
,,	Brass pipings, copper sheets (tender) ..	12224/E.D./E.C.
,,	Ash-crushing machine (tender)	12227/E.D./E.C./2
Spain ..	Tinplate, leather ..	372, 373
Switzerland	Drugs	375
United States	Iron and steel	377

* Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E.1.

TARIFF CUSTOMS EXCISE

Australia.—The deferred duties on hoop iron have been postponed to March 31, 1924.

Germany.—The current issue contains a list of goods subject to export licence, including animal fats, leather, oils, sugar, magnesite, gypsum, cement, talc, felspar, ores, tars, chemical and pharmaceutical products, artificial silk, building materials, paper, metals, iron and aluminium. The internal tax on sugar has been increased.

United Kingdom.—The current issue contains a list of goods of which export is prohibited.

United States.—Investigations are being made in respect of the cost of production of crude magnesite, adonite, arabinose, dulcite, inulin and other saccharides, and amido acids not originating from coal tar.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The heavy chemical market maintains the improvement recently recorded and trade seems now to be somewhat steadier. There is nevertheless no great volume of business, as it is mainly confined to spot orders and requirements for the immediate future.

The actual state of the textile trade, which always has a tremendous effect on the home consumption of chemicals, is still somewhat of an enigma; reports from the North and Midlands indicate that certain mills are on full work, while others are very short of orders. There is no indication that any improvement of a permanent nature has arrived and probably only a certain class of goods is in demand. Any change for the better in textiles is being looked for with great eagerness by the chemical trade.

Acetic Acid, 40% tech. ..	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric ..	3s. 6d. per carboy makers' works.
Acid Nitric 80° Tw. ..	£22 per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 65s. f.o.r. makers' works, with slight variations up and down.
Acid Sulphuric, 94% Arsenical	£6 per ton makers' works.
Ammonia Alkali ..	£7 10s. per ton, spot delivery. General export demand good, particularly from the Continent.
Arsenic (White) ..	£72—£73 per ton. Not much doing.
Bleaching Powder ..	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime ..	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride ..	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Copper Sulphate ..	£25 per ton. Dull.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate ..	5¾d.—6d. per lb. d/d.
Potass. Chlorate ..	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76% ..	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98% ..	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate ..	£10 10s. per ton carr. paid. In fair request.

Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Business in this section is generally on the dull side.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	5s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	Carload lots 8¼d. per lb. Less quantities 9¼d. per lb. ex wharf London. Supplies exceed the demand and prices have been reduced by 1d. per lb.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

The volume of trade is small and, except in acetates, there is very little life. The tar market seems slightly weaker.

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d. Regular demand and short supply.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£10 per ton, according to grade. Market quiet owing to slack demand for non-ferrous metals.
Iron Liquor	1s. 7d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d.—6s. 4d. per gall. 60% O.P. Steady market.
Solvent	6s. per gall. 40% O.P. Good demand.
Wood Tar	£5—£6 10s. per ton, according to grade. Slightly weaker.
Brown Sugar of Lead	£41—£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 1½d.—1s. 2d. per lb. Good demand. Market firmer. Limited quantities only available for prompt delivery.
Crude 60's	3s. 6d.—3s. 8d. per gall. Good demand for spot delivery. Supplies limited.
Acid Cresylic—97/99	2s.—2s. 2d. per gall. Steady demand.
Pale 95%	1s. 10d.—2s. 4d. per gall. Good quantities on offer.
Dark	1s. 7d.—2s. per gall. Fair parcels offered.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. Few inquiries, but no business.
Anthracene Oil—	
Strained	9d.—11½d. per gall. Supply short.
Unstrained	8½d. per gall.
Benzole—	Fair enquiry.
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 7d.—1s. 8d. per gall. Little business passing.
Pure	1s. 10d—1s. 11d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8¼d.—9½d. per gall. according to grade and district. Demand still good.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 2d.—1s. 3d. per gall. Market very quiet owing to rubber trade slackness.
Solvent 90/190	1s. 3d.—1s. 4d. per gall. Market very quiet.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. More inquiry, Difficult to meet demand.
Whizzed or hot pressed	£10—£12 per ton.
Naphthalene—	
Crystals	£19 10s. per ton.
Flaked	£19 10s. per ton.
Pitch, medium soft	120s.—130s. per ton, according to district and time of delivery. Several inquiries. Market firm.
Pyridine—90/140	21s.—21s. 6d. per gall. Market very strong.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

Slightly more business has been done in aniline dyes during the present week. This has been more especially noticed during the latter half of the week. Whether this improvement will keep up or no it is very difficult to say. It is very unlikely that any great improvement will take place in the near future, as there seems to be no change in the depressed state of the textile industry. Prices do not vary.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 9d. lb. 100% basis d/d.

Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 7d.—1s. 8d. per lb. Good demand.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 9d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Prices slightly reduced and a better demand is experienced.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£90 per ton d/d.
Dinitrotoluene—48/50° C	8d.—9d. per lb. naked at works.
66/68° C	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	2s. 9d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	4s. 10d. per lb. d/d.
m-Toluylene Diamine	5s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

A firmer tendency is shown all round, and more confidence may be placed in the immediate future, as supplies generally are keeping pace with the demand without accumulation of large stocks.

Acid, Acetic 80% B.P.	£52 10s. per ton.	
Acid, Acetyl Salicylic	3s. 3d. per lb. Good demand. Firm market. Price likely to advance owing to increase in raw material. Supplies limited and Continental position also firmer.	
Acid, Benzoic	2s. 6d. per lb. Firmly held, but very little inquiry.	
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.	
Acid, Citric	1s. 6½d. per lb., less 5%. Poor demand. Market dominated by weak holders and bad season.	
Acid, Gallic	3s. per lb. for pure crystal. Market steady.	
Acid, Pyrogallic, Cryst.	5s. 9d.—6s. per lb., according to quantity.	
Acid, Salicylic	2s. 2d.—2s. 3d. per lb. for 5 cwt. lots. Firm market in sympathy with other salicylates. Good inquiry. Supplies not heavy.	
Acid, Tannic	3s. per lb. for B.P. quality. Price somewhat lower.	
Acid, Tartaric	1s. 1¾d. per lb. less 5%. Demand fair and likely to improve. Raw material dearer. Prices will probably advance.	
Amidol	9s. per lb. d/d.	
Acetanilide	1s. 7d. per lb. for English manufacture. Extremely firm and demand active.	
Amidopyrin	12s. 6d. per lb. Demand still very poor.	
Ammon. Benzoate	3s.—3s. 6d. per lb., according to quantity.	
Ammon. Carbonate B.P.	£32 15s. per ton.	
Atropine Sulphate	12s. 6d. per oz. for English make. Firmer tone now prevails.	
Barbitone	17s. per lb. for quantity. Demand limited.	
Benzonaphthol	4s. 6d.—4s. 9d. per lb. Slight advance in price.	
Bismuth Salts	A steady market. Carbonate 13s., Nitrate 6s. 11d., Salicylate 10s. 5d., Subgallate 9s. 6d., Citrate 11s. 7d., Oxide 14s. 5d., Subchloride 12s. 8d., Subnitrate 11s.	
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.	
Bromides—		
Potassium	6½d. per lb.	Holders of stock are steadying up prices owing to uncertain position of Continental supplies
Ammonium	7d. ,, ,,	
Sodium	7½d. ,, ,,	
Calcium Lactate	2s. 6d. per lb. for best makes. Better enquiry.	
Chloral Hydrate	3s. 10d.—4s. per lb. In active demand. English makers are oversold.	
Chloroform	2s. per lb. for cwt. lots. Higher prices expected.	
Creosote Carbonate	8s. lb. Demand negligible.	
Formaldehyde 40%	75s. per cwt. ex wharf London. Slightly less for large orders.	
Guaiacol Carbonate	9s. 6d. per lb. Considerably firmer. Stocks low.	
Hexamine	3s. 9d. per lb. Spot parcels have been cleared and little coming forward.	
Homatropine Hydrobromide	30s. per oz.	

Hydroquinone ..	.. 3s. 3d.—3s. 6d. per lb. Now asked, according to quantity and holder.
Iron Ammon. Citrate	.. Reduced by 2d. per lb. 2s. 3d. per lb. for cwt. lots. 2s. 4d. for 28 lb. lots.
Magnesium Carbonate—	
Light Commercial	.. £36 per ton net. Prices reduced.
Magnesium Oxide—	
Light Commercial	.. £80 per ton, less 2½%. Prices reduced.
Heavy Commercial	.. £27 per ton, less 2½%. Prices reduced.
Heavy Pure ..	.. 2s.—2s. 3d. per lb., according to quality and quantity. Steady market.
Menthol	.. A.B.R. recryst. B.P. 75s. per lb.
Mercurials ..	.. Steadier. Quicksilver rather better.
Methyl Salicylate	.. 2s. 6d.—3s. per lb. Much firmer for English or imported, in view of seasonal advance now in progress.
Methyl Sulphonal	.. 14s. 6d. per lb. No demand.
Metol	.. 8s. 9d. per lb.
Morphine and Salts	.. Prices again advanced owing to dearness of opium. Alkaloid: Cryst. 14s. 8d., Precip. 14s. 5d., Acetate 11s. 6d., Hydrochlor. 11s. 6d., Sulphate 11s. 6d., Tartrate 14s. 5d. per oz.
Paraformaldehyde	.. 3s. 6d. per lb. Quiet.
Paraldehyde ..	.. 1s. 5d.—1s. 5½d. per lb. Average price in 5 lb. bottles.
Phenacetin ..	.. 6s. 3d. per lb. Demand steady. Moving to higher prices.
Phenazone ..	.. 7s. 6d. per lb. Firm. Stocks none too plentiful.
Phenolphthalein	.. 6s. 6d. per lb., according to quantity and holder. More active.
Potass. Bitartrate— 99/100% (Cream of Tartar) ..	.. 88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide	.. 3s. per lb. English makes are meeting foreign competition.
Potass. Iodide ..	.. 15s. 8d.—16s. 2d. per lb. Good demand.
Potass. Metabisulphite	.. 8d. per lb.
Potass. Permanganate	.. 10d. per lb. for B.P. crystal. Price would be shaded for ton lots.
Quinine Sulphate	.. 2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	.. 5s. 6d. per lb. Business poor.
Salol	.. 3s. 3d. per lb. Limited demand. Price would be shaded for quantity.
Silver Proteinate	.. 10s. per lb. A weaker market.
Sod. Benzoate ..	.. 2s. 6d. per lb. Spot price lower than replacement value owing to lack of demand.
Sod. Citrate, B.P.C. 1923	Reduced 2d. per lb. 2s. 1d. per lb. for cwt. lots.
Sod. Hyposulphite— Photographic	.. £15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Methylarsenate	.. 15s. 6d. per lb.
Sod. Potass. Tartrate (Rochelle Salt)	.. 82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate ..	.. Powder 2s. 8d. per lb., and Crystal at 2s. 11d. per lb. Firm, with tendency to rise. Large orders in hand.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal ..	.. 13s. 9d. per lb. Little inquiry.
Tartar Emetic ..	.. 1s. lb. net. Fair demand.
Thymol	.. 13s. 6d. per lb. quoted for synthetic and 14s. 6d. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone ..	.. 11s. 6d. per lb.	
Aubepine ..	.. 14s. ,, ,,	
Amyl Acetate ..	.. 3s. ,, ,,	
Amyl Butyrate ..	.. 7s. 3d. ,, ,,	
Amyl Salicylate	.. 3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	3s. 6d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol ..	.. 3s. ,, ,,	Higher prices anticipated.
Benzyl Alcohol free from Chlorine ..	.. 3s. ,, ,,	
Benzaldehyde free from Chlorine ..	.. 3s. ,, ,,	
Benzyl Benzoate	.. 3s. ,, ,,	
Cinnamic Aldehyde Natural ..	.. 18s. 6d. ,, ,,	
Coumarin ..	.. 18s. ,, ,,	
Citronellol ..	.. 19s. 6d. ,, ,,	
Citral	.. 9s. 6d. ,, ,,	
Ethyl Cinnamate	.. 10s. ,, ,,	
Ethyl Phthalate	.. 3s. 9d. ,, ,,	
Eugenol	.. 10s. ,, ,,	
Geraniol (Palmarosa)	.. 37s. 6d. ,, ,,	
Geraniol	.. 6s. 9d. to 13s. 6d. per lb.	
Heliotropine ..	.. 8s. per lb.	
Iso Eugenol ..	.. 15s. per lb.	
Linalol ex Bois de Rose	.. 18s. 6d. ,, ,,	
Linalyl Acetate ..	.. 18s. 6d. per lb. Considerably cheaper.	
Methyl Anthranilate	.. 8s. 6d. per lb.	
Methyl Benzoate	.. 6s. ,, ,,	
Musk Ketone ..	.. 40s. ,, ,,	
Musk Xylol ..	.. 12s. 6d ,, ,,	
Nerolin	.. 4s. ,, ,,	
Phenyl Ethyl Acetate	.. 10s. ,, ,,	
Phenyl Ethyl Alcohol	.. 16s. ,, ,,	
Rhodinol	.. 47s. 6d. ,, ,,	
Safrol	.. 2s. ,, ,,	
Terpineol ..	.. 3s. ,, ,,	
Vanillin	.. 22s. 6d.—23s. per lb. Firm and steady demand. Raw material dearer.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	.. 14s. 6d. per lb.
Anise Oil	.. 1s. 10½d. ,, ,,
Bergamot Oil ..	.. 12s. 6d. ,, ,, spot.
Bourbon Geranium Oil	.. 35s. ,, ,,
Camphor Oil ..	.. 80s. ,, ,,

Cananga Oil, Java	9s. " "
Cinnamon Oil, Leaf	4½d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 2d. " "
Ceylon	4s. per lb. Very little on offer, too many parcels arriving spirit. These have been seized by the Customs.
Clove Oil	8s. 6d. per lb. This market is now firmer.
Eucalyptus Oil 70/75%	2s. 9d. per lb.
Lavender Oil, Fresh	21s. per lb. Reliable offers are difficult to obtain and very high prices for new crop oil seem inevitable.
Lemon Oil	2s. 10d. per lb. Very high prices are being asked at the source.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	12s. 6d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	24s. per oz.
Palma Rosa Oil	23s. 6d. per lb.
Peppermint Oil—	
Wayne County	15s. per lb. Market very unsteady.
Japanese	12s. per lb. Market very unsteady.
Petitgrain Oil	8s. per lb. Dearer.

TRADE NOTE

Consumption of Acetic Acid in Malaya

Except on native rubber holdings and, possibly, one or two large estates, all rubber latex produced in British Malaya is coagulated with acetic acid. During the war, when supplies of acetic acid were difficult to obtain, sulphuric acid came into general use. This acid is cheaper than acetic, but its use has been condemned by the Department of Agriculture of the Straits Settlements and Federated Malay States and also by the Rubber Growers' Association. The subjoined table shows that the value of acetic acid imports has risen enormously since 1920). In 1921 Canada furnished almost 50 per cent. of the supply, but by 1923 she has altogether ceased to compete in the market. The bulk of the acid is now supplied by European Continental countries. Details as to the respective quantities exported by the different countries of the Continent in 1922 and 1923 are not yet available, but in 1921 the Netherlands and Germany were the only two European Continental countries exporting the acid to Malaya. The value of imports of Japanese acetic acid rose enormously in 1922, but fell during the first half of the current year. The following table shows the values of imports of acetic acid in 1921, 1922, and the first half of 1923:—

	1921	1922	1923. (6 months)
United Kingdom	£390	£7,920	£4,792
British Possessions	11,332	540	nil
Continent of Europe	3,819	80,347	52,213
U.S.A.	5,565	751	1,017
Japan	2,366	29,121	4.450
Other Countries	nil	245	nil
Total	£23,472	118,924	62,472

—(*Malay States Information Agency.*)

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EDITORIAL

CHEMICAL ENGINEERS—so we gather from letters we receive and articles we read—are imperfectly understood by many chemists. This is not necessarily the fault of the chemical engineers; there are some chemists, who do not even understand editors, the most guileless individuals the rain ever beats upon. Most of those chemical engineers we know are engineers who have specialised in the plant required by chemical manufacturers; many are not, and do not profess to be, chemists; sometimes they repudiate such an insinuation with fervour; on the other hand, they are familiar with chemical terms and chemical processes and with the machinery and plant which is used in them. If they are not the rose they are certainly found in the vicinity; we are told that one of the most pathetic sights to be seen in Whitehall Court is a young chemical engineer helping a prosperous chemical manufacturer on with his overcoat. We are not thinking of the story of Sir Charles Tennant's butler helping the departing guest in a similar way; the pathos of the sight we have mentioned is deeper. We ourselves fail to see the nervousness of the chemist concerning the engineer. If the engineer is able to be of service to the chemical manufacturer he will be employed and may even become liable to super-tax; if he is not useful to the chemical community he will be obliged to adopt some other livelihood. He will discard his physics and take up instead psychology, which Huxley—we think—described as a phantasm generated by the fermentation of the dregs of theology. We see no sign of such a cruel fate; some departments of the chemical industry are unusually suitable for study by chemical engineers; the chemical engineers have made valuable contributions to our journal and have also published elsewhere important generalisations on topics of interest to chemists—the recent monograph on "Industrial Oxygen" by T. Campbell Finlayson is a notable instance. Whether anyone can at the same time be both a competent engineer and a learned chemist is a problem of minor importance; whether the species of intellect which emits chemical research is identical with that of the man who can design a new coke-oven or filter is a point for the psychologist. The important question is where and how can the chemical manufacturer obtain the most useful and modern information on those engineering problems which he encounters.

* * *

It used to be said that good wine needs no bush. If this were ever true, which we doubt, it was in the days before railways, motor-cars or charabancs were invented and when the lads of the village needed no external assistance in finding the hostelry or the vintner best able to gratify their palates. At the present time goods find their way to distant places and both town and country are full of people who are ignorant of such vital facts as the best sources of supply. It seems to us that the best require advertisement more than the bad or the mediocre; and we think the public is glad to be guided—by a sure and impartial hand—to what is valuable and important. Among such excellent features to which attention may be directed is the dinner of chemists on the 31st of this month. We are informed that Lord Wargrave will propose the toast of "Chemistry and the Nation," to which Sir William Pope will reply; Mr. R. G. Perry is to propose "Our Chemical Organisations," to which the President of the Chemical Society will reply, and Dr. E. F. Armstrong is to propose "The Universities," to which the Vice-Chancellor of the University of Cambridge will reply. It is confidently predicted that these speeches will combine brevity with concentration and that the speakers have taken to heart the advice of the late Mr. Weller so to end that the audience wishes for more. There will be some excellent music of types to please both the fine and heavy chemists. What man of knife, or teeth, can keep away from a gathering! It will do much to promote the causes of civilisation and chemistry, and it seems to us quite possible that the evening will be more than a mere banquet. In any case, a considerable number of the well known figures have expressed their intention of coming and many are bringing ladies. More than a hundred have already taken tickets, and as many people do not make up their minds until a few days before the actual date it seems pretty certain that there will be a large attendance. The first duty of chemists is to know each other, it is so easy to know the science afterwards. We have heard it said that it is more important to know where the law can be found, than to know the law.

* * *

There is something else the excellence of which should be well advertised. We are thinking of British chemistry. Few of us recognise how good it is, but the Scientific Section of the Chemical Exhibit at the British Empire Exhibition next year should bring it home to us. We have always had our share of great names ever since the time of Robert Boyle, "the father of modern chemistry and brother of the Earl of Cork." But it is not generally realised what a volume of high-class work emanates at the present time from our Universities and from other laboratories in many parts. The chemical exhibit will surprise us all in demonstrating the variety and excellence of what is manufactured in this country, and if we reflect on the contribution which Great Britain has made to pure chemistry during the last score of years we shall find that our intellectual activity is of the first order. The object of the scientific section is to prove in no uncertain manner that the research conducted here is not merely adequate for the industrial applications of chemistry but is an achievement of which any country, however great, wealthy and learned, may be justly proud. Our industrial magnates and our statesmen need not fear, nor need our rivals hope, that our men of science cannot easily keep pace with the needs of the State and show a handsome surplus for the benefit of future generations. This scientific section is being organised by a committee fully representing the many branches of the science. Its chairman, Dr. Herbert Levinstein, has taken infinite pains over its organisation, and has tackled this difficult piece of work with youthful energy and pardonable enthusiasm. The whole field of chemistry, including physical chemistry, agricultural chemistry, bio-chemistry and so on is being covered, and the outstanding men in the various branches are directing and assisting the exhibit with most commendable assiduity. We have been privileged to learn much of what is taking place in this matter, and we believe that this section will be a wonderful representation of modern British chemistry.

ARTIFICIAL RESINS, VARNISHES AND LACQUERS

By REX FURNESS

The mists of empiricism which surrounded the manufacture and applications of artificial resins of the phenol-formaldehyde type were largely dissipated by the scientific work and technical ingenuity of Baekeland, Redman, Le Bach and others, only, however, to gather again around the substitute resins, lacquers and varnishes called into being as a result of war-time scarcity of natural resins and lacs. It was almost inevitable that little discrimination should be exercised during such periods of economic stress, so that coumarone and indene resins, naphthalene-formaldehyde condensation products, acrolein and furfural resins and so forth were manufactured with little regard to scientific control of quality or composition. Moreover, all-embracing claims as to their potential applications were made, standing in strong contrast to the proven statements as to the value of certain phenol-formaldehyde products.

It is quite comprehensible, therefore, that the high level of war-time production of coumarone resins, namely, from 10,000 to 12,000 tons per annum in Germany, should have sensibly declined in post-war years. Increased attention is, however, being paid to the control of raw materials and methods of manufacture of these useful resins, so that the production figure shows a distinct tendency to rise both in the United States and Germany as the properties of the standardised products are more fully appreciated.

The artificial resins as a class are of great utility in the varnish and lacquer industry, whilst the insoluble and infusible types have dielectric properties which have won them an established position in the electrical world. It has been possible to produce resins closely resembling various natural gums, lacs and resins, so that their employment in direct substitution may be expected to continue, even when normal supplies of the natural products are available at pre-war prices. On the other hand, special processes have been developed in which the effects of shellac and the like are imitated or surpassed, recourse being had to different types of synthetic resins. Thus, stoving enamels employing fusible phenol-formaldehyde condensation products as a principal constituent have become popular in the lacquered metal trade, a lacquered finish being formed which is harder, more durable, tough and elastic than that ordinarily obtained with the aid of natural shellac.

The varieties of artificial resins now available —phenol-formaldehyde resins and coumarone resins in particular—are so extensive and their individual properties so standardised that their use in the electrical and chemical industries as insulating and acid-resisting materials, respectively, and their employment as gum and lac substitutes and for the manufacture of moulded articles—pipe stems, toilet articles, acid-resisting transparent apparatus, constant measurement screws, gramophone records and many other things—will undoubtedly increase.

In this article it is proposed to deal with the constitutions and methods of controlled manufacture of artificial resins, rather than to detail the suggested applications, which are well cared for in the manufacturers' catalogues, brochures and in inspired articles in the trade Press.

Coumarone Resins

The fraction of normal coal-tar distilling between about 160° and 200° C. contains unsaturated hydrocarbons such as coumarone, indene and their homologues, in addition to the better known benzol hydrocarbons (naphthas), and substances containing oxygen and nitrogen. If, after the removal of the latter by washing with alkali and acid, respectively, the naphtha is treated with concentrated sulphuric acid in small amounts the unsaturated hydrocarbons are polymerised whilst a certain amount of sulphonation occurs. The dark acid layer on dilution gives an inferior resinous product, containing the sulphonated products, whilst the hydrocarbon layer may be worked up for the production of coumarone resins. On distillation in steam the benzols are carried over, leaving a resinous material, whose colour, hardness and solubility depend, *inter alia*, upon the extent of distillation. The products obtained broadly in this manner constitute the coumarone resins of commerce.

Other polymerisation agents may be used, such as salts of zinc, aluminium and tin, particularly tin tetrachloride, or a process combining polymerisation and oxidation may be employed, linoleates, resinates, etc., being used as catalysts. Again, oxidation may follow polymerisation, but by far the greater part of the coumarone resins available result from a modified type of the simple sulphuric-acid polymerisation method first indicated.

It is, then, to the improvements effected in this process that brief attention will be paid. If the original distillation of the coal tar is more carefully effected, and a fraction containing essentially only coumarone and indene as representatives of the unsaturated hydrocarbons be taken for sulphuric acid treatment, the resins finally obtained, *ceteris paribus*, are harder and lighter in colour than the ordinary types, resulting from the polymerisation of a fraction containing coumarone homologues. The greater definition of the product and the decreased possibility of the formation of low-melting eutectic mixtures contribute to the enhanced hardness of the resin. This result may be achieved in another manner by a fractional polymerisation. Thus, the treatment of a certain tar fraction with relatively dilute acid (50 Bé H_2SO_4) results in the polymerisation of the content of styrolene and dicyclopentadiene to hard black resins. After separation of the unconverted coumarone and indene in solution in naphtha by distillation, the distillate is treated with strong acid (66 Bé) in controlled quantities and at a definite temperature, say 50° C. The unsaturated hydrocarbons are polymerised to resins, which are recovered in the usual manner.

Apart from the control of the raw material selected for polymerisation, the details of the various operations have been surveyed and control measures adopted which increase the value of the final resin. The washing of the naphtha containing resin after separation of the acid sludge is a delicate operation and emulsions are formed only too readily. Not only is this troublesome in the manufacturing operation, but the final product is liable to contain acid and sulphonic derivatives, which it has been impossible to remove from the resin solution. These affect the colour and hardness of the final resin. Fractional neutralisation, neutralisation by means of solid alkalis, neutralisation of diluted solutions and the like have assisted materially the clean separation of resin solution and acid sludge, but there appears to be a favourable opening for the introduction of electrical or centrifugal separation devices, the addition of reverse colloids and, generally, of those methods of quick and complete emulsion breaking which have proved so effective and economical in oilfield emulsion treatment, soap stock separation, and similar operations. (*Cf.* this *J.*, 1922, 346 R.)

Again, the temperature at which polymerisation is effected influences the product, and at least one process suggests artificial cooling of the naphtha fraction during the addition of sulphuric acid. After removal of the naphtha by steam distillation, not omitting acid treatment and washing, the residual resinous product may be freed from the last amounts of solvent by heating *in vacuo* and, generally, attention to the temperature conditions during this stage is reflected in the quality of the final resin.

The coumarone resins are, as a class, soluble in naphtha, benzene hydrocarbons and turpentine, but are insoluble in alcohol. They are fusible and approach in many physical properties the natural gum resins; hence their value in the varnish industry. They also find applications as adhesives, in printing-ink manufacture, although their suggested use as varnishes for electrical insulation cannot be recommended in view of the availability of the fusible phenol-formaldehyde resins, noted in the following section. Further applications are being sought, and the modern standardised products —one American company manufactures nine types varying in melting point up to 150° C. and in colour from pale yellow to a dark amber —can be relied upon to provide constant, cheap and effective substitutes for many fossil resins, the supply of which is, in many instances, rapidly diminishing.

Phenol-Formaldehyde Condensation Products

As in the case of coumarone resins, it is a simple matter to produce a polymerised product if the quality, constancy of composition and general excellence of service capacity are left unconsidered. The manufacturer has, however, profited by the scientific investigations and technical control methods developed, so that first-class, constant quality products of many varieties are available in large quantities. Their uses in the manufacture of moulded articles of many kinds, as electrical insulators, for making insulating varnishes, as acid-resisting coatings for certain types of chemical apparatus, in the production of precision screws which have no "cold flow," and in many other fields depend upon their relative solubility or insolubility in solvents, as the case may require, their infusibility or fusibility, and their resistance to attack by acid and alkali. It will appear in the subsequent discussion of constitution that many products can be produced with definite properties which fit them for specific uses.

If phenol and formaldehyde be mixed in such amounts as to insure the presence of excess of one mol. of the former per mol. of the latter, reckoned as HCHO, the formation of oxybenzyl alcohol is readily effected on heating, but catalytic agents may be added if desired. On continued heating a molecule of water is lost between the phenol groups of two molecules of the phenol alcohol and a "saliretin" resin is obtained. This resin, especially in the presence of excess of phenol, is fusible, soluble in alcohol and acetone, and easily coloured by oxidation. Further heating causes polymerisation, and a final resin can be obtained which is apparently infusible, although it will soften on heating, and is insoluble in alcohol but swells in acetone. In no way can this be compared to the final product obtained in the reaction between phenol and excess of formaldehyde, the so-called Bakelite C, an insoluble, infusible resin, resistant to acid and alkali.

The saliretin resins occur in many types, according to the extent of dehydration and polymerisation of the phenol alcohols originally formed and to the amount of excess phenol held in physical admixture. The formation of the first product of reaction, a phenol alcohol, may escape notice on account of its immediate dehydration, the heat of reaction being considerable. These resins differ in many ways from those which are conveniently designated here as Bakelite resins the fusible saliretin resin differs in many respects from the so-called Bakelite A, and the final polymerisation product of the saliretin resin first formed differs from the infusible, insoluble Bakelite C, and since these are the more important commercially, they will be discussed more fully.

Bakelite Resins

A simple description of the formation of a Bakelite resin may indicate the general lines of production.

If a mixture be made of equal amounts of phenol and formaldehyde solution (40 per cent.), thus ensuring more than one molecule of the latter per molecule of phenol, the formation of two layers is soon observed upon heating. As the water is evaporated either from the separated or non-separated condensation product, the product becomes thicker, and finally a transparent viscous resin, solidifying on cooling, can be obtained, which is soluble in alcohol. On continued heating the final infusible, insoluble Bakelite resin is obtained, although great care is required so to control the exothermic reaction that frothing does not occur. (The effective control of the final hardening presented one of the most difficult of the many technical problems which confronted the manufacturers.)

It is suggested by Baekeland that the reactions may be represented by the equations :—

1. Dehydration of the phenol alcohol—

$$2CH_2OH{\cdot}C_6H_4{\cdot}OH = H_2O + CH_2OH{\cdot}C_6H_4{\cdot}O{\cdot}C_6H_4{\cdot}CH_2OH.$$

2. Reaction with formaldehyde—

$$3C_{14}H_{14}O_3 + HCHO = 3H_2O + C_{43}H_{38}O_7$$

3. Final polymerisation—

$$4C_{43}H_{38}O_7 = (C_{43}H_{38}O_7)_4.$$

Many modifications of the simplest form of the process described above form the subjects of patented processes. The variations in the original methods of Bayer (1873) and of that in the patent of Smith (1899), concern the methylene derivatives used and the catalyst, etc. Thus, in place of formaldehyde, trioxymethylene, hexamethylene tetramine, or paraformaldehyde may be used, and almost any acid or base may be taken as catalyst, although Baekeland points out that the action of acid and basic catalysts is essentially different. Ammonia, ammonium salts, amines and volatile basic substances may cause some trouble in the final hardening stage (*v. infra*), so that it is often preferred to employ small quantities of the solid alkalis as catalysts. It is impossible to do more than mention catalysts, for their number is legion—at any rate in patent literature—and, moreover, several catalysts recently suggested appear to possess no special advantages over those originally employed. It is possible to produce excellent qualities of fusible or infusible resins by the original method, using small amounts of solid bases as catalysts, for instance, and it is in the elaboration of control methods that success has been won.

If the product of condensation and reaction with formaldehyde, as represented by the fusible resin Bakelite A, be heated rapidly to

150° C., the polymerisation becomes so violent and the heat evolved so intense that foaming occurs, and the hard resin immediately formed is porous, rough and disfigured by the escaping water vapour, formaldehyde or volatile bases. By carrying out the polymerisation in closed moulds, in apparatus in which a counter pressure is created by means of an inert gas, or in hydraulic presses, the infusible resin obtained is free from defects. This phase of the manufacture is of considerable importance, as it was one of the determining factors in the successful technical production of synthetic resins. To-day, a better control of the first stage of polymerisation has enabled the final hardening to be effected at atmospheric pressure and at relatively low temperatures, in contrast, for instance, with a pressure of 100 lb. per sq. in. and a temperature of 150° C.

In addition to the normal soluble and insoluble resins which are produced regularly to a standard specification and possess constant properties, there are available several derived products. Suitable fillers have been discovered, such as wood flour or sawdust, which increase the elasticity and resistance to shock of the final product and generally confer improved physical properties upon the moulded articles. It has recently been found possible to produce homogeneous resin-rubber compounds with the aid of suitable mixed solvents. Laminated resins are perhaps the latest addition to the varieties now in commerce, and these find application, *inter alia*, as substitutes for thin hard rubber used as insulating material in the automatic telephone.

The dielectric properties of the resins are utilised in the moulded forms of the infusible type resins, in the varnishes obtained from the soluble types, and in products from paper or fabrics impregnated with the resins.

OTHER ARTIFICIAL RESINS

Several other types of resin substitutes have recently been described and deserve brief notice here. Production of these resins on a large scale, however, has not yet been attained, and it will be a difficult struggle to cut out the Bakelite type and coumarone resins, now so firmly established. Scientific work and careful technical control of production are essential before any attempt be made on the part of salesmen to introduce the newer resins. In the end, however, they should win a place in industry, for the sources of raw materials are abundant and varied, and their cost is relatively low.

FURFURAL RESINS

Furfuraldehyde has recently come upon the market as an industrial chemical, selling at less than a shilling a pound. It is made by hydrolysing certain waste cereal products, such as corn and maize cobs, oat hulls, etc., either in the presence or absence of acid. The aqueous distillate obtained can be rectified with relatively little difficulty. The sources of the necessary pentose-containing waste materials are wide, and it can confidently be expected that supplies of furfural will keep pace with demand, without any rise in the cost of the aldehyde.

The condensation of furfural with phenol, cresol or naphthol, readily occurs in the presence of catalysts, such as halogen acids, phosphoric acid, sulphuric acid, the chlorides of copper, zinc, aluminium, ammonium, etc. Black resins result, which are insoluble in acid and alkali even at boiling temperatures, and in all organic solvents except tetrahydronaphthalene.

The resins are capable of taking a high polish and can be turned upon the lathe. Fillers such as sawdust, kieselguhr, etc., may be incorporated into the reaction mixture.

If alkali be employed as the condensation catalyst, the resulting resins are brownish black, and are soluble in organic solvents. These solutions are suggested for use as varnishes, lacquers, and for waterproofing textiles.

Finally, furfural may be condensed with aniline or other amines to give distinctive products.

ACROLEIN RESINS

New methods for the cheap production and complete stabilisation of acraldehyde were worked out during the war by Moureu and Du Fraisse, whose investigations led them to the discovery of the "Anti-oxygens," which are destined to play an important part in the stabilisation of many industrial products such as oils and fats, rubber, dyes, and so forth. Cheap acrolein, capable of storage and transportation without resinification, provides the initial raw material for several soluble varnish resins as well as of insoluble hard resins, broadly of the Bakelite type.

Pure acrolein is polymerised in the cold by means of an organic or inorganic base, or salts of iron or lead, but not by means of an acid. The white precipitate produced is filtered immediately, washed and dried *in vacuo*. The polymerised product is soluble in alcohol but insoluble in water or hydrocarbons. The alcoholic solution dries to a brilliant varnished surface upon suitably prepared wooden or metallic structures.

Pure acrolein may likewise be condensed with a phenol by the aid of a mineral or organic base. The preparation of the artificial resins differs materially from that of Bakelite resins, since no water is present and the reaction occurs in one relatively simple stage. A yield of 100 per cent. is claimed upon simple mixing of the constituents in the presence of a suitable catalyst.

The resins produced are hard, insoluble in most solvents, of high electrical resistance, and can be moulded into desired shapes.

NAPHTHALENE-FORMALDEHYDE CONDENSATION PRODUCTS

Condensation products which have found some application in the German paint and varnish industry may be made from naphthalene and formaldehyde, a mixture of turpentine or refined tar with the product being employed. There would seem to be less prospect of established success for this type of product than any other, and a brief indication of the method of preparation will suffice. A mixture of 100 parts of naphthalene and 80 parts of 30 per cent. formaldehyde is gradually treated with 100 parts of H_2SO_4 (66 Bé). The mixture is heated under a reflux condenser at about 80° C. for several hours, and finally poured into water. The condensation product is washed with water, dilute alkali and finally water again and dried at 80° C. The hardness of the resin substitute varies with the conditions obtaining during its production.

The Bakelite type resins, manufactured by reputable organisations in this country, France, America and Germany, stand pre-eminent in the field of artificial resins, whilst the newer coumarone resins, carefully manufactured, are winning an established position.

Much research lies before the producers of many other types of artificial resins and gums, for the manufacturers of varnishes and lacquers, in particular, are inclined to regard the salesmen who call upon them "et dona ferentes" as suspect as were the Greeks before Troy.

PERSONALIA

The Abbé Taulergne, of Pontigny, has been awarded a silver medal and the sum of 5000 fr. for his scientific work, which includes a method of making three-colour prints, and investigations on radiography, etc.

Alois Walter, chemist to the Waldenburg porcelain works, has been appointed to a professorship in the German State training school for the porcelain industry.

Dr. E. S. Simpson, with the title of Government Mineralogist and Analyst, has been appointed to take charge of a new chemical branch opened on March 1, 1922, of the Australian Geological Survey and Government Analyst's laboratories, under the Department of Mines. This branch covers activities which were previously in large part distributed over separate health, agricultural and mineral laboratories.

* * *

The death is announced of Monsieur Brochet, professor of electrochemistry at the School of Physics and Chemistry of the City of Paris.

From France the death is reported of Monsieur Eugène Renevey, president of the Société d'Electro-métallurgie de Dives.

CO-ORDINATION AND THE ELECTRON

Prof. T. MARTIN LOWRY, F.R.S.

Dr. Main Smith's article on "Chelate Co-ordination" (this vol., p. 847) is of interest, less on account of its detailed criticisms than of the general propositions which are contained in the opening paragraphs. He suggests (i) that Werner's theory has been relegated until recently, by myself amongst others, to the limbo of lost causes, (ii) that it owes "less than nothing" to electrical theories of matter and energy, but (iii) that now that Werner is dead, there is almost a fashion for co-ordination; he also asserts (iv) that since Werner is dead "his co-ordination-theory should remain as he propounded it, built it, defended it and left it." In my own case at least, and I believe in that of many other chemists, co-ordination has "come to its own" largely on account of the factor to which it owes "less than nothing," namely, its intimate relationship to the modern electronic theory of matter. My diagnosis of the failure of Werner's theory to secure earlier the adequate recognition which it deserves would, therefore, be of quite a different character from Dr. Smith's, being based mainly on the limited range of chemistry in which it has hitherto made itself indispensable, on the altogether subsidiary part which it plays outside that range, as well as on the absence during Werner's lifetime of a clear theoretical basis for the facts to which he first directed attention.

(*a*) No chemist who has followed the work of Werner, and more recently of Jaeger, on the optically-active compounds of the metals, can fail to be impressed by the masterly character of the demonstrations whereby the octahedral symmetry of the six co-ordinated groups has been established in compounds such as the double oxalates of the transition-metals. This particular region of chemistry must, in my opinion, be dominated by Werner's conceptions, although one recent text-book of chemistry has been able to keep them in the background even in the volume in which the transition-metals are described. When, however, this particular group of elements is left behind, the usefulness of Werner's conceptions diminishes, as their application becomes less and less securely based on experiment. Thus even copper, although it shows its resemblance to cobalt and platinum by forming a large number of ammines, yields such a bewildering array of addition-compounds that Werner's rules are no longer a clear guide to their composition; and a cautious teacher is obliged to fall back on the old-fashioned molecular formulæ, rather than run the risk of bringing the theory of co-ordination into contempt by overmuch ingenuity in applying it. In the same way, the attempt to express the composition of the whole array of crystalline hydrates by means of co-ordination-formulæ has been marked by an ingenuity which has weakened rather than strengthened the theory. Finally, it is not clear that very much has been gained by replacing round by square brackets in the formulæ of compounds such as $[NH_4]Cl$, or by adding square brackets to formulæ such as $K_2[SO_4]$, except as a means of directing attention to an analogy of composition which might otherwise be overlooked.

(*b*) To organic chemistry Werner's theory contributed during his lifetime very little. It is true that he brings carbon within the scope of that theory by describing it as an element in which "the values of the maximum co-ordination number, and of the principal valencies are the same"; but this conception, although it is of interest to the student of co-ordination, has not aroused any enthusiasm in the organic chemist. Indeed, the theory of overlapping spheres of co-ordination is so much less practical than the earlier pictures of valency that its introduction in the formulæ of organic compounds would in most cases be a positive obstruction to progress, comparable with a reversion to the curly brackets by which the theory of types was expressed more than half a century ago.

In one of the few cases in which Werner suggests a modification of the current theories of organic chemistry, he appears to me definitely to have taken a retrograde step, by writing monomethyl ammonium iodide $(NH_3Me)I$ as $[CH_3\text{-}\text{-}NH_3]I$, and suggesting that whereas the three hydrogen atoms of the methyl group are bound to the carbon by a principal valency, "*the nitrogen atom . . . is bound to carbon by an auxiliary valency.*" I do not know of any facts in support of this view, and can see no justification for repudiating the traditional formula for this compound.

(*c*) As illustrating the limited range within which co-ordination has proved itself essential to the study and teaching of chemistry, one may notice that, in the new edition of Roscoe, Werner's theory is first used on p. 1305 of the second volume, and that its applications are limited to about 200 out of nearly 2400 pages. In this respect my own "Inorganic Chemistry" is not much better, although in writing it I had the utmost desire to do justice to Werner's point of view, which I had accepted many years before. Even under these conditions, however, co-ordination is only discussed in Part IV of the volume, and its applications are limited to seven or eight out of forty-five chapters. In organic chemistry I do not know of any text-book in which co-ordination is even mentioned, although the important work now being done in the Birmingham laboratory may soon make it necessary to remedy this defect.

(*d*) The theory of co-ordination has, however, suffered most of all from the lack of a clear picture of the fundamental factors which promote co-ordination. It is true that the laws of symmetry serve to explain the stability of groups 4, 6 or 8 as compared with 5 or 7 radicals; but, until the electronic theory of valency was developed, I have never seen any clear reason given for the extraordinary stability (to which I directed attention in my last article) of the co-ordinated cobaltic ammines, as contrasted with the non-existence of similar stable ammines of iron or nickel. It would be untrue to suggest that at the present time it is possible to supply a complete theoretical basis for all the phenomena to which Werner directed attention; but it is at least very instructive to compare Werner's own attitude on this matter with that assumed by Dr. Smith. Dr. Smith asserts that since Werner is dead, "his theory should remain as he propounded it, built it, defended it and left it," Werner, however, only claimed "to lay the foundation upon which, in the near future, it will be possible to build a consistent doctrine of valency." He looked forward to the development of "a general theory of valency" which would admit "not only of the deduction of valency-formulæ, but also of co-ordination-formulæ," and added that "the most important and pressing problem of valency resolves itself into the discovery and formulation of the general law which expresses all the combining possibilities of the atom."

So far as I know, this "comprehensive doctrine of valency," as Werner describes it in another passage, was not developed in his lifetime; but I am confident that if Werner had lived to see the modern electronic theory of atomic structure developed, he would have been one of the first to apply it to the phenomena of co-ordination, since he had already given evidence of his interest in electronic chemistry. The best proof of the value of Werner's "Neuere Auschauungen" is surely to be found in the vitality and growth of the theory of co-ordination and not in the embalming or mummification of that theory which Dr. Smith appears to regard as the best tribute to the genius of Werner.

(*e*) Even if the co-ordination-chemist can dispense with the electronic theory of valency (in much the same way as the organic chemist has managed to dispense with the theory of co-ordination), the converse proposition is obviously untrue. In the development of the electronic theory, co-ordination is no longer a mere "second string," to be used only when the ordinary rules of valency break down, but is co-equal with other manifestations of valency. Indeed, there are already indications that the boundary which has long existed between valency-compounds and co-ordination-compounds is about to disappear. In particular, Sidgwick's suggestion that in co-ordinated radicals, such as $PtCl_6''$, the six chlorine ions have given up their charges to the platinum, and in doing so have become united to it by six covalencies (or real "bonds" as G. N, Lewis would call them) exactly as in CCl_4. has in my opinion opened up a new chapter in the study of co-ordination, and may even make it possible to abandon the square brackets in which Werner's theory has been confined for so long, by substituting for them the familiar symbols by which valencies have been represented during the last fifty years or more.

2. (*a*) As regards the controversial part of Dr. Smith's article, there is not much that need be said, since I do not think that his comments affect the main line of argument of my previous article. If I may, however, adopt for a moment the attitude, which Dr. Smith (somewhat unjustly) assigns to me, of a recent convert to co-ordination, I might claim that a dispassionate survey of the data has convinced me that there really are two principal types of co-ordination-compounds. Some metals, of which tervalent cobalt and quadrivalent platinum are types, seem to behave like an electromagnet dipping into a heap of scrap-iron, since they will pick up and hold such a large variety of different types, both of ions and of molecules, that it would be tedious to attempt to enumerate them. On the other hand, however, the masterly work of the Birmingham school has brought into prominence the fact that there is a wide range of metals which can be made to form co-ordination-compounds of high stability, provided that the radicals are properly selected—that selection involving in most cases the choice of an unsaturated ring-forming group occupying two places in the co-ordination-complex. In these cases the functions of metal and radical appear to be reversed, since it is the radical rather than the metal that possesses the special characteristics which lead to the formation of stable compounds. One might indeed think of these radicals as horse-shoe magnets, and assign to the metal the relatively passive part of the soft-iron. The force which binds together the radical and the metal may very well be the same in both cases, and in that sense there may be only one kind of co-ordination, just as there is only one kind of magnetic attraction; but in one case the metal appears to be the main seat of activity and in the other the radical. It is also obviously possible to combine an active metal with an active radical, and so to unite both functions in one compound, just as a compound may at the same time be a sodium salt and an acetate, or an alcohol and an acid.

(*b*) In order to explain the special activity of these unsaturated ring-forming groups, I have made use of Thiele's view that the formation of a conjugated chain is an exothermic process, which can act as a source of energy in promoting chemical changes, such as enolisation. For this application of Thiele's theory there is very strong experimental justification. Thus Sidgwick, in a paper read at the Faraday Society's recent conference on valency, has shown that *eight* of the most active types of co-ordinating radical, including a new type recently investigated in the Oxford laboratory, give rise on co-ordination to conjugated six-atom rings, of which he distinguishes four types according to the elements which make up the heterocyclic ring. I do not, therefore, regard it as necessary at this stage to quote any further evidence in order to refute Dr. Smith's scepticism on this point.

(*c*) My original intention was to describe the two types of co-ordination-compounds as "centric" and "chelate"; but in doing so I should have been obliged to use the word chelate in a sense different from that of its original definition, since I wished to exclude those cases in which the chelate group has no special co-ordinating properties beyond those which are derived from a chemical analogy (to which Dr. Smith draws attention, but which I had not overlooked) to the familiar fact that it is easier to stand steadily on two legs than on one. It was for this reason that I used the word "cyclic" instead. I gather from the title of Dr. Smith's article that he is ready to admit the existence of a special type of co-ordination, provided that it is described as "chelate co-ordination." He has, however, given a new definition of the term "chelate" in which the original metaphor of the crab has not merely disappeared, but has actually been reversed, since ring-systems are apparently to be described as chelate, even if they act as a hindrance rather than as a help to co-ordination, flying open like coal-tongs rather than gripping like crabs. This appears to me to be an unfortunate use of an admirable term; but it fully justifies my hesitation to employ this term when defining a group of cases in which a real grip was postulated in the chelate group.

3. (*a*) In my earlier articles I should have made it clear that dotted lines were used only in order to lead the eye from a + to a − charge in its immediate neighbourhood. Under these conditions a large part of the field of force would be concentrated near the line joining the two atoms; but the line itself was not intended to have any physical significance beyond indicating the relatively close association in space of the two opposite charges. This close association may, of course, lead in some cases to the conversion of the electrovalency into a covalency, but that would be shown in the ordinary way by replacing the + — signs by a bond.

(*b*) I may add that the idea, to which I referred in the previous article, that hydrogen may form co-ordination-compounds, in which a proton replaces the ion of a metal, was already used (although perhaps in a slightly different form) by Werner in order to explain the structure of the acid fluorides. The suggestion that it may also be co-ordinated with the more powerful chelate groups is, therefore, not out of harmony with Werner's own conceptions.

SUMMARY

(*a*) The factors which have led to delay in the universal acceptance of Werner's theory of co-ordination are discussed.

(*b*) The view that the development of conjugated rings is an important factor in promoting co-ordination is maintained, in view of the strong experimental evidence on which it is based.

OBITUARY

Dr. J. A. HARKER

Chemists in several countries, and many other people who are not chemists, will be grieved to learn of the death of Dr. John Allen Harker, F.R.S., O.B.E., on Wednesday the 10th inst., after a short illness. Born in Cumberland in 1870, he was educated at the University of Manchester, where he took the degree of M.Sc., and became successively Dalton Scholar and Berkeley Fellow in Physics. He also was a D.Sc. of Tübingen. Entering the National Physical Laboratory he became chief assistant and head of the thermometry division and represented the British Government at the International Petroleum Congress in 1912.

From a national point of view his chief work was undertaken during the war, when he was appointed to organise the work of the Nitrogen Products Committee of the Ministry of Munitions. As director of the Nitrogen Products Research Laboratories he supervised much fundamental work on the fixation of atmospheric nitrogen, and since the close of the war he was responsible for the publication of the valuable statistical supplement to the report of the Nitrogen Products Committee. On the completion of his services to the Government he established a private practice as consultant. Those who attended the meetings of the Royal Institution, the Faraday Society and the Royal Society of Arts when questions relating to nitrogen were discussed will have reason to remember Dr. Harker's excellent contributions to the discussions and the readiness and clarity with which he spoke. Dr. Harker was engaged in interesting research work, and was, at the time of his death, a partner in the firm of J. F. Crowley and Partners, consulting chemists. His advice on important questions of physics and chemistry, especially on the manufacturing scale, was greatly esteemed. The loss of his charming personality will be widely felt in many circles.

FORTHCOMING EVENTS

Oct. 22.	SOCIETY OF CHEMICAL INDUSTRY, *Yorkshire Section*, Queen's Hotel, Leeds (Room 100), at 7.15 p.m. "The Colloidal Constitution of Clays and Soils," by N. M. Comber, D.Sc.
Oct. 22.	INSTITUTION OF MECHANICAL ENGINEERS, *Graduates' Section*, Storey's Gate, St. James's Park, S.W. 1, at 7 p.m. "Four-Wheeled Brakes for British Light Cars," by John Harrison.
Oct. 23.	UNIVERSITY OF LONDON, University College, Gower Street, at 5 p.m. "Ionic and Thermionic Valves," by Prof. J. A. Fleming, F.R.S.
Oct. 24.	THE ROYAL INSTITUTE OF PUBLIC HEALTH, Lecture Hall of the Institute, 37, Russell Square, W.C. 1. at 4 p.m. "Vitamins in Relation to Public Health," by Prof. J. C. Drummond, D.Sc.
Oct. 24.	THE INSTITUTE OF CHEMISTRY. Annual General Meeting, Textile Institute, Manchester, 7 p.m. "Some Aspects of Water-Tight Cases," by S. E. Melling, F.I.C.
Oct. 24.	THE UNIVERSITY OF LONDON, University College, Gower Street, W.C. 1, at 5 p.m. "Ionic and Thermionic Valves," by Prof. J. A. Fleming, F.R.S.
Oct. 24.	ROYAL INSTITUTE OF PUBLIC HEALTH, 37, Russell Square, W.C. 1, at 4 p.m. "Vitamins in Relation to Public Health," by Prof. J. C. Drummond, D.Sc.
Oct. 25.	SOCIETY OF DYERS AND COLOURISTS, *London Section*. Dyers' Hall, Dowgate Hill, E.C. 4, at 7 p.m. "Hydrogen Peroxide Bleaching," by I. E. Weber, B.Sc.
Oct. 27.	BRITISH ASSOCIATION OF CHEMISTS. Sixth Annual Meeting, to be held at the Chemical Dept., Birmingham University, Bournbrook, 3 p.m.
Nov. 1.	SOCIETY OF CHEMICAL INDUSTRY, *Bristol Section*, The Chemical Department, The University, Woodland Road, Bristol, at 7.30 p.m. "Some Aspects of the Paint Trade—Fine Colour and Lake Making." by A. H. Bridges.

OFFICIAL NOTICES

ROTHAMSTED LIBRARY

By the courtesy of the Lawes Agricultural Trust, any member of the Society of Chemical Industry on presenting a card from the General Secretary shall be allowed access to this Library. The rules of the Library preclude journals and periodicals from being sent out, and these are therefore always accessible.

A catalogue of the journals and periodicals is in the Society's Offices, at Central House, and may be consulted there by members.

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS,

October 31, 1923

This Dinner is being arranged under the joint auspices of the Chemical Society, the Institute of Chemistry, and the Society of Chemical Industry, and will be held in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on Wednesday, October 31, at 7 for 7.30 p.m. The arrangements are being made by a Committee consisting of representatives of the Societies mentioned, and of one or two other Societies.

Sir William J. Pope, K.B.E., F.R.S., will take the chair. There will be some speeches and some music as well as opportunities for social intercourse.

No similar dinner for chemists has hitherto been organised on exactly the same lines, and it is expected that the gathering will be not only very pleasant, but will be useful in promoting that social acquaintance which is so valuable in connexion with prevailing ideas and hopes.

Members of any of the Societies concerned are invited to attend and bring guests. The price of tickets for ladies and gentlemen is 12s. 6d. each, not including wine. Applications for tickets (accompanied by the appropriate remittance) should be sent to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2, as soon as possible.

Applicants are invited to state names of any friends beside whom they wish to be seated, and the names of guests should be furnished at the same time.

SOUTH WALES SECTION

The first meeting of the Session in South Wales took place in Cardiff on October 12 with Mr. W. R. Bird in the chair. A discussion was held on the smoke problem. Mr. H. J. Bailey, F.I.C., opened the subject with a survey of the rise of the smoke nuisance in the thirteenth century when coal was first burned in London. In the reign of Edward the First a Royal Proclamation was issued forbidding the burning of coal while Parliament was sitting, but the air thus cleared for the legislators did not enable them to think of any efficient mode of dealing with the difficulty.

Smoke was the subject of a Royal Commission in 1819, and again in 1845, but the only tangible result seems to have been the finding of the fact that smoke is a nuisance. The Sheffield conference in 1909 was a real step in the right direction. Since then the problem has received serious and skilled scientific attention, and one of the results is that a smoke abatement bill is now before Parliament.

It is open to question whether the private houses or factories contribute the more to the nuisance. In most districts modern types of furnaces are employed mainly, and the contribution of such is much less than that of the domestic fire. This supposition is borne out by the Meteorological Office observations during the period of the sudden coal strike of 1921, when nearly all factories closed down at once, whereas domestic fires were in the main unaffected.

Passing to the consideration of possible remedies for the nuisance and its enormous waste, it was suggested that the only real solution lies in the increasing use of gas for domestic heating and of low-temperature briquettes. The use of powdered fuel in furnaces largely obviates the emission of smoke, but there remains the difficulty of the dust from the ash of the fuel.

Mr. Bird, as the result of long observation in Manchester, considered that the domestic hearth creates much the greater nuisance. With regard to the industrial furnaces, he laid stress on the superiority of the water-tube boiler over the older Lancashire type. In New York only anthracite, which is practically smokeless, is allowed to be burned.

Mr. T. G. Watts referred to the economy resulting from the use of gas, coke and low-temperature briquettes, which latter can now be obtained sufficiently hard to withstand the effect of transport. Mr. H. W. Webb drew attention to the fact that a certain amount of distillation necessarily results from any form of top-feed stoker. No arches in the furnace can altogether eliminate waste and smoke resulting from such distillation. Under-feed stokers are the only kind which are scientifically correct.

It has been arranged to hold a dinner of the Section on the occasion of the President's visit on November 8 next. Also members of the Section will visit the Maritime Coke Works, Pontypridd, on Thursday, December 13.

CERAMIC SOCIETY

The autumn meeting of the Refractory Materials Section was held in Chester on October 4 and 5, the president (Mr. J. Holland) presiding over a large attendance. Brief notes are here given of the papers read.

(1) Mr. T. Acton gave a general sketch of the geology of the Chester district—including adjacent parts of North Wales—which was illustrated by lantern slides, maps, sections, diagrams and specimens of rocks and minerals.

(2) " Improvements in Drying Refractories or Other Goods," by J. Holland and W. J. Gardner. This relates to a tunnel dryer with travelling racks, the one specially described having a hot zone 60 ft. long and 3 ft. wide, with a longitudinal flue beneath, heated by

means of a furnace or by the heat from waste gases. The flue communicates with two longitudinal lateral flues, one on each side which lead to the chimney stack over the front end of the dryer. Continuous with the hot zone is a cooling chamber 10 ft. long. Two parallel steel tracks containing steel rollers extend the whole length from feeding end to delivery end of the dryer. As compared with hot-floor drying it is claimed that with this system conditions for workers are better and the goods are of higher quality. Much time is saved, and a very much smaller area is required for a given output of silica bricks or other goods. The stove of two chambers described can dry 5000 bricks per shift of 9 hours, using 4 cwt. of coal.

(3) " The Zenith Temperature," by Dr. J. W. Mellor. According to the kinetic theory of gases, temperature is determined by molecular or atomic movements, and their mean velocity V at the absolute temperature T is $V=15800\sqrt{T/M}$ cm. per sec. If the postulate of the quantum radiation theory is right, and the velocity of light (about 3×10^{-10} cm. per sec. in vacuo) is the maximum speed at which material things can travel, then for hydrogen the lightest gas, $M=1$, and therefore $3\times10^{-10}=1{\cdot}58\times10^{-4}\sqrt{T}$. Accordingly, if everything varies continuously on a rising temperature, the zenith temperature must fall short of four billion degrees C.

(4) " Notes on the Proctor Dryer," by A. H. Middleton. The Proctor dryer is essentially a close heated chamber, the atmosphere of which is dry at one end and very humid at the other. The wet goods are thoroughly heated to their core in a very humid atmosphere before any surface drying can take place. The machine at Consett is a three-track tunnel dryer consisting of a rectangular chamber 50 ft. long, 20 ft. wide and 6½ ft. high, holding 8 cars on each of the three tracks, and having a total capacity of 14,976 bricks. If bricks alone were being dried, the drying could be completed in 12 hours, and probably in 8 hours. Economical results can be obtained by working the different tracks on different schedules for different classes of goods, though of course the best results would attend the drying of one class of goods at a time. Advantages claimed for the Proctor dryer, as compared with hot floor, are that drying—especially of difficult shapes—can be carried out much more quickly and with less risk of cracking and setting up drying strains, that the conditions in the moulding shop can be made much healthier and pleasanter for the workers and that a large saving in fuel can be made, excepting when heat for drying can be provided from exhaust steam or some source that could not otherwise be utilised.

(5) " New Methods of Producing Gas for Industrial Operations," by R. Maclaurin. The three different chemical reactions utilised in making industrial gas are discussed at considerable length, viz., the distillation reaction, the reaction of air with large excess of heated carbon (producer gas reaction), and the water-gas reaction. In the Mond and Maclaurin producers, combinations of these reactions take place. A description was then given of the Maclaurin producer at Grangemouth. When full the plant holds about 30 tons of coal and working is continuous, about a ton of coal being put in at the top every hour and the equivalent in coke or residue withdrawn from the bottom. To change over from working for coke to working for complete gasification, it is necessary to adjust the valves controlling the air blast and the withdrawal of the gas respectively; by these adjustments either a black smokeless fuel or a hard grey coke or an ashy residue can be obtained. Several hundred tons of the coke have been used in blast-furnaces in Scotland. The yield of oil varies up to 30 or 40 galls. per ton, the average yield from bituminous coals lying between 14–20 galls. per ton; the oil has found use for the manufacture of resins, lacquers, lubricating and fuels oils. The ammoniacal liquors differ from ordinary gas works and coke-oven liquor in being free from ferrocyanides and sulphocyanides, and in containing polyhydric phenols, one of which gives a quinoneoxime somewhat similar to resorcinol green, this product being the first dye to be taken direct from ammoniacal liquors. A brown pigment and other coloured products are also obtained. The ammonia can be obtained as white sulphate by the ordinary methods, the yield ranging from 16 to 80 pounds. The author adduced figures to show that his plant could be advantageously applied in drying ceramic wares or bricks, as the gas could be produced at less than 1d. per therm. The great distinguishing feature of this gas is the relatively very large percentage (13) of methane, which enables flames of considerable length to be provided. The advantage of using the gas for power is urged, the cost per horse-power-hour being estimated at one-ninth of a penny.

(6) " The Effect of Salty Coal upon Refractory Materials," by L. M. Wilson, M.Sc. The author investigated the action of ammonium chloride, which is found in coke-oven gas from salty coal, and concluded that: (1) There is a critical temperature at about 900° C., at which the chemical properties of burned fireclay seem to undergo a change, quite apart from the critical temperatures at which the physical properties of either raw or fired materials are known to alter. Below this temperature very little alumina is removed, and above it a great deal of alumina is removed by the action of heated ammonium chloride. (2) The experimental evidence demonstrated the superiority of high-grade silica over fireclay for the lining of coke ovens as regards resistance to salty coal. (3) At temperatures from 700° C.

to 1200° C. and higher, ammonium chloride removes iron and alumina from fireclay and from silica bricks.

(7) "Carbonisation of Clay," by W. Smith. By saturating clay, at a certain stage of heating (when the clay has maximum porosity) with hydrocarbon gases or volatile hydrocarbons under pressure, finely divided carbon is deposited on all the particles of the clay. The biscuit clay so carbonised is black even when very finely divided. Subsequent heating produces the usual contraction of the clay, the carbon particles being enclosed under great pressure, forming a composite body of great density and hardness. By firing this product in a strongly oxidising flame, it is converted into a microscopically porous structure by the burning away of the carbon, the refractory properties being improved. For the black carbonised clay, the term "carbonite" is suggested for industrial purposes. Its hardness and toughness adapt it for abrasives, for mixing with cement, for road-making, etc. It is very refractory to heat in the absence of air, is resistant to acids, and impervious to weather or atmospheric action. The white carbonised clay or "carbo-calcined" clay, because of its artificially produced porosity, has good refractory properties. The durability of "carbo-calcined" bricks in industrial furnaces has been proved to be superior to that of articles produced from the natural clay. The binding of carbonised clay is accomplished by pressure, just as with magnesite. Artificial binders should be used sparingly. Carbonisation increases the normal formation of sillimanite in aluminium silicates.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held at the Offices of the Association on Thursday, October 11, 1923, Sir Max Muspratt, Bart., presiding.

The General Manager stated he had become a member of the Committee set up by the London Chamber of Commerce to correlate evidence to be given on behalf of the manufacturers and users in connexion with the use of preservatives and colouring matters in food. Mr. E. J. Boake will give evidence early next month on behalf of the makers of Sulphites.

The first film dealing with the chemical industry will shortly be ready for exhibition to the public. This deals with the Coal Tar section, and later a film dealing with Heavy Chemicals will be available.

The question of contracts with local authorities, etc., was again considered, and members are being asked for further information to enable the matter to be carried to a definite conclusion.

In connexion with the visit of the Colonial Premiers to this country it was agreed to bring the chemical industry before their notice and, if time permits, they will be asked to visit certain representative works.

A report from the General Manager on the working of the Dyestuffs Act revealed that there was an increase in the quantities of German dyestuffs imported into this country during the first six months of 1923, as compared with the corresponding period of last year, but this was largely due to the collapsed exchange. It is interesting to note that conversations are at present taking place between the makers and the users in an attempt to arrive at a stabilisation of prices.

The arrangements for the Chemical Section of the British Empire Exhibition are progressing satisfactorily. The exhibitors themselves have agreed to a comprehensive scheme of lay-out and decoration which will naturally serve to make the Chemical Exhibit more attractive. The editors of the Technical Press have undertaken to assist in every way in giving full prominence to the exhibition in their journals and elsewhere.

The Scientific Section promises to be one of the most pleasing parts of the exhibition. A very comprehensive classification of exhibits has been arranged, and some of the most eminent scientists have undertaken to be responsible for the work in the various sections.

The question of awards was considered, and having regard to all the circumstances the Council were of the opinion that the best way of dealing with the matter was to do away with the usual system, and in its place adopt a commemorative medal which could be given to all exhibitors. It was agreed to place this view before the exhibition authorities.

The Council authorised an objection being lodged with the Railway Rates Tribunal against the schedules of standard charges, as proposed by the railway companies.

ACADÉMIE DES SCIENCES

During the meeting held on October 8, Prof. Perrin utilised the phenomenon of fluorescence to explain the radio-chemical theory and show that temperature influenced, though but feebly, photochemical radiations.

Prof. Sabatier discussed the decomposition of calcium carbide and metallic salts in aqueous solution. In the presence of cupric chloride, cupric acetylide, insoluble under certain conditions, was obtained at the same time as acetylene. By means of this method a number of new acetylides were obtained.

* * *

Dr. J. Brand, who recently retired from the chair of pharmacology and pharmacy, in the University of Munich, has been succeeded by Dr. A. Joelbauer.

THE BRITISH EMPIRE EXHIBITION (1924)

The Editors of the various technical journals met Mr. Woolcock, the General Manager of the Association of British Chemical Manufacturers, at the offices of the Association, to discuss with him the progress which has been made with the preparation of the Chemical Section of the British Empire Exhibition. In the course of the conversation Mr. Woolcock said :—

"The Chemical Section which is being organised by the Association and occupies nearly 40,000 sq. ft. in the Palace of Industry will be built in such a way as to form a Hall within the Palace. About £100,000 will be spent in presenting to the public a picture of the present state of British chemical industry. No important firm in the industry will be unrepresented, and the whole of the individual exhibits, numbering about one hundred, will, by reason of their position and character, combine to form a magnificent illustration of the industry. It has not, however, been considered sufficient that we should merely show visitors examples of the products of the industry. The best possible exhibition of this kind would leave one question unanswered. The visitor may be satisfied that he is witnessing a demonstration of the position which the industry has attained, but what the critical person who examines the exhibit requires to know is whether there is behind this example of what has been achieved a scientific basis which will ensure the continuance of this progress. For this reason in the centre of the Chemical Hall there is to be illustrated the progress which has been made in pure chemistry during the past twenty or thirty years, with a view to showing that the stream of scientific invention in this country is still flowing steadily onwards."

The Scientific Section is being organised by a Committee consisting of representatives of the following bodies : The Chemical Society, the Society of Chemical Industry, the Institute of Chemistry, the Society of Dyers and Colourists, the Pharmaceutical Society, the Institution of Petroleum Technologists, the Institution of Chemical Engineers. The Committee is working in close co-operation with the Royal Society. In order that both the general public and scientific persons may have a record of the exhibits, it is proposed to publish a number of pamphlets, specially written for the purpose, dealing in popular language with the various classes of exhibits in the Scientific Section. In addition to this, it is proposed to publish in more technical language a work which will not only explain the scientific exhibits, but which will put on record in a very complete form the state of our knowledge in chemical matters at the date of the Exhibition.

The Editors present agreed to give any assistance in their power in organising the publicity service of the Chemistry Section.

A meeting of the Exhibitors was held in the Chemical Hall at Wembley on the 16th inst. ; we hope to publish shortly a complete list of the firms exhibiting.

The organisation of the Chemical Section is entrusted to various committees, the Executive Committee, of which Mr. Woolcock is chairman ; the Publication Committee, of which Dr. E. F. Armstrong is chairman ; and the Scientific Committee, of which Dr. H. Levinstein is chairman.

CORRESPONDENCE

THE DETERGENT ACTION OF SOAP

Sir,—In reply to "Raybell's" letter which appeared in your issue of October 5, concerning the purity of the materials used in investigating detergent action, I should like to point out that a paper published by Laing and McBain (*Trans. Chem. Soc.*, **117**, 1507) contains a full account of the degree of purity of various specimens of Kahlbaum's oleic acid which have been used in this laboratory. The potassium oleate used in detergent action, however, was not made up by us from oleic acid and potassium hydroxide, but was supplied as such by Kahlbaum's and was the purest obtainable. As was pointed out in the published paper, this potassium oleate was found to be 3 per cent. acid.

Myristic acid of undoubted purity (giving theoretical molecular weight and melting point, etc.) was used in the preparation of solutions of potassium myristate.—I am, Sir, etc.,

A. Millicent King

Department of Physical Chemistry,
University of Bristol

THE CHEMICAL ENGINEER

Sir,—The correspondence in your columns on the chemical engineer recalled the very valuable discussion held by the Faraday Society in 1917, and published in Vol. XIII. of its *Transactions*. In this many representatives of chemistry and engineering took part, and the whole discussion is well worth serious study by those who are interested. For my own part, I believe the right note was struck by Prof. Donnan in his statement that "the only road to real applied chemistry lies through a close and thorough study of physical chemistry." Mr. Greenfield, in your last issue, would have us think that a real chemical engineer is a "physical engineer," and his contention certainly has in it a good deal of truth. It is, however, too narrow. He should have said a "physico-chemical engineer," because there are many things, such as chemical equilibria, which enter into the problem, which we cannot fairly expect the physicist to have studied in such detail as the chemist. The study of

thermodynamics, chemical equilibrium, electrochemistry, the phase rule, colloid chemistry and the like is, in my opinion, an essential part of the training of the chemical engineer, and I think your readers would find in Professor Donnan's article a key to some of their difficulties. The actual "works sense" can probably only be acquired on the works, but with good will and the co-operation of the men of experience, the young chemist trained on the above lines would, I think, soon prove his value. I have no wish to dogmatise in a region outside my own activity, but I think some purpose may be served in calling attention to what has already been said on the matter.—I am, Sir, etc., J. R. PARTINGTON.
East London College, University of London.

NEWS AND NOTES

FRANCE

The Eighth Congress of Fisheries and Maritime Industries

The Eighth Congress held at Boulogne, from September 9 to 16, was extremely successful and well attended, a large English delegation being present, and the British Oceanographic Research Ship being available for inspection. Numerous papers were read, including "The Utilisation of Squalids," by Dr. Ehrenreich; "The Production of Fish Oils," by Monsieur E. André; "The Utilisation of Fish Scales," by Monsieur Dollfus; "The Life of the Eel,' by Prof. Joubin; numerous visits were made to factories and there were many excursions. One paper, on "The Origin of Artificial Pearls," by Monsieur Pohl, was of particular interest, as it traced the history of the manufacture of artificial pearls from early Chinese times when the silvery pigment from the bodies of certain fish was utilised. In 1860, the Frenchman Jacquin utilised the same material to manufacture the first artificial pearls in Paris. At first the scales employed were obtained from the "ablet": the organic matter is removed leaving a silvery pigment, which is preserved in ammoniacal solution. The solution is gradually dehydrated and is finally mixed in a plastic mass of cellulose ethers to be applied to a support. As only 500 g. of crude scales can be obtained from 2000 ablets, the industry could hardly be extended, though scales of various fish are also used, particularly those of the herring, scales of which were produced in the United States in 1921 to the value of $15,000.

Developments of Coking Installations

In a recent issue (*Chem. and Ind.*, 1923, 915) we referred to the erections of new batteries of coke ovens by an important iron and steel company in France. It is now reported that the Hauts Fourneaux et Fonderies de Pont à Mousson are to reconstruct their plant, and the Société de Chatillon Commentry et Neuves Maisons is to erect coke-ovens at Neuves Maisons, where its principal metallurgical works is situated. In Lorraine two new batteries are being erected at Moyeuvre by the Wendel Co., which is also considering the construction of one or two batteries at its Haynge Works. The Société Lorraine is also to erect a battery and similar projects are to be considered at Knutange, Hagondange and Rombas. These recent decisions are facilitated by recent studies carried out in the Saar District and in Lorraine on the production of coke (*cf. Chem. and Ind.*, 1923, 278). It is interesting to note that the Strasburg Gas Co. has formed a company under the name of "Alcok," with the object of building batteries of coke-ovens in the neighbourhood of Strasburg. The Société Minière and Metallurgique is now taking a new battery through a trial run. This particular battery is fitted with the high narrow ovens which recently gave such promising results.

Fuels

The decision of the Belgian Government to reduce by 50 per cent. exports of Belgian coal after October 1, has caused considerable discussion in France. The restriction is based on the quantities exported between August 20 and September 19. The reduction, however, will not be applied to the industrial coal from the Mons basin, or to briquettes. The importance of this decision is shown by the fact that France imports at least 100,000 tons of Belgian fuel per month, and is moreover the traditional customer of the Charleroi basin. The coal market in France is active and the improvement in the Ruhr situation is being followed with the closest attention.

CANADA

The Paper and Pulp Industry in 1922

The Canadian pulp and paper industry has made a satisfactory recovery from the unfavourable conditions which prevailed in recent years. The total net value of production was $236,420,176 in 1920, but during the period of reconstruction in 1921, the value fell to $151,003,165. The total of $155,785,388 for 1922, however, shows a tendency towards normal progress. In the year under review 104 pulp and paper mills were in operation (100 in 1921), 43 manufacturing pulp only, and 33 paper only, 28 being combined pulp and paper mills. The total output of pulp was 2,150,251 tons, valued at $84,947,598, an increase of 38·8 per cent. in quantity over 1921. Exports of pulp in 1922 were 818,247 t. ($41,037,849), as compared with 527,222 t. ($33,133,675) in 1921. During the same periods the imports of pulp amounted to 17,300 t., valued at $1,008,527, and 17,354 t., valued at $1,683,041, respectively. The total output of paper amounted to 1,366,815 t., together with certain miscellaneous pulp products valued at $107,085,766, an increase of 34·1 per cent. in quantity over 1921. In 1922 this output of newsprint paper amounted to 1,081,364 t., approximately 80 per cent. of the Canadian paper output, valued at $75,971,327. It is anticipated that Canada's newsprint output will exceed that of the United States during 1923 or 1924, thus making Canada the world's largest producer of newsprint paper. Exports of newsprint paper in 1922 amounted to 959,514 t., valued at $68,362,817.

The total number of employees in the industry in 1922 was 25,830, the total of wages and salaries amounting to $32,918,955 ; the capital invested has increased from $379,812,751 in 1921 to $381,006,324 in 1922.

Silica

The valuable series of monographs issued by the Mines Branch, Canada, Department of Mines, on the mineral resources of Canada has been enlarged by the recent publication of one entitled "Silica in Canada, its Occurrence, Exploitation and Uses" (No. 555, pp. 126) by L. H. Cole, Part I., now issued, is devoted to Eastern Canada and describes the nature and features of the various deposits of commercial silica. In addition to an interesting chapter on industrial uses, the results of laboratory tests are given and the brochure concludes with an illustrated description of methods of proving and working silica deposits. At present a large part of the higher grades of industrial silica used in Canada is imported from the United States, Great Britain and Belgium, but the Mines Branch has now shown that many deposits in Eastern Canada should, if properly operated, yield material equal to that imported.

GENERAL

World's Beet Sugar Production

The following table has been compiled, showing the area under sugar beet and the production of the roots in 1921 and 1922 in various countries :—

Country	Area (1000 acres)		Production (1000 metric tons)	
	1922	1921	1922	1921
Germany ..	1129	1086	10,791·6	7979·8
Belgium ..	148	143	1695·4	1462·9
Bulgaria ..	25	20	213·8	173·4
Denmark ..	60	88	573·0	868·6
England and Wales ..	8	8	—	—
Finland ..	2	2	11·5	13·0
France.. ..	286	298	2873·3	2060·6
Italy	222	158	2260·0	1751·3
Netherlands ..	143	183	1846·2	2708·3
Austria ..	27	20	176·7	93·8
Poland.. ..	269	196	2671·4	1128·8
Rumania ..	54	57	—	351·6
Sweden ..	41	121	456·5	1484·6
Switzerland ..	2	2	34·0	42·4
Jugoslavia ..	49	41	—	188·5
Spain	110	133	—	1816·4
Czechoslovakia.	519	544	5240·1	4071·7
Hungary ..	90	103	573·4	542·9
Canada ..	20	30	156·9	243·1
United States..	535	810	4744·6	6965·3

It will be noticed that most European countries increased their output of sugar beet in 1922, even where a decrease in the acreage is shown.

REVIEWS

Chemistry ; Inorganic and Organic, with Experiments. *By* Charles Loudon Bloxam. *Eleventh edition, edited by A. G. Bloxam, F.I.C., and S. Judd Lewis, D.Sc., F.I.C. Pp. ix+832. London : J. and A. Churchill,* 1923. *Price* 36*s*.

No one could be surprised if, after thirty-seven years from the date of its first issue, Bloxam's *Chemistry* could be shown to have lost some of its importance as a standard work, and there can be little doubt that a publication of this type must appeal to a class of reader which becomes more and more restricted as each successive edition appears.

Anyone desiring to acquire a passing acquaintance with a chemical subject, however, might do worse than to consult this work, for they will then find information which will be sufficient for many purposes, or at least prepare them for more adequate treatises.

That the book has not been thoroughly modernised is a fact obvious at first sight. It is hardly necessary to do more than make the following quotations :—"Such a substitution of chlorine for hydrogen accompanied by the simultaneous formation of hydrochloric acid is known as metalepsis, and is a very common reaction of chlorine with hydrocarbons ; since the formation of hydrogen chloride is initiated by light it is not surprising that metalepsis is aided by this agency." (Page 103.) "Its powerful action on bases places nitric acid among the strongest acids, though the disposition of its elements to assume the gaseous state at high temperatures, conjoined with the feeble attraction existing between nitrogen and oxygen, causes its salts to be decomposed, without exception, by heat." (Page 187.) "Nitrous acid may be regarded as a solution of NO and NO_2 in water ($H_2O.N_2O_3$ or $H_2O.NO.NO_2$). The former tends to combine with oxygen to form NO_2, and the latter tends to part with oxygen to form NO, so that nitrous acid can behave, according to circumstance, either as a reducing agent or an oxidising agent. Obviously any compound capable of parting with oxygen to NO cannot obtain oxygen in the same circumstances from NO_2." (Page 194.) It is obvious that no addition of footnotes will ever reconcile these statements with our present knowledge, and it is to be regretted that the editors went so far as to allow what is to all intents and purposes incorrect to persist in the eleventh edition.

After discussion on some fundamental principles in an introduction, the nature and properties of water are dealt with, together with a few words about hydrogen and oxygen. In this connexion it is noteworthy that no mention is made of permutit as a water softener. We are then given in connexion with air the properties of nitrogen and oxygen and also carbon dioxide, whilst more about hydrogen forms the fourth chapter. We have to wait till the sixth and seventh chapters to arrive at the properties of the compounds of oxygen and nitrogen respectively. In the eighth chapter part of the fourth group is dealt with, and carbon dioxide, having been dealt with under the heading of air, is omitted. Then after the inert gases come the general principles and physical chemistry. In the latter part of the book metallic elements are considered in a more or less normal way, the only peculiarity being that glass and niton (not the ultimate state of matter as stated) are included with the alkaline earths.

The organic section is dealt with on lines similarly unique, and the advantage of considering the paraffins, ethylenes, acetylenes, benzene, naphthalene, anthracene, phenanthene and fluorene in succession merely because they happen to be hydrocarbons is no more apparent than that of dealing with them in the order of their carbon content. However, it is admittedly a matter of opinion as to whether or not the arrangement adopted gives on the whole a balance of advantages, and the only serious criticism that can be made is the failure on the part of the editors to modernise isolated statements so out of date as to have become practically untrue, since this is apt to undermine the confidence of any class of reader with regard to the trustworthy character of the book.

G. N. White

Kolloide in der Technik. *By* Dr. R. E. Liesegang. *Wissenschaftliche Forschungsberichte. Naturwissenschaftliche Reihe edited by* Dr. R. E. Liesegang. *Pp.* 157. *Dresden and Leipzig: Theodor Steinkopff*, 1923. *Price* 3*s.* 6*d.*

In choosing "The World of Neglected Dimensions" as the title for his introduction to colloid chemistry, Wo. Ostwald displayed a sense of humour not unmixed with subtle irony, that will be readily appreciated by colloid chemists when they attempt a survey of the literature of their subject. To them will come this new volume of R. E. Liesegang as a boon and a blessing, or at least as an aid in coping with the neglected dimensions of the literature of their subject. As a survey of the field of colloid chemistry in technology the book will be welcomed, as it deserves to be, as a careful review of the progress made during the last few years. In the compiling of such a work there will always be the difficulty of adequately linking up so heterogeneous a mass of detail, without, on the one hand producing a mere catalogue of literature, or on the other an unwieldy volume. Dr. Liesegang has succeeded admirably in this task. In the fourteen chapters of his book he has provided the best short summary of the subject extant. Commencing with glue and gelatin and other adhesives, he next reviews recent work on protective colloids, plastic masses, tanning. soap, oils, resins, rubber, textiles and dyeing. metals, ceramics, foodstuffs, and concludes with a chapter on photography and reproduction technics. All this in the space of 147 pages.

It will be appreciated that the book is not designed for the general reader but for the worker in one or other branch of colloid chemistry, or more especially for the technologist whose subject involves the application of the principles of colloid chemistry, and to such its value will not be lessened by the fact that the greater number of literature references are to papers published since 1918.

To merely look for and catalogue omissions in such a book as this were a graceless task. The value of Dr. Liesegang's work is such that further editions are certain to be called for, and when that time comes the author will be enhancing the benefit he has conferred on colloid chemists by including, as he doubtless will, some further details of electro-endosmose, and in particular its application in the ceramic and metallurgical industries. Attention might also be drawn to the colloidal theory of corrosion and to the important applications of the study of disperse systems in gases.

Despite minor imperfections and omissions, the book can be confidently recommended as an exceedingly able and informing review of the applications of colloid chemistry to industry, and as such worthy of a place on the bookshelf of every colloid chemist.

H. W. Greenwood

A Handbook on Rubber Uses and Their Development. *Pp.* 162. *London: The Rubber Growers' Association, Inc.*, 1923. *Price* 2*s.* 6*d.*

In 1919 the Rubber Growers' Association organised a competition with the object of discovering new uses for rubber and thereby increasing the consumption. About 10,000 suggestions were received, and were examined by a board of adjudicators from the standpoints of practicability in manufacture, suitability of cost and ease of exploitation. A selection of the most promising suggestions has now been published in the book under review, which is divided into sections devoted, respectively, to moulded articles, open-heated goods, sheet rubber, proofed material, dipped goods and footwear. etc., sponge rubber and tyres, vulcanite and miscellaneous articles. It is impossible to review such a wide variety of suggested uses, which, to be of value, must be attractive both to the manufacturer and to the consumer, and, moreover, still await trial. The book makes interesting reading. and should stimulate interest in the already very varied uses of rubber. An appropriate note is provided by the use of rubber-latex paper for the book.

REPORTS

Report on the Economic, Financial and Industrial Conditions of Finland. Dated March, 1923. *By* C. H. Mackie, *H.M. Consul, Helsingfors. Department of Overseas Trade. Pp.* 64. *H.M. Stationery Office*, 1923. *Price* 2*s*.

In 1922, Finnish trade with foreign States began to develop. As a result of a large surplus of exports over imports much foreign currency entered the country and the value of the Finnish mark rose steadily. Further improvements in the economic condition of the country must depend largely on the progress of neighbouring States.

Industries have made rapid progress since the war, the number of factories having increased from 2582 in 1914 to 3138 in 1921. The glass industry made progress during 1922, the output being valued at 45 million F.mks. compared with 33·7 million F.mks. in 1921. Exports, though of less bulk, were of greater value, owing to the larger proportion of table glass and crystal. The Portland cement factories have a manufacturing capacity of about 1,000,000 barrels per annum, which leaves a margin for export. The sugar industry is in the hands of the Finnish Sugar Co.; output increased from 25,800 t. of refined sugar in 1921 to 33,700 t. in 1922. Large quantities are still imported. The year opened badly for the iron and steel trade, but as German prices rose the position of Finnish manufacturers improved and with an import tariff they are now in a much better position. No important developments have taken place in the pulp and paper industry, though the introduction of new methods has increased productive capacity. A new Government factory for the production of sulphuric acid was opened in August, 1922, capable of producing 9000 t. of 93 per cent. acid annually. A State-owned superphosphate factory has also been erected.

The trade balance in 1922 was favourable for the first time, exports amounting to 4461 million F.mks. and imports to 3953 mill. F.mks., compared with 3389 mill. F. mks. and 3585 mill. F.mks., respectively, in 1921. Great Britain, taking 37 per cent. of the exports was by far Finland's largest customer, France coming next. Germany led as a source of imports, though Great Britain improved her 1921 proportion; it is pointed out, too, that German competition is declining. Among the principal imports in 1922 were iron and manufactures, 81,000 t.; lead, 353 t.; tin, 152 t.; copper, 370 t.; phosphates and bone meal, 20,000 t.; saltpetre (Chile and Norwegian), 3788 t.; potash salts, 11,637 t.; basic slag, 14,539 t.; superphosphates, 11,617 t.; white lead, zinc white, etc., 1688 t.; aniline dyes, 391 t.; sulphur, 27,220 t.; caustic soda, 1575 t.; common salt, 76,660 t.; calcium chloride, 3423 t.; Glauber's salt, 19,125 t.; alum and aluminium sulphate, 4451 t.; soda, 3156 t.; oils, resins, wax, rubber, etc., 11,573 t.; mineral oils, 38,702 t.; cement, 3961 t.; coal, anthracite, coke, 243,097 t.

Report on the Economic Situation of Denmark, to March, 1923. *By* R. M. Turner, *H.M. Commercial Secretary, Copenhagen. Department of Overseas Trade. Pp.* 48. *H.M. Stationery Office*, 1923. *Price* 1*s*. 6*d*.

The year under review was characterised by general financial reconstruction (*cf. J.*, 1922, 405 R), and many concerns had to face considerable losses. The sacrifice, however, has had its desired result and general business conditions in Denmark have shown an improvement, though this is due in some measure to the general improvement throughout the world. The tendency seems to be persistent, though the dependence of such a small state on its foreign neighbours is an important consideration. Although wages have been reduced an increased number of workers is employed, making manufacturing costs excessive. The iron and steel industry suffered in 1922 owing to the quietness of the ship-building yards; the severe German competition of 1921 seems to be decreasing. The soda factories suffered delays in obtaining supplies of chemicals; prices have been lowered by competition and profits further reduced by the rise in sterling exchange. The largest firm making artificial manures was reconstructed in 1922, and managed to show a profit on the year's working, which will be used partly in covering the debts carried on from the old company. There was an improvement in the paper-making industry, imports of pulp being considerably increased. In 1922 the harvest, contrary to earlier expectations of a partial failure, was about normal. The sugar crop only amounted to 90,000 t., compared with 130,000 t. the previous year, and this will be insufficient to meet home demands in 1923.

Although the total value of imports during 1922 was less than in 1921, 1505 mill. Kr., against 1640 mill. Kr., their actual bulk was greater, the same being noticeable with exports, 1242 mill. Kr. against 1511 mill. Kr. As in previous years the chief customer was Great Britain, though details are not available. The value of goods imported from Great Britain seems to show an increase over the 1921 figure. Among the articles of trade during 1922, with their values in millions of Kroner, are skins, hides, etc., and manufactures, imports 41, exports 28; tallow, rubber, etc., and manufactures, imports 94, exports 28; chemicals, imports 24, exports 6; fertilisers, imports 44; mineral fuels, imports 125; raw or roughly worked minerals, imports 16, exports 20; iron and manufactures, imports 106, exports 15; other metals and manufactures, imports 33, exports 6.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Oct.* 11)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Electrical accessories, artificial silk	379, 380
British India	Hardware	381
,,	Oil-tank wagons, white lead, iron and steel (tender)	*
Canada ..	Surgical and medical appliances, drugs	384
,, ..	Centrifugal sewage pump (tender)	12199/E.P./E.C./2
Dominican Republic	Hardware, crockery ..	8660/F.L./G.C./A.2
Egypt ..	Paper (tender) ..	11614/F.E./M.P.
Finland ..	Saccharin, isinglass ..	394
Italy.. ..	Chemicals, fertilisers, oils	397
New Zealand	Patent medicines, drugs, photographic materials	389
Norway ..	Leather; asbestos, rubber goods, aluminium foil	398, 399
South Africa	Linseed oil (tender) ..	12290/E.D./C.C./2/A
,,	Machine oil (tender) ..	12290/E.D./C.C./2 (B)
,,	Antifriction grease (tender)	12290/E.D./C.C./2/C
,,	Buffalo hides (tender)	12339/E.D./M.P.
Spain ..	Dental specialities, druggists' supplies	400
,, ..	Porcelain, crystal, leather	401
Spain—Canary Is.	Building materials, iron and steel, cement, asbestos cement	404
Madeira ..	Tinplate, cement ..	405

* The Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E. 1.

TARIFF CUSTOMS EXCISE

Germany.—The internal tax on sugar has been increased. Ammonium nitrate, paper, and articles of platinum, gold and silver are exempted from export licences.

Greece.—The current issue contains particulars regarding the importation, preparation and sale of quinine.

Mexico.—Imports of opium, cocaine, heroin and morphine are prohibited.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The heavy chemical market maintains the improvement recently recorded and trade seems now to be more settled. No price changes have occurred, the slight variations which may have been noted from time to time being purely of a temporary character. Foreign materials are still being offered, but in general prices are comparable with those quoted by home manufacturers.

Acetic Acid, 40% tech. ..	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric ..	3s. 6d. per carboy makers' works.
Acid Nitric 80° Tw. ..	£22 per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 65s. f.o.r. makers' works, with slight variations up and down.
Acid Sulphuric, 94% Arsenical	£6 per ton makers' works.
Ammonia Alkali ..	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder ..	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime ..	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride ..	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate ..	5¾d.—6d. per lb. d/d.
Potass. Chlorate ..	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76% ..	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98% ..	£24–£25 per ton. Still scarce for spot delivery.
Sod. Bicarbonate ..	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96% ..	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.

Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£16 10s.–£17 per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Business in this section is generally on the dull side.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide ..	5s. 9d. per lb.
Carbon Bisulphide ..	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide ..	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark ..	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite ..	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d. Regular demand and short supply.
Grey	£21 per ton.
Liquor..	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£10 per ton, according to grade. Market quiet owing to slack demand for non-ferrous metals.
Iron Liquor	1s. 7d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d.—6s. 4d. per gall. 60% O.P. Steady market.
Solvent	6s. per gall. 40% O.P. Good demand.
Wood Tar	£5—£6 10s. per ton, according to grade. Slightly weaker.
Brown Sugar of Lead ..	£41—£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 1½d.—1s. 2d. per lb. Good demand. Market firmer. Limited quantities only available for prompt delivery.
Crude 60's	3s. 6d.—3s. 8d. per gall. Good demand for spot delivery. Supplies limited.
Acid Cresylic—97/99 ..	2s.—2s. 5d. per gall. Steady demand.
Pale 95%	1s. 11d.—2s. 4d. per gall.
Dark	1s. 10d.—2s. per gall.
Anthracene Paste 40%..	4d. per unit per cwt. Nominal price. Few inquiries but no business.
Anthracene Oil—	
Strained	8½d.—11½d. per gall. Supply short. Fair demand.
Unstrained	8½d. per gall.
Benzole—	Fair enquiry.
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor ..	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 6d.—1s. 8d. per gall. Little business passing.
Pure	1s. 10d—1s. 11d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24% ..	10½d.—11d. per gall. Not much business.
Middle Oil	8¼d.—9½d. per gall. according to grade and district. Demand still good.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160 ..	1s. 1½d.—1s. 3d. per gall. Prospects brighter.
Solvent 90/190 ..	1s. 3d.—1s. 4½d. per gall.
Naphthalene Crude—	
Drained Creosote Salts	£7 10s.—£8 per ton. More inquiry. Difficult to meet demand.
Whizzed or hot pressed	£9 10s.—£11 per ton.
Naphthalene—	
Crystals	£19 10s. per ton.
Flaked..	£19 10s. per ton.
Pitch, medium soft ..	130s.—140s. per ton, according to district and time of delivery. Several inquiries. Market firm and price tending to advance.
Pyridine—90/140 ..	21s.—21s. 6d. per gall. Market very strong.
Heavy ..	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

Improvement in dyestuffs business maintained. Prices show a slight hardening tendency.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%..	1s. 6d. per lb.
Acid H.	4s. 9d. lb. 100% basis d/d.
Acid Naphthionic ..	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech. ..	1s. 7d.—1s. 8d. per lb. Good demand.
Acid Sulphanilic ..	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 9d. per lb. 100% basis d/d.
Benzyl Chloride 95% ..	1s. 3d. per lb.

p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C. ..	5½d.—6d. per lb. Prices slightly reduced and a better demand is experienced.
m-Cresol 98/100% ..	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C. ..	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid ..	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol ..	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol ..	£85 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol ..	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine ..	1s. 6½d. per lb. d/d.
β-Naphthylamine ..	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6d. per lb. naked at works.
o-Nitrochlorbenzol ..	2s. per lb. 100% basis d/d.
Nitronaphthalene ..	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-o-amido-phenol .	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine ..	4s. 6d. per lb. d/d.
p-Phenylene Diamine ..	12s. 6d. lb. 100% basis d/d.
R. Salt	2s. 9d. per lb. 100% basis d/d.
Sodium Naphthionate ..	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	4s. 10d. per lb. d/d.
m-Toluylene Diamine ..	5s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Market more active and makers well employed. Prices gradually rising with steady tone in view of lack of foreign competition.

Acid, Acetic 80% B.P.. .	£52 10s. per ton.
Acid, Acetyl Salicylic ..	3s. 3d. per lb. Good demand. Firm market. Shortage not improbable.
Acid, Benzoic	2s. 6d. per lb. Higher prices quoted on the Continent.
Acid, Boric B.P. ..	Cryst. £54 per ton, Powder £58 per ton.
Acid, Citric	1s. 6½d. per lb., less 5%. Poor demand. Market dominated by weak holders and bad season.
Acid, Gallic	3s. per lb. for pure crystal. Market steady.
Acid, Pyrogallic, Cryst.. .	5s. 9d.—6s. per lb., according to quantity.
Acid, Salicylic	2s. 3d.—2s. 5d. per lb. for 5 cwt. lots. Firm market. Prices advanced and makers heavily booked ahead.
Acid, Tannic	3s. per lb. for B.P. quality. Weaker in view of Continental supplies coming forward.
Acid, Tartaric	1s. 1¾d. per lb. less 5%. Demand fair and likely to improve. Raw material dearer. Prices will probably advance.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d. per lb. for English manufacture. Shortage exists. Some holders asking 1s. 10d.
Amidopyrin	12s. 6d. per lb. Large inquiries from abroad are reported.
Ammon. Benzoate ..	3s.—3s. 6d. per lb., according to quantity.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate ..	12s. 6d. per oz. for English make.
Barbitone	17s. per lb. for quantity. Price stiffening.
Benzonaphthol	4s. 9d. per lb.
Bismuth Salts	A steady market. Carbonate 13s., Nitrate 6s. 11d., Salicylate 10s. 5d., Subgallate 9s. 6d., Citrate 11s. 7d., Oxide 14s. 5d., Subchloride 12s. 8d., Subnitrate 11s.
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.

Bromides—		
Potassium	6½d. per lb.	Holders of stock are steadying up prices owing to uncertain position of Continental supplies
Ammonium	7d. ,, ,,	
Sodium	7½d. ,, ,,	

Chloral Hydrate ..	4s. per lb. In active demand. English makers are oversold. A large Continental maker cannot supply.
Chloroform	2s. per lb. for cwt. lots. Very steady.
Guaiacol Carbonate ..	10s. per lb. for spot. This is below Continental price.
Hexamine	4s. per lb. Very steady.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate ..	Reduced by 2d. per lb. 2s. 3d. per lb. for cwt. lots. 2s. 4d. for 28 lb. lots.
Magnesium Carbonate—	
Light Commercial ..	£36 per ton net.
Magnesium Oxide—	
Light Commercial ..	£80 per ton, less 2½%.
Heavy Commercial ..	£27 per ton, less 2½%.
Heavy Pure	2s.—2s. 3d. per lb., according to quality and quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 75s. per lb.
Mercurials	Market dull.
Methyl Salicylate ..	2s. 6d.—2s. 10d. per lb. In steady demand.
Methyl Sulphonal ..	14s. 6d. per lb. No demand.
Metol	8s. 9d. per lb.

Morphine and Salts ..	Prices again advanced owing to dearness of opium. Alkaloid : Cryst. 14s. 8d., Precip. 14s. 5d., Acetate 11s. 6d., Hydrochlor. 11s. 6d., Sulphate 11s. 6d., Tartrate 14s. 5d. per oz.
Paraformaldehyde ..	3s. 6d. per lb. More active.
Paraldehyde	1s. 5d.—1s. 5½d. per lb. Average price in 5 lb. bottles. Higher prices expected when stocks are absorbed.
Phenacetin	6s. 3d. per lb. Demand steady. Moving to higher prices.
Phenazone	7s. 6d. per lb. Firm.
Phenolphthalein ..	6s. 6d. per lb. Scarce.
Potass. Bitartrate—99/100% (Cream of Tartar)	88s. per cwt., less 2½%. Demand fair.
Potass. Ferricyanide ..	3s.—3s. 6d. per lb.
Potass. Iodide	15s. 8d.—16s. 2d. per lb. Good demand.
Potass. Permanganate ..	10d. per lb. for B.P. crystal.
Quinine Sulphate ..	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	5s. 6d. per lb. Higher prices expected.
Salol	3s. per lb. Limited demand.
Sod. Benzoate	2s. 6d. per lb. Spot price lower than replacement value owing to lack of demand.
Sod. Citrate, B.P.C. 1923	Reduced to 2s. per lb. for cwt. lots. Makers kept active.
Sod. Hyposulphite—Photographic ..	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Potass. Tartrate (Rochelle Salt) ..	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 8d. per lb., and Crystal at 2s. 11d. per lb. Firm, with tendency to rise. Large orders in hand.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Thymol	13s. 6d. per lb. quoted for synthetic and 14s. 6d. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.	
Aubepine	14s. ,, ,,	
Amyl Acetate	3s. ,, ,,	
Amyl Butyrate	7s. 3d. ,, ,,	
Amyl Salicylate ..	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	3s. 6d. ,, ,,	
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	Higher prices anticipated.
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	3s. ,, ,,	
Benzyl Benzoate ..	3s. ,, ,,	
Cinnamic Aldehyde Natural	20s. ,, ,,	
Coumarin	18s. ,, ,,	
Citronellol	19s. 6d. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate ..	10s. ,, ,,	
Ethyl Phthalate ..	3s. 9d. ,, ,,	
Eugenol	10s. ,, ,,	
Geraniol (Palmarosa) ..	37s. 6d. ,, ,,	
Geraniol	6s. 9d. to 13s. 6d. per lb.	
Heliotropine	8s. per lb.	
Iso Eugenol	15s. per lb.	
Linalol ex Bois de Rose ..	18s. 6d. ,, ,,	
Linalyl Acetate	18s. 6d. per lb. Considerably cheaper.	
Methyl Anthranilate ..	8s. 6d. per lb.	
Methyl Benzoate ..	6s. ,, ,,	
Musk Ketone	40s. ,, ,,	
Musk Xylol	12s. 6d ,, ,,	
Nerolin	4s. ,, ,,	
Phenyl Ethyl Acetate ..	10s. ,, ,,	
Phenyl Ethyl Alcohol ..	15s. ,, ,,	
Rhodinol	47s. 6d. ,, ,,	
Safrol	2s. ,, ,,	
Terpineol	3s. ,, ,,	
Vanillin	22s. 6d.—23s. per lb. Firm and steady demand. Raw material dearer.	

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. ,, ,,
Bergamot Oil	14s. ,, ,, apot.
Bourbon Geranium Oil ..	37s. ,, ,,
Camphor Oil	80s. ,, ,,
Cananga Oil, Java ..	9s. ,, ,,
Cinnamon Oil, Leaf ..	4¾d. per oz.
Cassia Oil 80/85% ..	11s. 6d. per lb.
Citronella Oil—	
Java 85/90% ..	4s. 2d. ,, ,,
Ceylon	4s. per lb. Very little on offer, too many parcels arriving spirit. These have been seized by the Customs.
Clove Oil	8s. 6d. per lb.
Eucalyptus Oil 70/75% ..	2s. 9d. per lb.
Lavender Oil—	
French 38/40% Esters	26s. per lb. Reliable offers are difficult to obtain and very high prices for new crop oil seem inevitable.
Lemon Oil	2s. 10d. per lb. Very high prices are being asked at the source.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet ..	12s. 6d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	26s. per oz.
Palma Rosa Oil ..	24s. 6d. per lb.
Peppermint Oil—	
Wayne County ..	15s. per lb. Market very unsteady.
Japanese	12s. per lb. Market very unsteady.
Petitgrain Oil	8s. per lb. Dearer.

TRADE NOTES

Disinfectant Fluid for South Africa

His Majesty's Senior Trade Commissioner in South Africa (Mr. W. G. Wickham) reports that the South African Railway Administration are calling for tenders for the supply of disinfectant fluid during the period January 1, 1924, to June 30, 1924. (Tender No. 482.)

A copy of the tender form, specification, and conditions of tender is available for inspection by United Kingdom firms at the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1. (Ref. No. 12,337 E.D./C.C./2).

Chemicals (Coagulants) for South Africa

His Majesty's Senior Trade Commissioner in South Africa (Mr. W. G. Wickham) reports that the Rand Water Board are calling for tenders (contract No. 249) for the supply and delivery of 150 short tons, or alternatively 300 short tons, aluminium sulphate or alumino-ferric, on or before noon on Friday, November 9, 1923.

A copy of the tender form, specification, and conditions of tender is available for inspection by United Kingdom firms at the Department of Overseas Trade (Room 52), 35, Old Queen Street, London, S.W. 1. Reference No. 12,342/E.D./C.C./2.

Trade Notes from France

At a recent meeting of the Groupement des Sociétés Naphtifères Russes in Paris under the presidency of Sir H. Deterding, it was decided to begin negotiations at once with the Soviets for the protection of the group's interests in Russia.

The Société Anonyme d'Explosifs et de Produits Chimiques has installed new plant for distilling glycerin in its factory at St. Martin.

Export of Rubber Latex from Malaya

Rubber latex first appeared in the monthly return of exports from British Malaya in June, 1922. Since that date to the end of June, 1923 (13 months), a total of 97,015 galls., valued at £18,973, was exported, 72,409 galls. going to the United Kingdom, 20,792 galls. to the United States of America, 2468 galls. to the Continent of Europe, 720 galls. to British possessions, and 626 galls. to Japan. Investigations on the use of latex in pulp for paper making are largely responsible for this new development of the rubber industry. Experiments have also been conducted with latex in the manufacture of paints, varnishes, chewing gum, and in the waterproofing of cloths. The preservation and shipment of rubber latex in large quantities present considerable difficulties. Ammonia is the chemical recommended as a preservative. If time should bring any considerable demand for rubber latex satisfactory containers will be required, as no one of those now used—kerosine oil tins, petrol drums, crude oil drums, wooden barrels and other types of vessel—entirely satisfies all the requirements of an ideal type of container.—(*Malay States Information Agency.*)

Change of Address.—The offices of Messrs. Newitt and Son, chemical and process engineers, and agents for "Powminco" Asbestos Gooch filter fibre, have been removed to 17, Waterloo Place, Pall Mall, London, S.W. 1. Cablegrams: Enewitt, London. Telephone Nos.: Regent 899 and 159.

PUBLICATIONS RECEIVED

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Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1922–23. *Cmd.* 1937. *Pp. iv*+141. *London: H.M. Stationery Office,* 1923. *Price* 4*s*.

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Handbook on Rubber Uses and their Development. *Pp.* 162. *London: Rubber Growers' Association Inc.,* 1923.

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Report on the Industrial and Commercial Situation of Austria, to August, 1923. *By* O. S. Phillpotts, O.B.E. *Pp.* 71. *Price* 2*s*.

Report on the Financial and Industrial Conditions in Chile, April, 1923. *By* J. M. Macleod, C.M.G. *Pp.* 62. *Price* 2*s*.

Report on Financial, Industrial and Commercial Conditions in Canada to June, 1923. *By* F. W. Field, *together with a Supplementary Report on Western Canada by* L. B. Beale. *Pp.* 96. *Price* 2*s*. 6*d*.

Report on the Economic and Industrial Conditions in Esthonia, June, 1923. *By* J. E. P. Leslie, *assisted by* W. J. Sullivan. *Pp.* 28. *Price* 1*s*.

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Asbestos in 1922. *By* E. Sampson. *No. II*:6. *Pp.* 31—37.

Chromite in 1922. *By* E. Sampson. *No. I*:10. *Pp.* 107—112.

Fluorspar and Cryolite in 1922. *By* H. W. Davis. *No. II*:4. *Pp.* 15—22.

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Nitrates in 1922. *By* G. R. Mansfield. *No. II*:7. *Pp.* 39—40.

JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

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EDITORIAL

THE letter which we print in this issue from Mr. Doran interested us a great deal, especially the paragraph in which he indicates that twenty years in the laboratory and lecture room will lay a sure foundation, and that immediately upon their completion the necessity arises for the inculcation of business responsibility. Our own belief is that if a student sticks to his laboratory, say, from the age of eighteen until he is thirty-eight, with occasional interludes in the earlier part of this period in the lecture room, neither he nor his employer has any right to expect him to become a tolerable man of business. Let us take one instance; suppose such a man at the age of thirty-eight is asked to take charge of a new development, how is he to have acquired the judgment necessary to know what working capital is required, what the cost of his new works and plant will be, and other such vital factors? This judgment is not acquired in the laboratory, it is usually the result of experience which has involved months of worry and anxiety and a considerable loss of money. Our belief is that no one with sound business instincts would ever spend twenty years in laboratories and lecture rooms. A chemist might be a first-class chemist and have a very clear idea of the cost of various chemical operations, and might yet be an appalling man of business. Some men may learn at home a great deal of the essentials of business ways of thought just as they pick up a good taste in literature or pictures; they do this by association with those who are good judges. But a man who has not this early advantage must learn business sense by experience, and if he has any taste or aptitude for business methods he will certainly have made some business experiments on his own account before he is of the age of thirty-eight.

On the business training of chemists we have no wish to be unduly dogmatic or emphatic. Everyone has his, or her, own ideas as to how business propositions should be looked at and the sort of training required. Fortunately, among our chemists are many who, whether or not they have that *auri sacra fames* which is characteristic of some of our greatest men in industry, are both sensible and business-like. The Councils of the Chemical Society and the Society of Chemical Industry have within the last few days decided to form a Bureau of Chemical Abstracts which would be responsible for the preparation and issue of the abstracts at present issued separately by the two Societies. It is recognised that there are considerable difficulties in the way of complete unification of the two sets of abstracts, but it is believed that these can be solved and that the experience gained by the Bureau will be very helpful in suggesting economies and improvements. It is anticipated that the Bureau will be able in due course to submit to the Councils of the two Societies a scheme for further co-operation. Meanwhile it is proposed that the present form of the two sets of abstracts should be retained. This decision of the two Societies is an important step, and has, no doubt, required a good deal of time and thought to arrange. We hope that the Bureau, which will include four prominent men from each of the two Societies, will be able in a few months to make an interesting report on the whole situation; the experience they will gain will enable them, or perhaps compel them, to consider the possibility of arranging some comprehensive scheme which will include not only the abstracts of the two Societies who are now interested, but also the abstracts published by other chemical organisations both in this country and in those other countries where abstracts in the English language are required. Some such sets of abstracts might conveniently be treated in such a scheme; in other cases geographical or financial difficulties may be insuperable.

* * *

A number of interesting questions have been raised by the discussion which has appeared in these columns on the place of the chemist in industry, and on the attributes of the chemical—or is it "physico-chemical?"—engineer. That finality has not been reached is a sign of health in the body chemical; indeed, we are not sure that it could be reached. The discussion must always be general, the industrial application special. Both chemists and chemical engineers find employment, so the decision must perforce be left to those who employ them, as their respective utility, whether as "thinkers" or "doers," must ultimately be capable of material demonstration. In a further contribution to the discussion which we publish in this issue, Mr. Gray's remark that the distinction between pure and applied chemistry is largely one of time, reminded us of an example. A century ago—to be precise, on July 27, 1823—Johann Wolfgang Doebereiner, professor of chemistry, pharmacy and technology at Jena, discovered that spongy platinum in presence of oxygen can bring about the ignition of hydrogen. This discovery was made as a sequel to previous researches on the oxidation of alcohol to acetic acid and water by means of platinum black, and Doebereiner utilised it in making his "hydrogen lamp," of which the so-called "self-lighters" for coal gas are descendants. In the course of further work it was found that by the same means sulphur dioxide and oxygen could be induced to combine to form sulphur trioxide. The importance of this discovery was at once realised, and in 1831 Peregrine Philips made the reaction the subject of a patent. Commercially, however, the process proved impracticable, and success was only attained after 1875, when Squire and Messel in London, and Winkler in Freiburg, were induced to explore its possibilities by the increasing demand for fuming sulphuric acid, which had hitherto been made solely by the clumsy Bohemian process. The exact date when the "contact" process was perfected is uncertain, as but scant data have been published, but the interval of, at least, over fifty years shows the lag between discovery and application. Indeed, the "pure" chemistry of the process could probably be traced still further back, as the term "catalysis" was introduced by Berzelius, Faraday studied the acceleration of the combustion of hydrogen and oxygen due to the presence of platinum, and platinum was first described as a new metal by Sir William Watson in 1750. "The centuries are lineal children of one another; and often, in the portrait of early grandfathers, this and the other enigmatic feature of the newest grandson will disclose itself." And, as Goethe said, everything in life, to be of value, must have sequence.

POWER AND BORIC ACID FROM NATURAL STEAM IN TUSCANY

One of the most romantic of the European chemical industries is that which is being rapidly developed by the Società Boracifera di Larderello under the leadership of our honorary member, the Prince Piero Ginori-Conti. The company has established seven works within an elliptical area some forty or fifty miles south-south-west of Florence, namely, at Larderello, Castelnuovo, Sasso, Monterotondo, Lago, Lustignano and Sarrazzano, and an eighth which lies eastward at Travale; in these, the volcanic steam is utilised first to produce electrical power and afterwards for the manufacture of boric acid.

Fig. 1

The steam springs all lie on the slopes of the hills dividing the valleys of the Cecina and Cornia rivers; they are approached by excellent roads from Florence through some of the most magnificent scenery in Tuscany. The roads are tortuous, partly owing to the mountainous nature of the country and partly because they serve the numerous towns and villages, which are all built, from motives of prudence, on hill-tops in positions which could be strongly fortified. The journey of 70 or 80 miles from Florence to Larderello may be made either through Volterra, the gigantic fortifications of which stand almost as intact as when they were built by Lorenzo the Magnificent in the fifteenth century, or through Siena, which retains its mediæval aspect even better than most of the old Italian towns. The proximity of the steam springs is revealed in the replacement of the luxuriant fertility of

Central Italy by stretches of arid soil and rock and by the smell of hydrogen sulphide, a constituent of the escaping water vapour; it is notable that the odour of the latter is sweet and devoid of any nauseating effect, and that after a few hours any silver articles which one carries acquire a black tarnish which rapidly increases in depth of colour. Here and there steam may be seen escaping from the earth, and areas are remarked in which many jets of steam escape and where the soil is too hot to touch; these spots are interesting in that they are the seats of actual mineral formation. The borders of the orifices from which the steam issues are fringed with growing crystals of sulphur, the product of interaction between hydrogen sulphide and the sulphur dioxide formed by atmospheric oxidation at the high temperature. All around lie boulders of crystalline calcium carbonate, which are coated thickly, often to a depth of six inches, with a pseudomorphous growth of crystalline calcium sulphate, gypsum, formed by the action of the oxides of sulphur contained in the atmosphere.

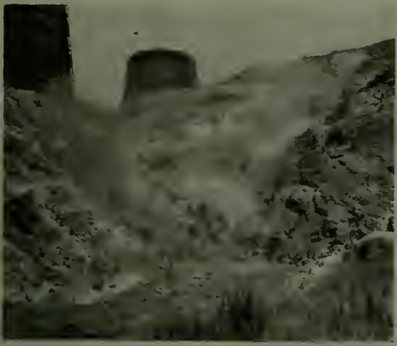

Fig. 2

The steam which emerges through these natural crevices or "suffioni" (Fig. 1), or which escapes through pools of water called "lagoni" (Fig. 2), is not great in quantity; the large sources of natural steam have been tapped by boring, and emerge from boreholes up to 40 cm. diameter and 180 metres deep. The boreholes are lined with iron tubes, a wide one going to the bottom enclosing a smaller one with the annular space filled in with concrete and enclosing others of still smaller bore similarly secured; essential joints are made with the oxyhydrogen blowpipe, hydrogen and oxygen being prepared by the electrolysis of caustic soda solutions. The steam thus tapped is delivered at the top of the boring at pressures up to nine atmospheres and at temperatures up to 180° C., although the mean pressures and temperatures are much lower than these values; it is estimated that some 600,000 kg. of water vapour per hour are thus in sight, although the quantity at present utilised is much smaller. At Larderello alone 135 boreholes are being utilised, and the issuing steam has a mean temperature of 120–130°.

The escaping steam contains up to 0·1 per cent. by weight of boric acid, the mean content being about 0·06 per cent., and also about 6 per cent. by volume of gases other than water vapour; these consist mainly of carbon dioxide with smaller quantities of hydrogen sulphide, nitrogen, oxygen, methane, hydrogen and helium. The presence of about 6 per cent. of gases uncondensable at ordinary temperature makes it inconvenient to use the pressure steam directly as a source of power; it is therefore used for the purpose of raising steam from boiling water, the secondary steam producing power by passage through turbines fitted with vacuum condensers. The electrical energy generated is distributed at 36,000 volts on a three-phase alternating current system for use at Siena, Volterra, Florence and a number of works within a radius of some thirty miles; the output of power seems only to be limited at present by the demand, and it is clear that it may be vastly increased as need arises. The presence of hydrogen sulphide in the atmosphere has necessitated the replacement of copper by aluminium in the electrical conductors.

Fig. 3

During the conduction of the steam to the turbines and its subsequent reduction in potential, large quantities of condensed water containing boric acid in solution are obtained. This water is evaporated in series of shallow lead-lined troughs, working on a counter-current principle, by means of the partially exhausted steam; the highly concentrated boric acid solutions which thus result deposit crude boric acid which is collected at Larderello and purified by re-crystallisation. The production again is in its infancy; the works at Castelnuovo in the Val di Cecina produces actually about 10 tons of boric acid per day, but aims at a production of 20 tons. The same works has begun to utilise the waste carbon dioxide contained in the steam and already manufactures 10 tons of ammonium carbonate per month, not in powder but in crystalline masses. The evaporation troughs are shown in the middle of Fig. 3, and it will be seen that they present little resemblance to the concreted tanks shown in our most modern text-books as used in the preparation of boric acid.

The situation of Italy as concerns power production is peculiar; in the north water power from the Apennines is available, and near Pisa natural gas is being used. Prolonged droughts make water power precarious in other parts of the kingdom and, although peat and lignite are used, little economic value attaches to the exploitation of these and other power-raising media. In the Province of Pisa, where none of these sources of power or heat are readily available, the initiative of the Società Boracifera has harnessed the volcanic steam for the production of power and has developed the economic production of boric acid in such a manner as to make the manufacture entirely self contained—namely, quite independent of the use of imported fuel or chemicals. This achievement has involved the exercise of considerable engineering skill and also a profound chemical study of the components of the steam and the modes of chemical treatment appropriate to their economic separation. Much of this chemical work has been done by Prof. Raffaello Nasini, who is at present compiling a book on the subject. The manufacture of boric acid is now upon a sound basis, and attempts are being made to utilise the minor constituents of the steam; at Castelnuovo the carbon dioxide, as noted above, is already converted into ammonium carbonate by a satisfactory process and the work is developing in yet other directions.

It is interesting to contrast the Tuscan manufacture of boric acid, which involves evaporation by volcanic heat, with the Californian manufacture, which still provides the major part of the world's needs. In the latter, calcium borate has to be decomposed with hydrochloric acid before a solution is obtained from which boric acid is separated by evaporation, fuel being required for this latter operation. The Italian process seems to have marked economical advantages.

The volcanic steam is markedly radioactive, that of Larderello being especially rich in emanation, as Nasini has shown. Whilst driving or riding through this magnficent country—up wooded hills from the summits of which the Island of Elba can be seen and down into valleys thick with vines and fruit trees—it is seen that the situation is ideal as that of a health resort. This notion may soon pass into execution, for Italy has changed greatly during the last two years. Beggars have almost disappeared from the towns and a new air of alertness is evident everywhere; employer and employed fraternise with a cordiality little known in England. In fact, Italy has suddenly become the most democratic country in the world.

THE CHEMIST AND INDUSTRY

Another Point of View

By J. H. WEST, A.M.Inst.C.E.

The discussion ably started, or rather revived, by Mr. H. H. Gray under the above title is undoubtedly of national importance, and it is to be hoped that it will be continued with adequate representation of all points of view, and especially that of British chemical manufacturers themselves.

The present writer's endeavour will be to examine the subject from the point of view of a keen student of the science of organisation and also from that of the chemical engineer. The views expressed may be right or wrong; they are not put forward in any dogmatic spirit, but as the result of a good many years of thought and not a little experience.

Mr. Gray complains, not without reason, that employers undervalue a University trained mind, but I venture to think that his own remark as to anxiety about costs being beside the mark throws much light upon the reason for this. The question of costs, the difference between profit and loss, is the life or death of industry. No amount of the most brilliant research work will avail if the process does not show a profit. This may be a sordid fact, and one repugnant to the high ideals of pure science, but there it is. Let me give an illustration.

It happened a few years ago in a very large concern which shall be nameless. The manufacture of a certain product on a large scale was under consideration by the advisory committee, which consisted not only of the active directors and the heads of the technical staff, but also of University professors. One of these professors, undoubtedly one of the foremost authorities in the country on the subject, had been asked to work out a new and improved process for making this product, to take the place of an old process which had been in use for some years on a small scale. After what was no doubt a brilliant piece of research, he submitted a new process, the great point of which was that a much better yield of product was obtained from a given quantity of the substance which was the starting point of both processes. After that, for well over twelve months a large part of every meeting of the advisory committee was devoted to a discussion of the relative merits of the two processes. This discussion between the old school and the new became very bitter, but no decision was arrived at. At last an engineer was asked to get out the comparative cost of plant for the two processes, in the hope that this factor might prove decisive; but it was found that there was not much to choose between them. Still no decision. Then it occurred to the engineer to make a comparison between the cost of materials —*all materials*—in the two cases. To do this he had to ask for the prices of the various reagents used. For some time this information was refused, and he was bluntly told to mind his own business and stick to the engineering side. Finally, however, pressure was brought to bear, and the information was reluctantly given. In half an hour he was then able to show that while the new process saved less than a halfpenny per pound of product on the primary raw material, it cost for other reagents something like two shillings per pound of product more than the old process. That ended the discussion right away.

Mr. Gray says that from the point of view of the chemist there is very little difference between real science and ideal industry. Unfortunately real industry is far from being ideal, and that is why the raw University graduate, who has not been taught to think industrially, is of little use to the employer until he has had time to readjust his mental values to the hard facts of profit-making.

Now as to the chemical engineer. Much harm has been done by incompetent people calling themselves chemical engineers. That should come to an end with the establishment of the Institution of Chemical Engineers, which will exercise control over the qualifications and competence of chemical engineers. Quite as much harm can be done by the few, if, indeed, there are any, who claim that a chemical engineer can supersede or do the work of a chemist. Obviously no man can be fully trained and experienced in both chemistry and engineering. To begin with, supposing a man could be found with sufficient ability in both directions, the double training would take nine or ten years. The genuine chemical engineer is not in any way the industrial chemist's rival, but rather his best friend.

What, in the writer's opinion, is wanted is a cessation of futile discussion as to who is to be top dog, and the adoption of a spirit of mutual co-operation, of team-work, based upon each man doing the work for which he has been trained. The chemical manufacturer has to make profits, and he has to build up a very complicated organisation to handle the many factors involved. The specialists employed, whether chemists, engineers, process managers, cost accountants, buyers, financial experts, or sales managers, must all work together to the common end of helping to make profits. It is as futile for one branch to claim paramount importance for itself, as it would be to single out the nervous system, the circulation of the blood, or the alimentary system, as the most important factor in the life of the human organism. All are equally essential.

All these specialists have their own ways of thought and their own particular jargon, and they are often as much at cross purposes with each other as the builders of the tower of Babel. Let each and every specialist stop worrying whether he is the most important man and should therefore have control, and let him remember that his work is, after all, only one phase among many, all of which working in harmony are essential to success. For satisfactory team-work in games it is necessary that each player shall not only play for his side and not for himself, but that he shall know the individual peculiarities of every member of his side. Similarly, members of different branches of an industrial organisation should be familiar with the work, the outlook, and the difficulties of their colleagues. They can then understand each other better, and appreciate each other's point of view.

Mr. Gray suggests that the chemist should be administrative (" thinking "), and the engineer executive (" doing "). Does he not realise that " thinking " is absolutely necessary in every branch? The " most scientific, the least complex, and the most beautiful plant," to which Mr. Gray refers elsewhere, will certainly not be evolved by chemical research alone, but only by the most earnest co-operation between chemist and engineer, and the expenditure of an immense amount of thought and an infinitude of pains by each of them.

Except in the very largest organisations it is not possible to employ separate people for thinking and doing. In most cases the same man has to do some of each, acting as executive to those in authority over him, and in an administrative capacity to those under his authority. This is unfortunate because a man whether chemist or engineer, who is perpetually bothered with details of executive routine cannot devote his attention properly to thinking out administrative problems.

That brings us to the distinction between doing research and thinking out research. There are many chemists, and this is particularly true of raw University graduates, who are quite competent to carry out the experimental part of a research on lines laid down for them, but in the writer's opinion there are very few who are capable of taking an average industrial chemical problem and thinking it out in all its bearings so that the expensive experimental work is reduced to a minimum. There must be hewers of wood and drawers of water in every department. Routine analyses must be made and plant must be repaired, but the man who has learnt to think industrially will become too valuable to be kept at such work.

British manufacturers do restrict their technical men too much to executive work. It would pay them better if the best of the technical men were taken more into their inner councils, and I think that if the spirit of industrial objective and team-work were better developed this would be done far more than it is. In this connexion it has often struck me that technical men as a rule are not skilful in the way they bring their proposals before business men. The latter like crisp short reports supported by definite figures, with every essential factor in the problem clearly set out in as non-technical language as possible, and nothing irrelevant left in, showing that the whole scheme has been thoroughly thought out in every detail before being submitted.

Finally a word may be permitted on the subject of thoroughness. Chemists are rather apt to bring forward processes before they have been fully worked out in the really minute detail necessary for satisfactory working. The physical factors which the chemical engineer must have to design the plant properly, such as specific heats, heats of reaction, volumes of filter cake and so on, are often neglected, and sometimes the engineer is to blame in not insisting upon having proper data before making his designs. The preparation of a quantitative flow-sheet, showing the path and ultimate destination of every pound of matter entering the process is a splendid means of finding out how much is really known about the process, and is too rarely used. This, combined with heat and energy flow-sheets, gives the whole story in the form most intelligible to both chemist and engineer. Do not let our overseas competitors beat us by greater thoroughness.

"COPPER ORES"

The monograph by R. Allen, bearing the above title, is issued by the Imperial Institute (220 pp., John Murray, 7s. 6d. net), and contains chapters on "Occurrence, characters and uses," "Sources of supply, Empire and foreign countries," and a carefully compiled list of references arranged generally and geographically. The monograph is a conveniently arranged digest of published statistics and information, official and unofficial, and its publication, rendering such matter more readily available, would have been justified had the Imperial Mineral Resources Bureau not already issued a pamphlet covering much the same ground.

CHEMISTRY AND THE BLEACHING INDUSTRY

By S. H. HIGGINS, M.Sc.

In considering the development of the bleaching industry during the last hundred and fifty years, it is interesting to point out to chemists of the present day that, both as regards the materials used in the industry and the methods employed, changes and improvements were always introduced by chemists. At the beginning of the period mentioned the industries of chemical manufacture and of bleaching were sometimes carried on together, with the result that chemistry was brought to bear on the bleaching industry and, as will be shown, completely revolutionised the industry and enabled it to deal with the large quantity of cloth which was being turned out by the power loom.

In early times bleaching was carried out in a crude manner in all countries and often by farmers. The webs of cloth were heated or 'stewed' in a solution of plant ashes (usually obtained by burning weeds), then washed, steeped in butter milk, washed and exposed to the sun on the grass. This treatment was repeated until the goods were white. The farmers had the weed ash, the buttermilk and the fields, so that it can be readily understood how bleaching became a kind of subsidiary industry to agriculture. Large areas of agricultural land were used for the grassing of the cloth and as the output of the looms increased this tying up of agricultural land became a consideration. The introduction of different chemicals into the industry enabled the bleacher considerably to hasten his process, and for most classes of goods to eliminate the grassing operation altogether: if chemistry had not done this the whole of Lancashire would be required at the present time to grass the cloth which is now bleached in that county.

The first radical alteration which chemistry introduced into the bleaching industry was the use of sulphuric acid in the place of buttermilk, the juices of crab apples, lemons, etc., for souring the cloth. Then the introduction of chlorine compounds as whitening agents completely revolutionised the industry. Lime came into use as a scouring agent in place of plant ashes and sometimes the lime was added to the ash solution to causticise it and make it a more effective scouring agent. The production of artificial soda provided the bleacher with purer materials than he had been used to and also placed at his disposal another acid, namely, hydrochloric acid, of which he soon made use. Later, the production of cheap caustic soda enabled the bleacher in some cases to dispense with lime boiling, to return to soda boiling, and to shorten his process.

These advances in chemical industry had a tremendous effect on the bleaching industry. The time required for bleaching cotton goods was reduced from months to a few days, and occasionally goods were bleached in 24 hours. But the changes mentioned were not allowed a smooth entry into the industry. For instance, the British Government stipulated in 1823 that no acids should be used in bleaching government material; any bleacher using lime for bleaching in the eighteenth century was liable to be hanged; the use of hypochlorites for whitening was not well received by French bleachers when Berthollet displayed their action, and British bleachers in many cases did not approve of their use, for in 1823 a Cheshire calico printer was still grassing his cloth and using no hypochlorite for whitening.

Gradually, however, these prejudices were overcome and it is not difficult to understand, with our present-day experience, why the objections arose. When acid is employed carelessly and not well washed out of the cloth it causes "tendering," and if hypochlorites are not carefully used they also rot the cloth. In the case of lime, tendering in the lime boil sometimes occurs and if lime is added to ash solution, to produce a caustic solution, care is required in using this, because in some cases in the presence of air tendering of the cloth takes place. It is probable that when first used all these new agents caused some cloth to become tender, but with experience bleachers began to use the new materials without causing injury to the cloth and then prejudice disappeared because it became recognised that the new materials produced a bleached cloth much superior to that produced by the old long and tedious methods. Nowadays, by the chemical control of the process, scientific investigation from many points of view has shown that the modern process of bleaching produces an article which for strength, weight, colour and handle would be difficult to improve upon.

As regards the effect of hydrochloric acid on the bleaching industry, its introduction to bleachers enabled them to sour the cloth after the lime boil. In 1823 it was known that by washing the cloth out of the lime boil, and then souring in sulphuric acid a very good effect was obtained; but it was also known that this system of bleaching produced a deposit of calcium sulphate in the cloth, a deposit which could not be removed by subsequent treatment. The lime sour was, therefore, abandoned and it was not used in the industry until about 1840, when bleachers were able to obtain hydrochloric acid, which did not cause a deposit on the cloth. This change was introduced into the industry from Mulhouse, and shows another example of the effect of progress in chemical manufacture on the development of the bleaching industry.

Dr. E. F. Armstrong* has shown the development of the alkali industry in this country, and from his account the effect on the development of the bleaching industry can easily be traced; Berthollet (*The Art of Dyeing*) has described the effect of hypochlorites on the bleaching industry; and the present writer has traced these and other effects at length in a series of articles appearing in the current numbers of the *Journal of the Textile Institute*, but it is of interest to note the effect of the chemist on the bleaching industry during the last hundred years.

The effect has been small. The process of bleaching as carried out in 1823 is practically the same from the chemical point of view as that used at the present time. Alterations in details and improvements of a minor character have, of course, been made; but the fact remains that as regards the chemical side nothing revolutionary has taken place. And this state of affairs is not difficult to understand. Chemistry had had its innings and it had been a glorious one. It had completely revolutionised the industry and enabled it to turn out the quantity of material which was demanded of it. The bleaching industry had been developed along with the chemical industry by such men as Tennant and Bealey, so that chemical knowledge had been brought to bear on it to the fullest extent. In short, the bleaching industry had been made a chemical industry. It is not right to say that the bleaching industry is founded on "empiricism" and "rule of thumb"; it is founded on the chemical discoveries of the latter half of the eighteenth century, and by 1823 we find a system of chemical control introduced into the industry which amazes those with a knowledge of present-day methods. In fact, the bleaching of 1823 was as well controlled from the chemical point of view as much of that of to-day.

After the turn of the chemist the engineer had a large effect on the industry, and by introducing machine bleaching enabled it to cope with the development of the cotton trade and the large quantity of cloth sent to the bleacher. The chemist had to take a back seat; he seldom found employment in the industry except where calico printing and dyeing were carried on under the same roof, and it is manifest that the industry suffered accordingly, but it is interesting to recall that some distinguished chemists were connected with the bleaching industry during the last century.

John Dalton tested the water at Sykes' Edgeley bleach works in 1826, and Crace Calvert was consulted by the same firm in 1851. The Sykes family studied chemistry and confirmed their findings by consulting outside authorities. Other bleachers had consulting chemists, but the study of chemistry by bleachers themselves became less and less. Sir William Crookes was engaged in colour printing at one time but left it for pure science. Many bleachers consulted German chemists because in later years their fame in dyestuff manufacture seemed to infer a knowledge of the chemistry of textile fibres, but the records show that these consultations did not always yield happy results. C. F. Cross was engaged for some time at a Lancashire bleachworks in developing a new process of bleaching, and at the same works was a chemist, Horace Lowe, who discovered the process of lustring cotton by treating it in the stretched condition with caustic soda solution. Mercer, Horace Koechlin and others might also be mentioned, but the names are few; in fact, too few to keep the industry on the stage of a chemical industry as it was founded.

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* Presidential Address, *Chem. & Ind.* 1923, June 22, p. 603.

THE WORLD'S PETROLEUM PRODUCTION

By H. G. SHATWELL, B.Sc.

The following table, based on estimates prepared by the American Petroleum Institute, shows the variations in the world's production of petroleum for the four years, 1919 to 1922 :—

Table I—*The World's Production of Petroleum* 1919-1922. Estimates in thousands of barrels by the American Petroleum Institute

	1919	1920	1921	1922
United States..	377,719	443,402	469,639	551,197
Mexico ..	87,073	163,540	195,064	185,057
Russia ..	34,284	25,430	28,500	35,091
Dutch East Indies ..	15,780	17,529	18,000	16,000
India	8,453	7,500	6,864	7,980
Sarawak ..	—	—	1,411	2,915
Rumania ..	6,518	7,435	8,340	9,817
Persia	6,290	12,353	14,600	21,154
Poland-Galicia	6,255	5,606	3,665	5,110
Peru	2,561	2,817	3,568	5,332
Japan and Formosa ..	2,121	2,140	2,600	2,004
Trinidad ..	2,780	2,083	2,354	2,445
Argentina ..	1,504	1,666	1,747	2,674
Egypt	1.662	1,042	1,181	1,188
France-Alsace-Lorraine ..	—	389	392	494
Venezuela ..	321	457	1,078	2,335
Canada ..	220	197	190	178
Germany ..	925	212	200	200
Italy	38	34	35	31
Algeria ..	—	4	3	9
England ..	—	3	3	—
Colombia ..	—	—	—	323
Other countries	—	1,016	1,000	5
Totals ..	554,504	694,855	760,434	851,539

It will be observed that steady increments in the quota of oil are provided by the Argentine, Venezuela, Peru and Rumania, whilst decreases occur in Canada, Egypt, Poland and Germany. An interesting case is that of Persia, whose output—more than trebled in the period under review—now comes in the fourth position in the table, from which the Dutch East Indies has been ousted.

The table also serves to show to what extent the oil situation is dominated by the United States and Mexico. These countries between them supply 86 4 per cent. of the world's total output, the United States contributing 64·7 per cent. and Mexico 21·7 per cent.

Table II and Fig. 1 below give details for the United States and Mexico for the last ten years, and indicate clearly the wonderful development which has taken place with regard to the latter country. The slight decrease for 1922 is due to the fall in the price of crude oil, to lack of transport and storage facilities, and to political causes.

Table II

Oil production in thousand barrels

Year	Mexico	United States	World	Mexico %	U.S.A. %	Total %
1913	25,902	248,446	384,668	6·7	64·6	71·3
1914	21,188	265,762	399,667	5·3	66·5	71·8
1915	32,910	281,104	426,371	7·7	66·0	73·7
1916	39,817	300.767	459,433	8·6	65·5	74·1
1917	55,293	335,315	505,362	10·9	66·4	77·3
1918	63,828	355,928	514,729	12·4	69·1	81·5
1919	87,073	377,719	554,504	15·7	68·0	83·7
1920	163,540	443.402	694,855	23·5	63·9	87·4
1921	195,064	469,639	760,434	25·6	62·0	87·6
1922	185,057	551,197	851,540	21·7	64·7	86·4

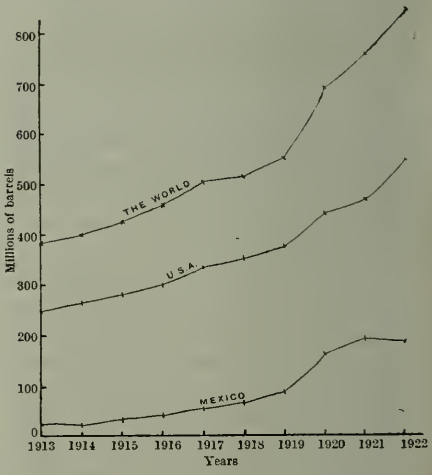


Fig. 1

United States

The influence of the United States upon the supply of crude oil is affected very considerably by the huge demand of that country for petrol and other fuel oils. It has been estimated that over two and a-half million motor vehicles were manufactured in the United States during 1922, bringing the number of cars in service to the huge total of twelve million, excluding farm tractors and stationary gasoline engines. Consequently, an interesting race between production and consumption is being witnessed, and the following table (III), showing consumption as estimated by the U.S. Geological Survey, indicates that the United States is now quite definitely an oil-importing country :—

Table III

Year	Production	Consumption	Deficit
	Thousands of barrels		
1916	300,767	318,599	17,832
1917	335,315	377,736	42,421
1918	355,928	413,078	57,150
1919	377,720	420,462	42,742
1920	443,402	530,532	87,130
1921	469,639	526,032	56,393
1922	551,197	587,000	35,803

The annual deficit is being made up principally by increased importations from Mexico, though many of the United States fields such as Arkansas, Oklahoma, California, Wyoming and Montana, are themselves producing greatly increased amounts of oil. It should be noted, however, that these new supplies of oil are poor in low-boiling constituents, and that consequently serious doubts are felt as to future supplies of straight-run petrol. The effect of this is to direct more attention to other sources of motor-spirit, particularly the " cracking " of heavy oils, the provision of blended motor-spirit, and the utilisation of benzol, alcohol, ether, acetone, etc., whilst a great impetus is being given to the exploitation of new oil fields and of oil-shale deposits.

ANTI-KNOCK GASOLINE

Gasoline to which tetra-ethyl lead has been added to prevent " knocking " is now being marketed in Dayton, Ohio, under the name of " ethyl gas." An apparatus known as an " ethyliser " has been devised to fit any gasoline pump and add the anti-knock compound in the proper proportion. The best results are obtained with 3 c.c. of tetra-ethyl lead and 2 c.c. of carbon tetrachloride per gallon of gasoline. The use of tetra-ethyl lead alone causes the rapid deterioration of the sparking plugs, but with carbon tetrachloride added, lead chloride is formed and readily passes out through the exhaust. The only disadvantage noted thus far is the deposit of some white lead chloride in the combustion chamber and exhaust valves. Whilst ethyl gas is no better for a motor than benzo-gas, the latter is sold for 6 cents. per gall. more than gasoline, and ethyl gas costs but 3 cents. per gall. more. If the use of anti-knock compounds becomes general enough, so that higher compression motors can be built, almost double the mileage could be obtained from a gallon of gasoline. The General Motors Corporation has built such a motor and has been able to get 31·5 miles per gallon, whereas 16 miles is a good return with the present type.—(*Chem. & Met. Eng., Sept.* 24, 1923).

OBITUARY

WILLIAM THOMSON

Mr. William Thomson, F.R.S.(Ed.), F.I.C., F.C.S., the well-known consulting chemist and analyst who died so suddenly in his laboratory, on Thursday, October 4, was a prominent figure in the chemical circles of Manchester and London during the last fifty years.

Born in 1851 in Glasgow, he came to Manchester in 1869, and entered as assistant to Dr. Crace-Calvert, in the Royal Institution Laboratory in Princess Street, the oldest chemical laboratory in Great Britain. Four years later, on August 25, 1873, at the age of twenty-two years, he became a partner in the firm of Crace-Calvert and Thomson, and on the death of Dr, Crace-Calvert two months later took sole charge of the practice, and combined with this the office of Public Analyst for Stockport, which he continued to the moment of his death.

He joined the Literary and Philosophical Society in 1873 and served on the Council for many years, acting as President to that Society from 1917–19. The Society is richer for his many contributions on different subjects of scientific interest, some of which during his lifetime developed into discoveries of supreme and world-wide renown. Only in November of last year he presented the actual tubes containing sulphides of calcium, barium, etc., which he demonstrated to Sir Wm. Crookes in 1877, and which proved to be the first of three steps which led to the discovery of X-rays by Prof. Röntgen. He presented some of these sulphides to Wm. Crookes, who wrote on February 13, 1879, as follows :—

" When I had the pleasure of seeing you in Manchester about a year ago you kindly gave me some specimens of highly phosphorescent powders. I have lately been working on the electrical phenomena in very high vacua, and I have found great use from these powders, as their great luminosity enables me to examine the phenomena I am studying without difficulty. Unfortunately, I have used up all the stock you gave me, and am obliged to come to you to ask if you can spare me a little more, or, what would be better, let me know how to prepare some myself, and then I would not trouble you."

Again, on March 26, 1879, Sir Wm. Crookes wrote :—

"Accept my thanks for the phosphorescent powder; it is invaluable for my researches, as it has wonderful power of glowing under the influence of the molecular discharge."

A third letter dated April 28, 1897, is as follows:—

" My dear Prof. Thomson,—I was much interested in reading a copy of our correspondence in 1877–1879. It takes one back to the very beginnings of my Radiant Matter experiments and Phosphorescence in high vacua, which has been so splendidly carried on by Lenard and Röntgen. When I have occasion to write anything about the early history of the X-rays, it will be very useful to have these letters to refer to, and I will not fail to mention the part you played in the progress of the research, when you drew my attention to the phosphorescing properties of the sulphides of calcium. With kind regards, believe me, very sincerely yours,

"William Crookes"

His numerous and various chemical and physical investigations can only be dealt with, however, in scientific journals, but his medico-chemical and legal work is known to many specialists in Manchester. A few weeks ago he prepared some material which he hoped would be found of assistance in the cure of cancer. His work is also known on the detection of arsenic in beer during the outbreak of arsenical poisoning some years ago, and his indefatigable and original work on the amount of soot in the smoke-laden atmosphere of Manchester and, in association with the Manchester and Salford Sanitary Association, his efforts to obtain a purer atmosphere should be a memorial to him among the public of this city.

In recognition of his many original contributions to science he was elected a Fellow of the Royal Society of Edinburgh, May 1, 1876.

He was also the author of a book on *The Sizing of Cotton Goods*, of which the first edition was published in 1877 and the second in 1879.

Mr. Thomson was one of the original members of the Society of Chemical Industry. He was elected to the committee in October, 1884, and acted as the Chairman of the Manchester Section for some years.

He was also one of the leading forces in the Institute of Chemistry, of which he was elected a Fellow in 1877, and served on the Council from 1887–90 and from 1893–96. For some years also he was on the committee of the Society of Dyers and Colourists.

There was a quiet reticence about him which prevented many from ever visioning his many-sided genius and rich and sympathetic nature, but those who were privileged to know him in private life knew a just and generous man, and his charitable acts will never be revealed.

He was past-president of the Caledonian Association, and interested in the Burns-Scott Fund as Chairman of the Committee.

The writer has heard from many lips during the last few days the following remark, which seems to epitomise his whole character:—"He was the dearest friend I ever had or ever shall hope to meet." His death is an irreparable loss to the City.

The Salters' Institute of Industrial Chemistry has awarded 64 grants in aid to chemical assistants, occupied in factory or other laboratories in or near London, to facilitate their further studies.

FORTHCOMING EVENTS

Oct. 30. Society of Chemical Industry, *Edinburgh and East of Scotland Section*, in the Hall of the Pharmaceutical Society, 36, York Place, Edinburgh, at 7.30 p.m. "Old and New Problems in Agricultural Chemistry," by Dr. A. Lauder. "Galegine, an Alkaloid from *Galega officinalis*," by Dr. F. D. White.

Oct. 31. Society of Chemical Industry, *Newcastle-on-Tyne Section*, the Chemical Lecture Theatre, Armstrong College, Newcastle, at 7.30 p.m. "Milk," by H. R. Whitehead, M.Sc.

Nov. 1. The Institution of Electrical Engineers, The Lecture Theatre, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "Industrial Research, with special reference to Electrical Engineering Development," by W. Wilson.

Nov. 2. The University of London, University College, Gower Street, W.C. 1, at 8 p.m. "The Fundamental Concepts of Natural Science" (Lecture I.), by Prof. G. Dawes Hicks. Also on the 9th, 16th, 23rd, and 30th.

Nov. 2. The Institute of Chemistry, *Manchester and District Section*. Joint Meeting with the Society of Chemical Industry, of Dyers and Colourists, and the Manchester Literary and Philosophical Society, in the Textile Institute, Manchester, at 7 p.m. "Electrometric Methods in Analytical Chemistry," by Prof. Treadwell.

Nov. 5. The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, at 7 p.m. "Engineering Training." Discussion to be opened by Dr. A. Russell, M.A.

Nov. 6. Institution of Civil Engineers, Great George Street, S.W. 1, at 6 p.m.

Nov. 7. Society of Public Analysts. Ordinary Meeting at Burlington House, Piccadilly, W. 1, at 8 p.m.

Nov. 8. Institute of Metals, *London Local Section*, The Royal School of Mines, South Kensington, S.W. 7, at 8 p.m. "Some Impressions of American Non-Ferrous Metallurgy," by W. Rosenhain, D.Sc.

Nov. 8. Society of Chemical Industry, *South Wales Section*, The Engineers' Institute, Park Place, Cardiff, at 7.30 p.m. "The New Chemistry," by Dr. E. F. Armstrong, F.R.S.

Nov. 9. Institute of Metals, *Sheffield Local Section*, The University, St. George's Square, Sheffield, at 7.30 p.m. "Substitutes for Platinum," by E. A. Smith, A.R.S.M.

Nov. 9. The University of London, University College, W.C. 1, at 5.15 p.m. "Vitamins," by Prof. J. C. Drummond.

Nov. 9. The University of London, W.C. 1, at 8 p.m. "The Fundamental Concepts of Natural Science," by Prof. G. Dawes Hicks. (Lecture 2.)

SOCIETY OF CHEMICAL INDUSTRY

DINNER OF CHEMISTS,

October 31, 1923

As we have previously announced, a dinner of Chemists is to be held next week under the joint auspices of the Chemical Society, the Institute of Chemistry, and the Society of Chemical Industry. The arrangements for the dinner, which will take place in the Edward VII Rooms, Hotel Victoria, Northumberland Avenue, London, W.C. 2, on Wednesday, October 31, at 7 for 7.30 p.m., have been made by a committee representing the above Societies and certain other Societies as well.

Sir William J. Pope, K.B.E., F.R.S., has consented to take the chair and the committee now announces that a limited list of toasts has been arranged and that a short musical programme will be presented by Mr. Ivor Foster and Miss Megan Foster, both well-known on the concert platform.

This is the first dinner of its kind to be held for chemists, and as nothing has been neglected that will make the evening attractive, it is hoped that a large and representative gathering will be present and thus ensure success. It is especially to be noted that there will also be opportunities for social intercourse, a feature of great value in view of present aspirations.

Members of any of the participating Societies are invited to attend and bring guests, including ladies. The price of tickets is 12s. 6d. each, not including wine, and applications (accompanied by the appropriate remittance) should be sent *immediately* to the General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C. 2.

Applicants are invited to state the names of friends, beside whom they wish to be seated and to furnish the names of their guests.

LIST OF MEMBERS ELECTED

October 12, 1923

Atsuki, Katsumoto, Dept. of Applied Chemistry, Faculty of Engineering, Tokyo Imperial University, Tokyo, Japan. Professor.
Board, T. F. Anthony, 13, Cornwallis Crescent, Clifton, Bristol.
Bowker, Frederic C., 20, Hawcoat Lane, Barrow-in-Furness. Analytical Chemist.
Burke, Dr. Stephen P., c/o Combustion Utilities, Corporation, 125, Van Dam Street, Long Island City, N.Y., U.S.A. Chemical Engineer.
Carpenter, Leonard, c/o The Derbyshire Silica Firebrick Co., Ltd., Friden Station, Hartington, nr. Buxton, Derbyshire. Chemist.
Carter, John F., Elizabeth, Louisiana, U.S.A., Chemical Engineer.
Cooper, Francis J., 45, Berw Road, Tonypandy, Glam., South Wales. Manager of Coke and By-products Works.
Cripps, Charles V., West Bank, Widnes, Lancs. Analytical Chemist.
Davis, Jack B., c/o The Standard Textile Products Co., 320, Broadway, New York City, U.S.A. Technical Engineer.
Elford, William J., 35 Northumberland Road, Redland, Bristol. Student.
Frith, James S., Ascog, Thelwall, near Warrington. Works Chemist.
Goring, Arthur W., Messrs. Wm. Barbour and Sons, Ltd., Hilden, Lisburn, Ulster. Textile Chemist.
Henry, James, Burmah Oil Co., Ltd., P.O. Box 67, Rangoon. Petroleum Chemist.
Heppell, S. Bulmer, British Cellulose and Chemical Co., Ltd., Spondon, near Derby. Chemical Engineer.
Hogan, George, 69, Dock Street, Newport, Mon. Chemist.
Hughesdon, Reginald S., Australian Fertilizers Pty., Ltd., Port Kembla, N.S.W., Australia. Chemist.
Lancaster, Roy, c/o Mrs. Smith, 161, Merton Road, Wimbledon, London, S.W. 19. Analytical Chemist.
Langdon, Guy M., Dunwood, Uphill, Weston-super-Mare. Student.
Lewis, Essington, c/o The Broken Hill Pty. Co., Ltd., 320, Collins Street, Melbourne, Victoria, Australia. General Manager.
Lyon, Joseph, 14, Storey Square, Barrow-in-Furness, Lancs. Analytical Chemist.
Marsh, Eric R., 14, Sheen Gate Gardens, East Sheen, London, S.W. 14. Chemical Engineer.
Maxwell, Stanley C., 36, Grange Park, Ealing, London, W. 5. Engineer.
Muir, Robert I., c/o Creamola Food Products Ltd., 54, Great Clyde Street, Glasgow. Chemist.
Muspratt, Rudolph, St. John's College, Oxford. Student.
Naidu, D. Satyanarayana, Indian Institute of Science, Hebbal, Bangalore, India. Research Student.
Osmond, Donald A., 13, Southside, Weston-super-Mare. Student.
Penny, Thomas, 11, Devonshire Road, Westbury Park, Bristol. Soapery Manager.
Reynolds, Herbert F, "Cooroona," 12, Proctors Road, Hobart, Tasmania. Chemical Engineer and Metallurgist.
Richards, William G., Morro Velho, Nova de Lima, Minas Geraes, Brazil. Industrial Chemist.
Sapojnikoff, Alexis, Zabalkansky pr. No. 9, Petrograd, Russia. Professor of Chemistry.
Smart, John, Minerals and Metals, Ltd., 4, Lloyd's Avenue, London, E.C. 3. Analytical Chemist.
Warr, John C., 11, Cavendish Road, Henleaze, Bristol. Chemist.
Whitworth, Dr. Abraham B., 42, Murray Road, Rugby. Chemist (B.T.H. Lamp Works).
Williams, Evan C., Ramsay Memorial Laboratory, University College, Gower Street, London, W.C. 1. Professor of Chemical Engineering.
Wilson, Donald M., Highways Construction, Ltd., Point Pleasant, Wandsworth, London, S.W. Chemist.
Wright, Gerald S., 2, Wharncliffe Villas, Sunny Bank, Sheffield, Yorks. Brewery Chemist.

NOTTINGHAM SECTION

The opening meeting of the Session was held on October 17, when the chairman, Mr. J. M. Wilkie, read his address entitled: "Some reflections on the importance of Chemistry to the Community and the means which should be adopted to bring the fact home to the 'man in the street.'"

Not until the outbreak of war was the importance of chemistry realised by the community. During the war, informative and often eulogistic articles, appeared quite frequently in the Press upon the fine work performed by chemists. Since the war, however, the Press rarely and scantily referred to the importance of chemistry or to the strenuous efforts of chemists in pursuing vital investigations. To illustrate the importance of such investigation Mr. Wilkie discussed the direct relationship between dietetics and deficiency diseases such as scurvy. The systematic study of the effect of various vitamins would ultimately be of the greatest benefit to the human race.

Another most important problem to be solved by the chemist was the exhaustion of the soil. Supplies of nitrogenous fertilisers were now assured by the synthesis of nitrates, but a very different state of affairs existed with regard to potash and phosphates, ultimate supplies of which were limited. Until we found some means of replenishing the natural stocks of such things, we were foolishly "living on capital."

If such questions as these could be placed frequently before the public, the importance of chemistry in attacking such problems would be brought home. The trouble nowadays was to get the Press to realise that discussion of such things is at least as important as long descriptions of sports.

In conclusion the speaker referred to the efforts which were being made to make the *Journal* more interesting and attractive, so that it would appeal to people outside the chemical profession.

Mr. H. Droop Richmond in opening the discussion, asked if the Society of Chemical Industry was doing all it could to further the importance of the chemical profession. He thought not, and considered that insufficient publicity was being given either to the meetings or the *Journal* itself. He rather deprecated the introduction of too much merely interesting and amusing matter, rather than the solid scientific material of bygone years. He also considered that articles in the *Journal* appealed rather to the production departments of manufacturing establishments than the sales departments which were of more importance to the advertiser.

Mr. Pentecost agreed with Mr. Richmond and thought that the *Journal* of ten to twenty years ago was of much greater interest than that of the present day. He recommended the omission of the weekly "Trade Report," which he thought was of but little interest for most members. Greater publicity of the work of the chemist would be obtained if reports of meetings were published in other journals.

Mr. Burford described the popular idea of a chemist who was supposed to be one of three things—a wizard, a detective, or a money maker (for his employer). The schools were the starting place for educating the public as to what a chemist really did, and the Press also could do a great deal in making the ordinary layman familiar with the methods and aims of chemistry.

Dr. Firth considered the *Journal* much improved as it differed from many others in being very readable, and therefore it had an attraction even for the outsider; the subject matter in "lighter vein" was a distinctly advantageous feature.

Mr. Barker stated that personally he found the weekly market report of considerable advantage.

Mr. Dunford agreed and said that these reports were especially useful for back reference. He thought that extension of the popular lecture would be beneficial in bringing the public into closer understanding as to what chemistry was. He mentioned his appreciation of the lighter articles in the *Journal*.

Dr. Prideaux said that chemistry possessed a distinctly cultural value. Although the chemical profession consisted of a large body of men of many varied attainments, recognition of such a body would only come when internal schisms and strife ceased. Chemistry in the elementary school had suffered a retrograde movement in being gradually eliminated from the curriculum.

Messrs. Povey, Mayfield and Meek likewise expressed the importance of starting with school children as a first step in bringing home the importance of chemistry.

Dr. Firth and Mr. Higson read a paper describing the action of aqueous sodium hyposulphite (hydrosulphite, $Na_2S_2O_4$), upon silver chloride. The reaction with solid silver chloride at ordinary temperatures was very slight (using hyposulphite solutions up to 6 per cent.) and the main product was silver sulphide. For higher concentrations of hyposulphite, increased action occurred up to a temperature of 50° C., when silver sulphide and metallic silver were produced.

When a solution of silver chloride in sodium thiosulphate was treated with hyposulphite solution the product was entirely silver sulphide, quantitatively precipitated. Silver chloride dissolved in an excess of ammonia solution was rapidly and quantitatively reduced to metallic silver when treated with hyposulphite.

Finally, a similar quantitative reduction to finely divided metallic silver occurred when a solution of silver nitrate in excess of ammonium hydroxide solution was acted upon by hyposulphite solution. The quantitative precipitation of silver sulphide from the thiosulphate solution of silver chloride, and of metallic silver from the ammonium hydroxide solution afford two convenient methods for the recovery of silver from silver residues, as both the silver sulphide and finely divided metal were readily converted into silver beads by lightly fusing.

Mr. Burford, Mr. Lambourne and Dr. Prideaux commented upon the possibilities of a simple and economical recovery of silver from silver residues in the light of the above results. Mr. Prince inquired whether the cost of the formerly unfamiliar sodium hyposulphite would render the recovery of silver from residues unproductive. Mr. Wilkie asked whether silver residues containing a mixture of chloride bromide and iodide could be economically treated. Dr. Firth, in reply, stated that sodium hyposulphite was now a commercial article, and that a mixture of the three silver halides could probably be extracted with sodium thiosulphate and subsequently precipitated.

CHEMICAL SOCIETY

At an ordinary meeting held on Thursday, October 18, 1923, at 8 p.m., the President, Prof. W. P. Wynne, F.R.S., occupied the Chair.

An important announcement was made which concerned the future of the Abstract section of the *Journal*. Arrangements had been made whereby the publication of abstracts of papers in the domains of pure and of applied chemistry would be directed as from January next by a Bureau consisting of representatives of the Chemical Society and of the Society of Chemical Industry. The members nominated by the former are Prof. W. P. Wynne, F.R.S., (President), Prof. J. F. Thorpe, F.R.S., (Treasurer), Dr. Irvine Masson (one of the Secretaries), and Prof. G. T. Morgan, F.R.S. The Bureau would co-opt a ninth member as Chairman, and would then proceed immediately to examine the position with a view to unifying the abstracts hitherto prepared separately by the two societies, apportioning the cost, and thereby effecting substantial improvements and economies. In the meantime, however—certainly until the end of next year—no change in the present format or method of preparing the abstracts was contemplated, apart from that announced at the last meeting.

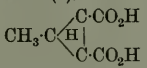
Dr. C. K. Ingold gave an account of

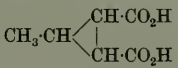
The chemistry of the glutaconic acids. Part XV. Three-carbon tautomerism in the cyclopropane series. Part 2. By F. R. Goss, C. K. Ingold, and J. F. Thorpe.

The study of the isomerism of a glutaconic acid, in which the possibility of geometrical isomerism is excluded by ring formation is of interest, because, in such a case, the evidence is clearer than any which has previously been obtained, that in three-carbon tautomerism structural conditions may be encountered which cannot be interpreted by conventional space models.

Further experimental evidence is now brought forward that the tautomeric relationship of the three isomeric esters of the cyclic glutaconic acid (I) is such that after the mobile hydrogen atom has passed into the carboxyl group, as in the enol-ester, it cannot return to the position which it takes up in the normal ester directly, but only by way of its position in the labile ester, that is, on the α-carbon atom of the system, which forms a halting place in the two stage migration.

In view of the apparent impossibility of reducing the acid (I) to the saturated cyclopropane acid (II), the converse process has been studied. The acid (II) has been isolated in each of its three possible stereoisomeric modifications, and a double bond has been introduced into each by more or less conventional methods. In each case the product is the acid (I).

(I)




(II)

The President commented on the authors' skill in obtaining the three definite crystalline isomers from a viscous mass, whereby it was possible to complete the investigation.

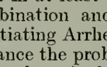
Mr. R. G. W. Norrish dealt with the effect of a containing surface on chemical reaction, as follows :—

Studies of electrovalency. Part III. "The catalytic activation of molecules and the reaction of ethylene and bromine." R. G. W. Norrish.

The hypothesis is advanced that molecular activation is at any rate partly a catalytic process consisting in the polarising of the reactant molecule by association with the molecule of a polar catalyst, either in a gaseous, surface, or liquid phase. This is supported by the fact that complete desiccation of reactants suspends reaction in the great majority of the cases investigated. Lowry's view that the molecules of unsaturated organic compounds which are unreactive in their resting form may become reactive by developing an electrovalance in the double bond—*e.g.*, by contact with some polar substance (gaseous or otherwise), is a special form of this hypothesis in which the complete ionisation of the bond is postulated. The hypothesis is tested experimentally by investigation of the reaction of ethylene and bromine. It is shown that the dried gases practically cease to react when enclosed by "non-polar" walls of paraffin wax, but that they react rapidly when enclosed by a "polar" surface of glass, stearic acid or cetyl alcohol. The reactivity of the gases as measured by the bimolecular velocity constant varies with the chemical nature of the enclosing surface, being greatest for stearic acid—the substance which may be considered the most polar of those investigated. On passing dry ethylene and bromine, diluted with air, through a paraffined tube, and then through a glass tube, no ethylene dibromide was observed in the paraffined tube, while about ·3 gm. collected in the glass tube. These results are considered as evidence in favour of the contention that molecular activation is normally associated with a process of catalytic polarisation.

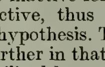
Dr. J. Kenyon asked whether all the bromine was known to react with the ethylene, to the exclusion of the formation of bromostearic acid.

Dr. E. K. Rideal said that the investigations on the "activation" of ethylene by a polar surface indicate that the ethylene molecule can exist in at least two forms, one inactive for the combination and the other active, thus substantiating Arrhenius' original hypothesis. They advance the problem a stage further in that the active form is shown to be stabilised by a polar substance, and must therefore itself be polar. Lowry suggests that the active or polar form is Thomson's intramolecularly ionised form; it is possible, however, that there exist between the symmetric non-polar form and the completely ionised form not only one (intramolecularly ionised) state of the ethylene molecule, but several of different degrees of polarity, corresponding with the various possible quantic orbital rotations of the binding electrons. Gaseous ethylene may consist of a mixture of molecules in the various quantic states, and the catalyst may operate by stabilising one state by means of association; alternatively, the catalyst may actually raise the quantic state of an adsorbed molecule by means of its powerful field. In a non-symmetrical molecule two forms of the active state may be envisaged (I and II), to which we may give the term electro-isomers; these will add on a polar molecule, *e.g.*, $\overset{+}{H}\overset{-}{Br}$ to form different compounds. The saturated bromide on dissociation into the unsaturated hydrocarbon and hydrobromic acid would at the moment of dissociation be polar; but on cooling, recombination to form both bromides would take place, *i.e.*, the polar form does not persist, but relapses into the resting or non-polar state.



$$\begin{matrix}H\cdot C\cdot CH_3+\\ |\\ CH_2\quad -\end{matrix}$$

(I)



$$\begin{matrix}H\cdot C\cdot CH_3-\\ |\\ CH_2\quad +\end{matrix}$$

(II)

From what had been said by Dr. Ingold, it would appear to be possible, in Dr. Rideal's view, that the degree of activation or the degree of polarisation in a molecule necessary to produce interaction with another substance varied with the reaction. Activation apparently increased the magnetic moment of a molecule, and experiments in the intense magnetic fields recently made possible by a device of Mr. Capitzlea in the Cavendish Laboratory might yield interesting results.

Prof. T. M. Lowry, F.R.S., remarked that further experimental work in a similar direction was in progress.

Dr. Irvine Masson, congratulating the author on his suggestive and very interesting facts, enquired to what extent they might be explicable on Langmuir's hypothesis concerning surface catalysis. According to this "fly-paper" hypothesis, the molecules of one reactant, pinned down on the solid in patches or sheets to a varying extent, and oriented favourably for the impact of those of the other, were the seat of the reaction; was this not operative here, where it might then be unnecessary to import any further hypothesis as to the existence of free activated molecules in the gas?

Replying, Mr. Norrish said that the behaviour of ethylene and bromine separately had been examined in coated vessels; with the former, no effect had been detected, whereas with the latter the slight absorption corresponded with an error in the main experiments of not more than 1 per cent. The colour of the bromine persisted when the mixture was contained in a paraffined vessel, but disappeared almost immediately when other coatings were used. He considered that Langmuir's surface catalysis hypothesis was insufficient since it would involve an expectation of some reaction taking place in the gaseous mixture; further, the reacting molecules, even if they were pinned down, must be altered so as to be in some intrinsically more active form.

Mr. R. R. Le G. Worsley read a paper entitled:

Selenium trioxide and chlorselenic acid. By R. R. Le G. Worsley and H. B. Baker.

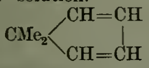
MANY attempts have been made, without success, to obtain the selenium analogue of the trioxides of sulphur and tellurium, both by direct union of oxygen with the element and the oxide, and by dehydration of selenic acid. The action of ozone on dry selenium had already been shown to produce only the dioxide, but by the use of a solvent this agent has carried the oxidation a stage further and selenium trioxide has been isolated. The solvent used was the oxychloride of selenium, which when alone was found to be unaffected by ozone. The solution of selenium in the oxychloride showed little or no apparent change by treatment with 7% ozone for 30 hours, but after this the trioxide separated out in considerable quantity. Analysis showed 62·01% of selenium, SeO_3 requiring 62·26. The molecular weight by lowering of the freezing point of phosphorus oxychloride was found to be 136. Selenium trioxide is a very pale yellow powder of density 3·6. It decomposes at 120° without melting or subliming. It dissolves in water with evolution of heat, but is insoluble in ether and other common solvents. It combines directly with dry hydrogen chloride producing chlorselenic acid, which is found to be very similar to chlorsulphonic acid. Analyses and molecular weight determinations confirm the existence of the new acid.

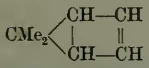
The President remarked on the interesting fact that the new oxide had not been found to polymerise.

Dr. C. K. Ingold summarised the following paper :—

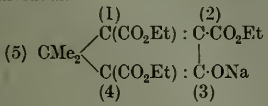
The chemistry of polycyclic structures in relation to their homocyclic unsaturated isomerides. Part V. Orientation in the gem-*dimethyl*dicyclo*pentane series.* R. C. Grimwood, C. K. Ingold, and J. F. Thorpe.

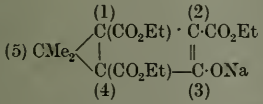
The proof adduced by recent experiments that derivatives of dimethyl*cyclo*pentadiene (I) are tautomeric with corresponding derivatives of dimethyl*dicyclo*pentene (II), and that the nucleus of each substance of the series possesses two distinct phases which together confer on the compound a dual chemical character, raises certain problems of structure, principally relating to the orientation of attached groups, which require special methods for their solution.

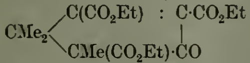
(I) 

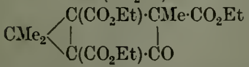
 (II)

Thus there are two positions in which the sodio-ester (III, IV) might methylate on carbon; namely, position (4) through the operation of the β-ketonic ester residue derived from $CO_2Et{\cdot}\underset{(4)}{\overset{|}{C}} : \underset{(3)}{\overset{|}{C}}{\cdot}ONa$ in (III) and position (2) through the β-ketonic ester group derived from $\underset{(3)}{\overset{|}{C}}(ONa) : \underset{(2)}{\overset{|}{C}}{\cdot}CO_2Et$ in (IV). The product should therefore have either formula (V) or formula (VI), and in either case, since the nucleus cannot now revert to the quasi-aromatic structure (types I or II), intra-annular tautomerism must be suspended, and the substance should be capable of being orientated as a static individual.

(III) 

(IV) 

(V) 

(VI) 

Experiment showed that the substance has formula (VI), methylation having fixed the tautomeric nucleus in its bridged modification.

SOCIETY OF GLASS TECHNOLOGY

The first meeting of the session was held in Sheffield on October 17, the president, Prof. W. E. S. Turner, D.Sc., in the chair. "Frank Wood" medals were presented to Mr. A. R. Sheen, B.Sc.Tech., and Mr. F. Winks, B.Sc.Tech. by Sir W. H. Hadow, vice-chancellor of the University of Sheffield.

It was resolved to send a cordial invitation for a conference in this country sometime during 1924, jointly to members of the Society in France and to the Chambre Syndicale des Maîtres de Verreries (the representative body of French manufacturers which had welcomed the party to Paris in July).

A paper entitled "The Effect of Titania on the Properties of Glass," by A. R. Sheen, B.Sc.Tech., and Prof. W. E. S. Turner, D.Sc., was read by Mr. Sheen. In presenting this paper Mr. Sheen remarked that a great deal of interest had recently been shown in the production of heat-resisting glass. Manufacturers, especially of scientific glassware, were realising the necessity of making a glass which had a high thermal endurance and which at the same time was resistant to the attack of solid, liquid or gaseous substances. Modern heat-resisting glasses contained a high percentage of silica and also boric oxide in considerable amount. There were, however, objections to the use of these oxides. With silica the difficulty was merely that of obtaining a sufficiently high melting temperature. Glasses containing boric oxide were readily melted, however, but here the objection was the effect of the oxide on the durability of the glass. As the B_2O_3 content of a glass increased the durability towards water and acid rose to a maximum, but when the B_2O_3 content was further increased, the durability fell off rapidly. It seemed that titania glasses were heat-resisting, but no experimental data were available. It was with this consideration specially in mind that this piece of work was undertaken.

At the outset preliminary tests were made to find out what mixture of silica, titania and soda would give glasses at the highest temperature obtained in glass melting practice, *e.g.*, temperatures of 1400° to 1450° C. It was found impossible to obtain a glass from silica and titania alone at this temperature. Batches were then calculated out on the basis of the glass formula :—

$$6\ SiO_2\ xNa_2O\ yTiO_2 \text{ where } x+y=2.$$

and it was found that the first six members of the series gave glasses quite readily, *i.e.*, glasses of the approximate molecular compositions :—

(1) $6\ SiO_2\ 1{\cdot}9Na_2O$; $0{\cdot}1\ TiO_2$.
(2) $6\ SiO_2$, $1{\cdot}8\ Na_2O$, $0{\cdot}2\ TiO_2$.
etc., etc., etc.
(6) $6\ SiO_2$, $1{\cdot}4\ Na_2O$, $0{\cdot}6\ TiO_2$,

in which the soda was gradually replaced by titania. Above 1·8 mol. TiO_2, *i.e.*, 13 per cent. TiO_2, it was found increasingly difficult to melt the glass and higher temperatures were required. If these glasses were melted under reducing conditions, their colour varied from light amber to dark brown. Therefore part of the soda content was added as soda nitre and the melting operation was carried out in crucibles with well-fitting lids. By this means colourless glasses were obtained. There were indications during these melting operations that titania glasses were heat-resisting. It was found in many cases that the glass could be removed straight from the furnace and allowed to cool down in the open air without splintering or cracking of the mass of glass occurring.

It was found on comparing with the corresponding lime and magnesia glasses that the titania glasses were less attacked by water than the lime glasses, especially in the earlier members of the series. The durabilities of the titania glasses were found to be practically the same as those of the corresponding magnesia glasses. The annealing temperatures were found to be rather less than those of the corresponding lime and magnesia glasses. The melts were repeated on a large scale (28 lb. pot), tubing was drawn and the expansion determined by the ordinary dilatometer method. The thermal expansions of the first four titania glasses were only slightly less than those of the corresponding lime glasses. Therefore, if titania glasses were heat-resisting this was not due to their low expansion, as was the case with Pyrex glass, but to some other factor such as tensile strength or elasticity.

These glasses possessed good working properties, their viscosity increasing as titania replaced soda. Throughout all the glasses melted in connexion with this work there was hardly any evidence of devitrification occurring. This bore out the statement of previous workers that titania hindered devitrification.

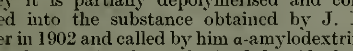
Mr. A. Cousen, B.Sc., A.R.C.S., then gave a paper entitled, " The Estimation of Selenium in Glass." Illustrating his remarks with experiments, Mr. Cousen said that during the course of researches on the use of selenium as a decolorising agent it was found desirable if possible to obtain a method for the estimation of selenium in the glasses obtained. The amount of selenium actually added to the batch was, in general, sufficient to give only 1 part of the element per 42,000 parts of glass, or 0·0024 per cent., if no loss occurred. But as selenium was volatile at the furnace temperature (the boiling point at 1 atmosphere pressure was 680°), considerably smaller values were likely to be found. The only chemical method for estimating selenium in glass so far published was that of Fränkel and described by Witt (*Sprechsaal*, 1914), and this was not quite comparable since it dealt with proportions of selenium at least ten times as great as those it was desired to estimate. The following modification of the above process was found to give results of fair accuracy. Twenty grams of finely powdered glass was dissolved slowly in hydrofluoric acid, and after standing in the cold the products of decomposition, with the exception of selenium, were dissolved by pouring into excess of boiling water. The selenium itself was filtered off on a filter pulp pad in a Gooch crucible. From the pad the selenium was removed by treating with a dilute chlorine solution (about 1/300 N). To the filtered solution was added 1 c.c. of 5 per cent. gum arabic and 5 c.c. of 0·5 per cent. phenylhydrazine hydrochloride, the whole being made up to 50 c.c. Colloidal selenium was obtained, a yellow colour slowly developing, which after half an hour was matched against a standard solution of sodium selenite similarly treated. The method on testing with synthetic mixtures gave results well within 0·0002 per cent. of the actual values and a commercial glass, for which sufficient selenium had been used to give, theoretically, 0·0025 per cent., was found to contain actually only 0·0006 per cent. of the element.

BIRMINGHAM UNIVERSITY CHEMICAL SOCIETY

A meeting was held recently in the Lecture Theatre of the Chemical Department, with Prof. G. T. Morgan, F.R.S., in the Chair. Prizes for work during the past Session were presented by Prof. A. R. Ling, who afterwards gave an address on " Some Recent Advances in our Knowledge of the Chemistry of Starch."

Dealing with the historical portion of the subject, Prof. Ling paid a high tribute to the work of the late Cornelius O'Sullivan and to that of Dr. Horace T. Brown, remarking that these pioneer workers had furnished methods whereby advances had been made in solving the problem of the constitution of starch.

According to Maquenne and Roux and Mme. Gatin-Gruzewska, starch granules consist of two substances, amylo-cellulose, or amylose, the inner portion, which is soluble in water and gives a clear blue coloration with iodine, and amylopectin, the outer portion, which gives a viscous paste when heated with water. Ling and Nanji have found that when starch paste is kept in a mixture of salt and ice for several hours the starch is precipitated as a fibrous mass resembling a wad of moist cotton wool. After this mass has been brought to the ordinary temperature the amylose may be extracted from the amylopectin by washing with water at a temperature just below the gelatinising point of the starch employed. Amylopectin gives a viscous paste when heated with water, and if to the cooled paste iodine solution is added a bluish-black precipitate is produced. Amylopectin as it exists in the granules is a phosphoric ester, and it is suggested that the conversion of potato starch granules into soluble starch by treatment with 7 per cent. hydrochloric acid at ordinary temperature, according to Linter's method, consists in the hydrolysis of this ester and the removal of phosphoric acid. Morphologically there is no difference between potato starch granules and soluble starch. When amylopectin is acted on by ungerminated barley it is partially depolymerised and converted into the substance obtained by J. L. Baker in 1902 and called by him α-amylodextrin. This substance has been obtained devoid of reducing properties, and in solution gives a pure blue coloration with iodine. When either amylopectin or Baker's dextrin is treated with malt extract at 70° until the iodine reaction just disappears, it is converted into a hexatriose which is shown to be α-glucosidoisomaltose or β-glucosidomaltose,



$$C_6H_{11}O_5\underset{\alpha}{—O—}C_6H_{10}O_4\underset{\beta}{—O—}C_6H_{11}O_5,$$

which has a specific rotatory power of $[\alpha]_D$ 165° and reducing power, in terms of maltose as 100, of R=66. It is an amorphous, highly hygroscopic powder, melting at 202—203°. It forms a definite crystalline phenylosazone of melting-point 122°. Treated with malt diastase or maltase at 55° it is converted into isomaltose and glucose, whilst treated with the β-enzyme of almonds it is converted into maltose and glucose. Isomaltose is shown to have the properties described by Lintner. It is an amorphous powder somewhat less hygroscopic than the hexatriose. Its specific rotatory power is $[\alpha]_D$ 140° and its reducing power R=80. It is unfermentable by ordinary *Saccharomyces cerevisiæ*. Isomaltose when treated with the enzyme of almonds is converted into two molecules of glucose.

Ling and Nanji accept the view of Pringsheim, Karrer and Irvine, that starch consists of polymerised non-reducing substances to which Pringsheim has given the name amyloses. The basal unit of polymerised amylose is α-hexa-amylose, and this consists of three condensed diamylose residues. It is quantitatively converted into maltose by diastase of ungerminated and germinated grain. The basal unit of amylopectin is α-β-hexa-amylose, and this consists of two β-diamylose residues and one α-diamylose residue. Treated with precipitated malt diastase at 70°, it is converted into two molecules of β-glucosidomaltose. Treated with malt extract at 55° it yields two molecules of isomaltose and one of maltose. Maltase converts it into two molecules of isomaltose and two molecules of glucose.

It has recently been shown by S. B. Schryver that certain of the starches contain hemicellulose complex, and Ling and Nanji have confirmed this. In agreement with Schryver, they show that the starches of potato and arrowroot consist entirely of polymerised amylose and amylopectin.

CORRESPONDENCE

ELLIS'S PRACTICAL BACTERIOLOGY FOR CHEMICAL STUDENTS

Sir,—Here's a pretty kettle of fish! A chemical journal asks a medical man to review a book for chemists, written by a biologist. The medical man sets about it with gusto and spices his review with a tinge of malice. Before dealing in detail with Dr. Renshaw's review I must, at the outset, present one of my chief credentials, namely, that my book was written after the precepts and rules laid down in it had been put into practice in the teaching of chemists for a period of eighteen years. Imagine a young chemist deposited in a factory and having to tackle some trouble that has arisen owing to a microbe having run amuck in the works. What does he need in the way of bacteriological instruction to tackle a situation of this kind? My book set down what I had found by experience to be possible in a first course of this kind. Your reviewer has not the imagination to see this. In his mind's eye he envisages only that particular brand of bacteriologist that is turned out in medical laboratories.

Some of the objections raised by him are truly puerile. Suppose I did cite *Cladothrix dichotoma* as an organism which stored glycogen. What then? This organism is extremely important in industrial bacteriology, and its depredations in other countries have called Royal Commissions into being. Apart from that why mention such a trivial feature, which occupies one line in the book, as a reasonable ground for objection to the book as a whole? Again, why bother about the insertion of a diagram of an Erlenmeyer flask? Even Dr. Renshaw does not appear to be able to spell the name correctly. His utter lack of comprehension is shown in his objection to the prominence given to *Bac. megatherium*. He says it is an organism which is not of "great consequence." I will supplement that by stating that it is of no consequence whatever. What is of consequence is its extreme usefulness for use in *inculcating the principles of Bacteriology*. It is a giant of its kind, a prince in its own country, and that prince can be got from the Lister Institute for the sum of 1s. It forms spores, it exhibits motility, and develops solid reserve materials. It is an ideal organism for teaching purposes, but note the comment: "It is not of great consequence in routine bacteriological work."

Then, again, I am indicted for not including ultra-microscopic methods of examination and other branches of bacteriological work. What does he expect? My object was to write an introductory text-book, not an encyclopœdia. I aimed at the housetops and he blames me for not striking the moon. I hesitated before finally rejecting the bacteriological treatment of disinfectants, but even this had to go owing to the imposed limits of the book. It is difficult to deal seriously with the statement that a coccus is scarcely visible when magnified 350 times. The average coccus is 1 μ in diameter; when magnified to this amount its magnitude = 350 μ = ·35 mm. Does it need an "optimist" to work with cocci magnified to this extent?

Again, exception is taken to the lack of finish of my cultures, and to priority of place of gelatin cultures. Incidentally, these are given not priority, but equality of place. Does it not occur to Dr. Renshaw that this might have been done purposely? The media as prepared in my laboratory will secure the development of 99·9 per cent. of all the organisms that the works' chemist is likely to meet, and, after all, the proof of the pudding is in the eating. I find gelatin-media not only useful but necessary for the particular class of work for which this book was written. If Dr. Renshaw thinks otherwise from his experience of this aspect of bacteriology, he is welcome to his opinion. All the other points, with two exceptions, are like the above, either counsels of perfection or else superficial nonsense. The two exceptions are the omission of the counterstain in Gram's stain, and the omission of two diagrams, to which he did right to call attention. These omissions were the results of a pure accident.

The plain fact of the matter, Sir, is this, that throughout the whole of this review Dr. Renshaw is judging the book according as it is going to be helpful or otherwise to a person wishing to undergo the routine work of a medical bacteriological laboratory. Whatever may be the merits or demerits of the medical training it is quite useless for the student of chemistry, who must be taught the foundations of the subject; and this can only be accomplished by approaching the subject from the biological side. An intensive study of pathogenic organisms may necessitate an approach of the subject in a purely empirical manner, but I must protest when obstructive criticism is levelled at my book because your reviewer has not the imagination to project his mind to the requirements of the works' chemist, who must be given the rudiments of a bacteriological training to enable him to face the biological problems that crop up in the factories.—I am, Sir, etc., David Ellis

Sir,—I have seen in your issue of October 5 a review of the book, *Practical Bacteriology for Medical Students*, by Dr. Ellis. While I am fully in agreement with most of the criticisms of your reviewer, there is one point on which I beg to differ. I have found in actual practice that it is best not to counter-stain in carrying out Gram's method of staining. If the diaphragm is well cut down and a good light is employed, there is no difficulty whatever in seeing Gram negative organisms, and the distinction between Gram negative and Gram positive is very much more marked than is the case if a counter-stain is used. Moreover, the latter tends to obscure the slight differences in degree of staining which certain organisms exhibit. It seems to me probable that Prof. Ellis has reached the same conclusion, and that is why he does not advocate counter-staining.—I am, Sir, etc., R. F. Hunwicke

THE CHEMICAL ENGINEER

Sir,—I am not sure that the academic ventilation of definitions or a discussion on the functions of this reputedly weird species is likely to be of value outside the chemical engineering community, because in my experience the only people who really have an adequate notion of the functions, training and uses of a so-called "Chemical Engineer" are those who employ a competent one or else the trained chemical engineer himself. One of your correspondents is unconvincing because he endeavours to judge chemical engineers by the books they read, but Mr. Gray is both entertaining and suggestive.

Do your correspondents really think that it would be desirable to include in a book on chemical engineering or its principles, chemistry, which can be better culled from standard text-books written by real chemists? My experience of chemical engineers is that when properly trained they refuse to pad their books or their brains with unessentials, and it is ridiculous to think that because chemical engineering rests largely on engineering, physics and common-sense, that in the works or in practice a chemical engineer is not in daily contact with chemistry and chemical processes for which a substantial leaven of chemistry in his training is obviously essential. To call such a man a physical engineer would be a terrible indictment, and although his function is sometimes that of a doctor versus a patient, the administration of the physic and its proper compounding usually requires knowledge both of chemistry and business. The latter ingredient is, unfortunately, often overlooked. How would Mr. Greenfield, as a logical sequence to his letter, define a "Physical Chemist," and what would he think of a book on physical chemistry which says nothing about the principles of chemical engineering, which he seems to consider as a branch of "Physics"?

Why not simply accept the fact that a hybrid species has been gradually evolved during the last decade, which the general public has, rightly or wrongly, become accustomed to call a "Chemical Engineer," and leave it at that? The hybrid which is suitable for a by-product or acid plant would hardly be suitable for the control of complicated organic processes, unless his training has been wide enough, and, for instance, in America there has been a tendency to subdivide the hybrids into organic and inorganic chemical engineers. The definitions, if any, and educational work are, since the

Institution of Chemical Engineers has come into active being, in safe hands.

In conclusion, I think Mr. Gray was not quite fair to Liddell's "Handbook on Chemical Engineering," in that he made little reference to volume 2, which, in my opinion, contains just as much chemistry as is desirable, rightly leaving the reader to consult known text-books for the rest, instead of endeavouring to publish a kind of encyclopædia, which, if completely assimilated by our budding hybrid, would produce a "dud."—I am, Sir, etc.,

C. J. Goodwin,

708, Idol Lane, London, E.C. 3

THE CHEMIST AND BUSINESS TRAINING

Sir,—In your editorial in the *Journal* of October 12 reference was made to a matter of considerable importance at the present time, viz., the relationship between training in chemistry and business training.

If the number of men who combine a keen business sense with adequate scientific knowledge and judgment is comparatively few, one is compelled to assert that the cause is not to be traced to hereditary inability of the "brains" of this nation to unite the two faculties in one man.

Those examples of such a desired "finished product" whose names are familiar to many of us must inspire many young men in our colleges with a real wish to develop towards a similar career.

What, then, is the obstacle to the fulfilment of this laudable desire? The sons of wealthy business men who are fortunate enough to start with a training in chemistry and to proceed (the necessary opening for them in industry having been provided in advance) to a responsible post with scope for their ideas and special facilities for gaining business experience, need not concern us here.

Our problem is connected with the young chemists who are graduating in large numbers from the Universities and for whom, apparently, very few posts are available.

Whilst it may be true that "if suitable men are chosen in good time the desired result will be obtained," what machinery is proposed for finding the right type of man and for grafting upon him the business training which, combined with his particular scientific bent, will tend towards productive results?

Those most important "twenty years in laboratory and lecture room" have laid what we believe to be the sure foundation; it is immediately upon their completion that the necessity arises for the inculcation of business responsibility together with opportunities for advancement, provided that the candidate's rate of progress corresponds with the first estimate of his ability.

Two urgent requirements would seem to present themselves. The first is that undergraduates in our schools of chemistry should be made to realise that not every person with a degree is destined for a purely chemical post, *e.g.*, in research or applied chemistry. This means also that the "control" and "costs" side of chemical operations must never be lost sight of in our teaching, both theoretical and practical.

The second is that our "captains of industry," works directors, and managers of all departments should be alive to the possibilities of introducing young men with scientific training into every branch of the businesses which they control, so that chemistry may be applied as much outside the laboratory as inside.

In conclusion, whilst one is aware that amongst the great industrial concerns and also in the Universities and colleges there are many gentlemen of high standing who have had the conviction and foresight to face these problems and to point the way to a solution, the need of the moment is that experiments on similar lines be tried as widely as possible.—I am, Sir, etc.,

William Doran

Dept. of Organic Chemistry,
Liverpool University
Oct. 17, 1923

THE CHEMIST IN INDUSTRY

Sir,—Whilst fully accepting the editorial decree that my recent article, entitled, "The Chemist and Industry," should be regarded as raising the issue of the "Chemical Engineer," I cannot but express regret that the original title "chemist" was not retained. However, in replying to the correspondence on the subject, I may say that the criticisms put forward have been very fair and not nearly so drastic as one might have expected. Mr. G. J. Greenfield, whilst he seems to be tired of the subject, cannot refuse to discuss it. That, Mr. Editor, proves the perennial fascination of the question and explains a good deal. I cannot agree that the subject can ever become stale while there is such a great discrepancy between the ideal treatment of chemists and the present state of affairs. Further, age in a maxim is like age in good wine—it indicates quality and potency. With regard to Mr. Greenfield's point about the neglect of physics, nobody will disagree with him, but surely he is a physical extremist?

In reply to Mr. H. A. Wilson's courteous letter, I have re-read with care the original article and can find no condemnation of the "professional chemical engineer" as such. The object of my criticism was always the *soi disant* chemical engineer, and one cannot but wish well to all such bodies as the Institution of Chemical Engineers and their efforts to set a high standard of initial attainment before admission.

By the phrase "that the directing intelligence of chemical concerns should be of a chemical nature," I certainly do not mean that the managing director of a chemical firm should necessarily have a diploma as a chemist. The purposely general nature of the phrase was intended to imply something better than that—namely, that the technical strategy, as well as the actual works tactics, should be decided upon after due weight (and recognition) has been given to the counsels of the chemist. That means that chemists must be represented on the board of directors. It is inclusion that I plead for, not exclusion. Mr. Wilson's ideal of a manager or managing director, though the point is not raised by me, seems to be a very high one, and I am doubtful of the frequency with which such very able men can be found. I would be satisfied with an honourable business man, preferably a University man, who, as an organiser, gives "due weight and recognition to all his staff" and persuades them to sink self in the general good. That is the essence of organisation.

Although, from his letter, Prof. Partington would seem to have read only the correspondence and not the causative article, I must express my obligation to him for so carefully dotting my "i's" and crossing my "t's" even to the extent of supplying the original reference. His list of subjects will inevitably be studied by any future chemical engineer who takes the course recommended in my article. To his plea for the co-operation of the older men in helping the young novice to find his feet I would offer my hearty support: it is difficult for the young graduate to work in an atmosphere of sullen resentment from older men, and a little charity would help a great deal.

It will, I think, do no harm if I make the chief points in the article to be:—(1) I am not ashamed to plead for special treatment for the highly specialised product who nowadays is turned out from the Universities. He ought not to be subjected to treatment other than that due to a gentleman. Britain needs chemists. (2) Mind must be given its due place in the chemical industry as apart from "smartness." (3) True economy and speed would indicate that adult education applied to men already in the profession would save much time and produce an atmosphere of good fellowship which we shall need very much in the critical decade which lies before us. (4) There is no real difference between pure chemistry and so-called applied chemistry. The only difference is in point of time. Fuel technology in this country is a direct outcome of the pioneer teaching of Dixon, as any sensible man is proud to acknowledge. The technology of gas heating and carbonisation has been stimulated and clarified by the researches of Smithells, Cobb and Wheeler, whilst the colloidal and cognate industries must find material of enormous value in the address to Section B given by its President at the last British Association meeting. Let us give credit where credit is due. Even "surface combustion" is a model of what extra aeration can do with a gas flame. (5) Lastly, Science should be taught as one of the "Humanities."—I am, Sir, etc., H. H. GRAY

Chemical Dept., Technical College,
Huddersfield
October 22, 1923

PERSONALIA

The Council of the Institution of Civil Engineers has made the following awards in respect of selected engineering papers published without discussion during the session 1922-23:—A Watt Medal to Mr. T. E. Houghton, M.Eng., Assoc.M.Inst.C.E. (Liverpool), and Telford Premiums to Mr. J. W. Meares, C.I.E., M.Inst. C.E. (Guildford), Mr. J. W. Spiller, M.Inst.C.E. (Maidenhead), and Messrs. G. S. Coleman, D.Sc., Assoc.M.Inst.C.E. (Manchester), and Dempster Smith, M.B.E., M.Sc., Tech. (Manchester); and in respect of papers read before meetings of students of the Institution in London and the provinces during the same period:—Miller Prizes to Mr. E. L. Everatt, Stud.Inst.C.E (Newcastle), Mr. J. G. Kimber, Stud.Inst.C.E. (London), Mr. A. H. Naylor, M.Sc., Stud. Inst.C.E. (London), Mr. E. Sykes (Birmingham), and Mr. F. J. Symonds, Stud.Inst.C.E. (London).

To mark the completion of forty years' service with the firm of Bayer & Co., Prof. C. Duisberg is to be presented with a volume containing his collected works and discourses.

* * *

The death is announced from France of Prof. Minguin, professor of chemistry in the Faculty of Sciences at Nancy, well known for his attempts to synthesise the diamond. Prof. Minguin was one of those to whom the Jecker prize had been awarded.

From Germany the death is announced of Prof. H. Geitel, hon. professor in the Technical Hochschule at Brunswick, and an active worker in the field of radium investigation.

The death is reported of Dr. H. E. Richards, of Bloomfield, N.J., president of the Martin Dennis Co., Newark, N.J., a manufacturer of chemicals. Also of Prof. A. J. F. da Sibra, professor in the University of Oporto, and for many years director of the Municipal Laboratory.

From Germany the deaths are announced of: Dr. B. Jaffé, founder of the Vereinigte Chemische Werke A.-G., Charlottenburg; Dr. H. Byk, founder of the Chemische Werke vorm. Dr. H. Byk, Charlottenburg; K. Heidenreich, well known in the gas world.

NEWS AND NOTES

AUSTRALIA

Establishment of a Chair of Metallurgy

In order to establish a chair of metallurgy at the Melbourne University, the Australian Mines and Metals Association has guaranteed the sum of £400 per annum from its members, which, together with the amount of £600 at present paid to a lecturer and assistant, will cover the costs of the chair.

UNITED STATES

Silver Anniversary of Chemists' Club in New York

Arrangements have been made to celebrate, on October 25, the silver anniversary of the founding of the Chemists' Club in New York. The festivities are to be in the nature of a home coming, and special efforts are being made to bring together on that day all those through whose efforts the club has achieved its present degree of success.

CANADA

Nickel

Approximately 1000 tons of ore is being treated daily at the British-American smelters at present. The second furnace of the British-American Nickel Co. has been blown in, and is rapidly reaching maximum production. The erection of a third furnace is in hand, but will not be in commission for another 6 months. With both furnaces operating at capacity, it is hoped that the monthly amount of ore treated will be close on 50,000 t.

FRANCE

Notes from Paris

The metallurgical market is in no hurry to interpret the recent political events. French industry is aware of the disadvantages that could arise from a restriction of the metallurgical and coal enterprises of the Ruhr. In general, prices of metallurgical products are expected to fall steadily but slowly.

Three decrees, issued on September 26, regulate the sale prices of nitrated cotton.

The production of the "Domanial" Mines of the Saar reached 1,096,959 metric tons in July, as against 1,025,716 t. in June. Altogether these mines found employment for 76,039 workers and employees.

JAPAN

The Mineral Industry

The aggregate value of the Japanese mineral output in 1922 reached 346,813,540 yen, against 332,620,331 yen in the previous year. The 1922 output was as follows (the figures for 1921 being shown in parentheses) :—Lead, kin 5,398,657 (5,229,938); bitumen, kin 4350 (1233); quicksilver, kin 2009 (9916); zinc, kin 20,618,336 (17,289,352); chrome iron ore, kwan, 1,001,921 (898,186); manganese ore, kwan, 1,183,946 (1,034,836); arsenic acid, kin 3,406,091 (2,325,745); arsenic ore, kwan 612,083 (401,657); phosphates, metric tons 12,330 (32,001); graphite, kin 1,742,700 (1,449,538); crude petroleum, koku 1,799,096 (1,961,068); natural gas, 1000 cu. ft., 1,144.416 (1,091,975); pitch, kwan 74,646 (1,850,370); sulphur, metric tons 34,642 (3659); sulphur ore, metric t. 42,089 (30,631). A summary report issued by the Japanese Bureau of Mines states that the output of zinc, bitumen, lead, arsenic, pitch, petroleum, graphite and sulphur exceeded previous records.

GENERAL

The Journal of Scientific Instruments

It is announced that arrangements have now been made for the regular monthly publication of the *Journal of Scientific Instruments*, and the first number appeared on October 15. The Journal contains 32 pages of reading matter and is somewhat similar to the preliminary number, copies of which have already been sent out. The annual subscription to the Journal, which is produced by the Institute of Physics, with the co-operation of the National Physical Laboratory, is 30s., including postage (24s. to corporate members of the Institute of Physics). Single copies are sold at 2s. 6d. each, post free 2s. 9d. Copies can be obtained from the Secretary, Institute of Physics, 10, Essex Street, London, W.C. 2.

New Russian Industrial Chemical Journal

A new journal is being published in Berlin in Russian under the editorship of Prof. Ipatieff, for Russia, and Prof. Grossmann for Germany. The object of the journal is to keep Russian technical chemists in touch with developments in chemical industry in Germany and other countries.

British Phosphate Commission's Report, 1922-23

According to the above report, favourable conditions were experienced both at Nauru and Ocean Island during the period reviewed, and operations were conducted in a satisfactory manner. The *Nauru Chief*, a steamer of 4000 tons dead weight, was acquired, and the tonnage of phosphate cargo shipped amounted to 361,205 t., compared with 364,251 t. for the previous year. Australia received 47·20 per cent. of the shipments. New Zealand 10·64, the United Kingdom 4·45, and other countries 37·71. All demands for the United Kingdom, Australia, and New Zealand were met at satisfactory prices, and the surplus output was disposed of to other countries at market rates. The trading account for the year showed that the receipts from sales of phosphates and sundry credits, less freight and insurance, amounted to £823,044. The f.o.b. cost of phosphate, including interest on capital, contribution to a sinking fund for the redemption of capital, and other charges specified in the agreement, was £732,406. The credit balance for the year was therefore £90,637.

REVIEW

The Determination of Hydrogen Ions. *By* W. Mansfield Clark. *Second edition reprinted. Pp.* 480. *References* 2000. *Baltimore, U.S.A.: Williams and Wilkins,* 1923. *Price* $5.50.

When the first edition of this book appeared in 1920, the reviewer welcomed it as an authoritative exposition of an important subject, the applications of which are increasing rapidly, and which is of fundamental importance, particularly to the biological sciences. In the short time that has elapsed since then, a reprint of the first edition and a second edition in 1922 have become necessary. The latter having already become exhausted has now been reprinted. These facts are evidence of the widespread recognition among chemists of the importance of hydrogen-ion concentration, and of the growing interest that is taken at the present time in its determination. The reviewer was able to commend the first edition for clearness, trustworthiness, comprehensiveness and interesting style. These features have been well maintained in the edition now before us. The book has been brought up to date by the inclusion of the work done in the interval since its first publication. Of the new items which have appeared of particular interest, mention may be made of the description of the quinhydrone electrode, the account of Goode's application of the electron-tube to the control of hydrion concentration and the detailed discussion of Gillespie's and of Michaelis' and Gyemant's work on colour matching of indicators. These, however, by no means exhaust the new work incorporated. To the technical applications summarised in the first edition have been added descriptions of those of a more purely scientific character. The number of bibliographical references has been increased from about 1100 to 2000. The author has evidently been at pains to widen the appeal of the book, so as to make it suitable for as large a number of readers as possible, and the experience gained of difficulties encountered by students and others has doubtless been utilised in the preparation of the present edition. Many chapters have been rewritten, some have been divided into two, and the discussion is fuller throughout. As a result, the number of pages has grown from 312 to 480, without, however, making the first edition obsolete, as might be at first supposed. The price has remained the same.

The book can be confidently recommended not only to those seeking information on hydrion-determination for purposes of scientific research or technical application, but also to the wider class who may wish to become acquainted with the general principles governing the subject from the purely scientific aspect.

Henry J. S. Sand

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Oct.* 18)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia	Steel sheets	413
Belgium ..	Paper	420
British India ..	Steel rails, sodium nitrate, iron posts (tender) ..	*
Egypt ..	Paper (tender)	11642/F.E./M.P.
Finland ..	Iron, steel, brass and copper pipes	423
Netherlands	Aluminium, enamel-ware, chinaware, crystal glassware	427
Norway ..	Untarred roofing paper ..	429
South Africa ..	Disinfectant fluid (tender)	12337/E.D./C.C./2
,, ..	Red oxide paint (tender)	12338/E.D./C.C./2
,, ..	Chemical coagulants (tender)	12342/E.D./C.C./2
Sweden ..	Rails, angle-iron ..	433

* The Director-General, India Store Department, Branch No. 10, Belvedere Road, S.E.1.

TARIFF CUSTOMS EXCISE

British Guiana.—An increase has been made in the export duty on refined petroleum.

Italy.—Under the "temporary importation" system, zinc scrap, iron and steel, brass, aluminium, and metallic materials may be imported duty-free.

Lithuania.—The export duty on hides has been retained.

Southern Rhodesia.—Prohibition has been declared of the importation, exportation, production or manufacture of any habit-forming drug, except under permit.

Tunis.—Imports of anthraquinone are duty-free.

NEW SOURCE OF PETROLEUM IN RUSSIA

A new petroleum well at Maikop, in Kuban, Northern Caucasus, has recently been producing 3000 t. daily of a light petroleum oil, rich in benzine.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

No material changes have taken place in the heavy chemical market either in demand or prices. Considering the general state of trade chemical products are in satisfactory request, although of course very considerably below what would be expected in more normal times. The home trade is steady but quiet, and the main features in export lines continue to be the "heavier" classes of alkalis.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 6d. per carboy makers' works.
Acid Nitric 80° Tw.	£22 per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 65s. f.o.r. makers' works, with slight variations up and down.
Acid Sulphuric, 94% Arsenical	£6 per ton makers' works.
Ammonia Alkali	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	5¾d.—6d. per lb. d/d.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Business in this section is generally on the dull side.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb. Reduced 1s. per lb. following drop in metal.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d. Regular demand and short supply.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£10 per ton, according to grade. Market quiet owing to slack demand for non-ferrous metals.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d.—6s. 4d. per gall. 60% O.P. Steady market.
Solvent	6s. per gall. 40% O.P. Good demand.
Wood Tar	£5—£6 10s. per ton, according to grade. Slightly weaker.
Brown Sugar of Lead	£41—£42 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 1½d.—1s. 2d. per lb. Fair inquiry. Good business for prompt delivery.
Crude 60's	3s. 6d.—3s. 7d. per gall. Good demand for spot delivery. Supplies limited.
Acid Cresylic—97/99	2s.—2s. 5d. per gall. Steady demand.

Acid Cresylic	
Pale 95%	1s. 7d.—2s. 4d. per gall.
Dark	1s. 7d.—2s. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.
Anthracene Oil—	
Strained	8½d.—10d. per gall.
Unstrained	8½d. per gall.
Benzole—	Fair enquiry.
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 6d.—1s. 7d. per gall. Little business passing.
Pure	1s. 9d—1s. 11d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8¼d.—9¼d. per gall. according to grade and district. Demand still good.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 1½d.—1s. 3d. per gall. Prospects brighter. Market steady.
Solvent 90/190	1s. 3d.—1s. 4½d. per gall. Market flat.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. More inquiry. Difficult to meet demand.
Whizzed or hot pressed	£9 10s.—£11 per ton.
Naphthalene—	
Crystals	£19 10s. per ton.
Flaked	£19 10s. per ton.
Pitch, medium soft	130s.—140s. per ton, according to district and time of delivery. Several inquiries. Market firm and price tending to advance.
Pyridine—90/140	21s.—22s. 6d. per gall. Market very strong.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

Dyestuffs business has been steady during the week.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 9d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Quieter.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 9d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Better demand.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S, Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£85 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	2s. 9d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
p-Toluidine	4s. 10d. per lb. d/d.
m-Toluylene Diamine	5s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

Market more active and makers well employed. Prices gradually rising with steady tone in view of lack of foreign competition.

Acid, Acetic 80% B.P.	£47 10s. per ton.
Acid, Acetyl Salicylic	3s. 3d.—3s. 6d. per lb. Good demand. Firm market. Shortage not improbable.
Acid, Benzoic	2s. 6d. per lb. Higher prices would be paid for good B.P. quality, which is unobtainable.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Citric	1s. 5d. per lb., less 5%. for ton lots. Poor demand.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	5s. 9d.—6s. per lb.
Acid, Salicylic	2s. 4d.—2s. 6d. per lb. for 5 cwt. lots. Firm market. Prices advancing.
Acid, Tannic	3s. per lb. for B.P. quality.
Acid, Tartaric	1s. 1¾d. per lb. less 5%. Demand poor. Second-hand parcels reported at less than 1s. Germany offering at 1s. 0½d. per lb. Raw material dearer.
Amidol	9s. per lb. d/d.
Acetanilide	1s. 7d.—1s. 10d. per lb. for English manufacture. Large orders in hand.

Amidopyrin	13s. 6d. per lb. for spot stocks with little coming forward.
Ammon. Benzoate ..	3s.—3s 6d. per lb., according to quantity.
Ammon. Carbonato B.P.	£32 15s per ton.
Atropine Sulphate ..	12s. 6d. per oz. for English make. In better demand.
Barbitone	17s. per lb. Neglected.
Benzonaphthol	4s. 9d. per lb.
Bismuth Salts	A steady market. Carbonate 13s., Nitrate 6s. 11d., Salicylate 10s. 5d., Subgallate 9s. 6d., Citrate 11s. 7d., Oxide 14s. 5d., Subchloride 12s. 8d., Subnitrate 11s.
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	
Potassium	6½d. per lb. Show slight improvement. Ample stocks exist.
Ammonium	7d. ,, ,,
Sodium	7½d. ,, ,,
Calcium Lactate ..	2s. 6d. per lb.
Chloral Hydrate ..	4s. per lb. In active demand. English makers are oversold.
Chloroform	2s. per lb. for cwt. lots. Very steady.
Creosote Carbonate ..	9s. per lb. Little demand.
Guaiacol Carbonate ..	10s.—11s. 6d. per lb. for spot. Supplies short.
Hexamine	4s. per lb. Very steady.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate ..	Reduced by 2d. per lb. 2s. 3d. per lb. for cwt. lots. 2s. 4d. for 28 lb. lots.
Magnesium Carbonate—	
Light Commercial ..	£36 per ton net.
Magnesium Oxide—	
Light Commercial ..	£80 per ton, less 2½%.
Heavy Commercial ..	£27 per ton, less 2½%.
Heavy Pure	1s. 6d.—2s. per lb., according to quality and quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 72s. 6d. per lb.
Methyl Salicylato ..	2s. 6d.—2s. 10d. per lb. In strong demand.
Methyl Sulphonal ..	14s. 6d. per lb. No demand.
Morphine and Salts ..	Prices again advanced owing to dearness of opium. Alkaloid: Cryst. 14s. 8d., Precip. 14s. 5d., Acetate 11s. 6d., Hydrochlor. 11s. 6d., Sulphate 11s. 6d., Tartrate 14s. 5d. per oz.
Paraformaldehyde ..	3s. 9d. per lb. More active. Higher rates for forward delivery.
Paraldehyde	1s. 5d.—1s. 5½d. per lb. Some holders asking 1s. 6d.
Phenacetin	6s. 3d. per lb. Demand active.
Phenazone	7s. 9d. per lb. Firm. Price advancing.
Phenolphthalein ..	7s. per lb. Scarce. Very firm.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Fair business passing.
Potass. Ferricyanide ..	3s.—3s. 6d. per lb.
Potass. Iodide	15s. 8d.—16s. 2d. per lb. Good demand.
Potass. Permanganate ..	10d. per lb. for B.P. crystal.
Quinine Sulphate ..	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	5s. 6d. per lb. Higher prices expected.
Salol	4s.—4s. 6d. per lb. Very scarce.
Sod. Benzoate	2s. 6d. per lb. Spot supplies not plentiful.
Sod. Citrate, B.P.C. 1923	Reduced to 2s. per lb. for cwt. lots. Makers kept active.
Sod. Hyposulphite—	
Photographic ..	£15—£17 per ton, according to quantity, d/d. consignee'a station.
Sod. Potass. Tartrate (Rochelle Salt) ..	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 8d. per lb., and Crystal at 2s. 9d. per lb. Firm and active.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Thymol	13s. 6d. per lb. quoted for synthetic and 14s. 6d. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.	
Aubepine	14s. ,, ,,	
Amyl Acetate	3s. ,, ,,	
Amyl Butyrate	7s. 3d. ,, ,,	
Amyl Salicylate ..	3s. 6d. ,, ,,	
Anethol (M.P. 21/22° C.)	3s. 6d. ,, ,,	Higher prices anticipated
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. ,, ,,	
Benzyl Alcohol free from Chlorine	3s. ,, ,,	
Benzaldehyde free from Chlorine	3s. ,, ,,	
Benzyl Benzoate ..	3s. 9d. ,, ,,	
Cinnamic Aldehyde Natural	20s. ,, ,,	
Coumarin	20s. ,, ,,	
Citronellol	20s. ,, ,,	
Citral	9s. 6d. ,, ,,	
Ethyl Cinnamate ..	10s. ,, ,,	
Ethyl Phthalate ..	3s. 9d. ,, ,,	
Eugenol	10s. ,, ,,	
Geraniol (Palmarosa) ..	37s. 6d. ,, ,,	
Geraniol	6s. 9d. to 13s. 6d. per lb.	
Heliotropine	8s. per lb.	
Iso Eugenol	15s. 9d. per lb.	
Linalol ex Bois de Rose ..	18s. 6d. ,, ,,	
Linalyl Acetate	18s. 6d. per lb. Considerably cheaper.	
Methyl Anthranilate ..	8s. 6d. per lb.	
Methyl Benzoate ..	6s. ,, ,,	
Musk Ketone	47s. 6d. ,, ,,	
Musk Xylol	13s. 6d ,, ,,	
Nerolin	4s. ,, ,,	
Phenyl Ethyl Acetate ..	10s. ,, ,,	
Phenyl Ethyl Alcohol ..	16s. ,, ,,	
Rhodinol	47s. 6d. ,, ,,	

Safrol	2s. „ „
Terpineol	3s. „ „
Vanillin	22s. 6d.—23s. per lb. Firm and steady demand. Raw material dearer.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. „ „
Bergamot Oil	13s. „ „ spot.
Bourbon Geranium Oil	37s. „ „
Camphor Oil	80s. „ „
Cananga Oil, Java	9s. 6d „ „
Cinnamon Oil, Leaf	4¾d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 6d. „ „
Ceylon	4s. 2d. per lb. Very little on offer, too many parcels arriving containing spirit. These have been seized by the Customs.
Clove Oil	8s. 6d. per lb.
Eucalyptus Oil 70/75%	2s. 9d. per lb.
Lavender Oil—	
French 38/40% Esters	26s. per lb.
Lemon Oil	2s. 10d. per lb.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	12s. 6d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	26s. per oz.
Palma Rosa Oil	24s. 6d. per lb.
Peppermint Oil—	
English	70s. per lb. Market very unsteady.
Wayne County	15s. per lb. Market very unsteady.
Japanese	12s. per lb. Market very unsteady.
Petitgrain Oil	8s. 9d. per lb. Dearer.

TRADE NOTES

Trade Information

Fine Chemicals.—The latest catalogue issued by The British Drug Houses, Ltd., reveals a further expansion of the range of fine chemicals supplied by this firm for research, analytical and bacteriological work. Amongst the new products listed are nearly 100 new compounds, and the already wide choice of indicators for determining hydrogen-ion concentration—a B.D.H. speciality—is increased by the addition of 5 new ones, viz., benzeneazobenzylaniline, brilliant cresyl blue, bromocresol purple, α-naphtholbenzoin and phenoltetrachlorphthalein. Attention should be drawn to the B.D.H. universal buffer solution (prepared according to the formula devised by Dr. E. B. R. Prideaux) and to the B.D.H. comparator case, which provides in compact form everything necessary for the rapid determination of hydrogen-ion concentrations. Recently we have received testimony to the value of the service which The British Drug Houses is doing in supplying such a wide range of research and other fine chemicals, and we learn that proofs of equal appreciation are coming from abroad.

The Plauson Colloid Mill.—We have received a catalogue issued by Plauson's Mill and Filter Press, Ltd., of 17, Waterloo Place, London, S.W. 1, describing the Plauson system of mixing, disintegration and emulsification. The mechanical element in this system is the Plauson colloid mill, in which the usual friction and pressure between relatively slowly moving elements is replaced by exceptionally high velocity communicated to semi-liquid contents by beaters having a peripheral speed of 3000 metres per minute and passing between stationary anvils. The chemical agents, or "dispersators," used to assist in disintegration and to prevent re-agglomeration, vary with the substance under treatment. These "dispersators" are usually innocuous and cheap materials such as gum, glue, gelatin and soap. The catalogue contains a full description of the colloid mill and of its industrial and scientific applications, and concludes with photomicrographs of various materials showing the results of treatment by the Plauson method.

PUBLICATIONS RECEIVED

THE GENESIS OF PETROLEUM. *By* P. E. SPIELMANN, PH.D., B.SC. *Pp.* 72. *London: E. Benn, Ltd.*, 1923. *Price* 5*s*.

THE PREPARATION OF PERFUMES AND COSMETICS. *By* J. -P. DURVELLE. *Pp.* 420+*viii*. *London: Scott, Greenwood and Son*, 1923. *Price* 21*s*.

ORGANIC CHEMISTRY FOR ADVANCED STUDENTS. *By* J. B. COHEN, PH.D., B.SC., F.R.S. *Part I. Reactions. Pp* viii+423. *Part II. Structure. Pp.* vii+461. *London: E. Arnold and Co.*, 1923. *Price* 18*s. each.*

TREATISE ON GENERAL AND INDUSTRIAL ORGANIC CHEMISTRY. *By* DR. E. MOLINARI. *Second edition, translated by* T. H. POPE, B.SC. *Part II. Pp.* viii+457—897. *London: J. and A. Churchill*, 1923. *Price* 30*s*.

BRIQUETTING. *By* A. L. STILLMAN, E.M., M.SC. *Pp. x*+466. *Easton, Pa.: The Chemical Publishing Co.*, 1923. *Price* $6·0.

PUBLICATIONS OF THE IMPERIAL MINERAL RESOURCES BUREAU. *The Mineral Industry of the British Empire and Foreign Countries. London: H.M. Stationery Office*, 1923.

GOLD (1919-21). *Pp. iv*+42. *Price* 1*s*. 6*d*.

SILVER (1919-21). *Pp. iv*+37. *Price* 1*s*. 6*d*.

GYPSUM (1913-19). *Pp. iv*+31. *Price* 9*d*.

PUBLICATIONS OF THE DEPARTMENT OF THE INTERIOR, BUREAU OF MINES. *Washington: Government Printing Office*, 1923:

THE ELECTROTHERMIC METALLURGY OF ZINC. *By* B. H. O'HARRA. *Bulletin No.* 208. *Pp. vi*+106. *Price* 15 *cents*.

LEACHING NONSULPHIDE COPPER ORES WITH SULPHUR DIOXIDE. *By* C. E. VAN BARNEVELD *and* E. S. LEAVER. *Technical Paper* 312. *Pp. v*+91. *Price* 20 *cents*.

TIMBERING OF METAL MINES. *By* E. A. HOLBROOK, R. V. AGETON, *and* H. E. TUFFT. *Bulletin No.* 215. *Pp. vi*+72. *Price* 25 *cents*.

WATER-GAS TAR EMULSIONS. *By* W. W. ODELL. *Technical Paper* 304. *Pp. iv*+51. *Price* 10 *cents*.

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EDITORIAL

"THEY order, said I, this matter better in France." It is a good many years since this was written, and there are yet some matters which they order better in the country of our ally. The first thought which occurred to us on our visit to the Annual Meeting of the Société de Chimie Industrielle was the extraordinary excellence of the social gatherings provided for the entertainment of those who were present. All such chemical gatherings are distinguished by hospitality; we are fond of our colleagues and are glad to meet them, and there is consequently a sincerity about the welcome which lifts such occasions above the usual level. But the recent receptions and banquets in Paris had a distinction to which we cannot attain in England and which we ought to hold before us as an example, a goal to which we should strive. The decorations, the music and the dancing were as refined, as dainty and as artistic as anyone could wish. Nothing short of the best is good enough for the French chemists and the ladies who were present. It was worth going from London to Paris to see how artistic our neighbours are. They took pains to have a high standard in everything, light agreeable music by the best composers, performed by the best artists. The speeches, too, were excellent, and the reason is obvious: the French are proud of their language and take pains to write it and to speak it, not only correctly but even elegantly. Here many of us are too apt to express our thoughts simply and bluntly, caring but little except to make ourselves understood and to end the task. Our language is a noble one, melodious and sonorous; our literature one of the finest and richest the world has ever known. Why should not we, especially our academic leaders, take an equal pride in the expression of our thoughts instead of leaving this almost to chance? Fortunately there are a few both here and on the other side of the Atlantic who take pains over their writing, but how many in both continents are content with a diction and a style which are more appropriate to the warehouse than to the library.

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We think a comparison of the artistic taste of the French and the English will convince us that in another respect we fall short of the high standard to which our neighbours have attained. Many of the French chemical advertisements are things of beauty and joy—if not for ever—at least for a few minutes after the hasty perusal we give to such pictorial demonstrations. Ours rarely attain to any grace or artistic feeling; the feat is not beyond our powers, and we call to mind a picture of a steamer adjoining a dock building which sometimes appears in our pages; when it does it affords us a considerable though transitory pleasure. This is not decisive, the true test is to hand over to some young children a few numbers of our *Journal* and a few of *Chimie et Industrie* with permission to cut out from the advertisements some pictures for a scrapbook. They will not be biassed by any knowledge that the soda which bears the Crescent Brand is probably good enough for many practical purposes, or that the Analytical Reagents "A.R." are guaranteed to be of exceptional purity. We may therefore safely take them as impartial judges of the pictorial qualities of the advertisements, their power of catching the eye and retaining the attention. We have before us a charming booklet giving a number of pictures and some notes about the firm of Messrs. Berk; of course, it is an advertisement, but it will stand the test. No doubt most of us receive an immense number of advertisements of things which we do not want or cannot afford; among the latter are loans negotiated with the utmost secrecy and despatch, motorcars and trips to the Riviera. Some of these advertisements are so well got up that it seems a pity to consign them at once to the waste-paper basket, and they lie about the house until they attain that contempt which is the result of familiarity. Probably they have in this way answered their purpose. But what a sudden and ignominious fate is in store for the advertisements which are dull, dreary or ugly. With the assistance of some very junior members of the chemical profession we are preparing a record of the chemical manufacturers and the goods and wares they advertise, but the right of admission to this record is jealously restricted; it is a case of the survival of the fittest.

* * *

Although the announcement of the award of the Nobel Prizes for medicine for 1922 and 1923, which we record in another column, may seem remotely connected with chemistry, yet it is of distinct interest, as the awards have been made, not only to four physiologists, but to three British subjects. It is true that Professor Hill has been more interested in the physical rather than the chemical side of physiology, but the point can be neglected. There can be no one but will concur with the justice of the award to Dr. Banting, the discoverer of insulin, though, as he does, all will regret the omission of the name of his co-worker, Dr. Best. It is legitimate to feel a sense of pride when we recall the number of British names included in the list of recipients of Nobel Prizes, though it may be doubted if, in proportion to population, any other country has so distinguished a record as Holland in this respect. The Nobel Prizes for physical science and chemistry are awarded by the Swedish Academy of Sciences, and those for physiology and medicine by the Caroline Institution of Stockholm, all the awards being made without distinction of nationality. Amongst the names of British subjects who have received Nobel Prizes for their distinguished work in physical and chemical science are those of Rayleigh, Ramsay (both in 1904), Thomson (1906), Rutherford (1908), and the Braggs (1915), but until the present year, Sir Ronald Ross, who discovered the method of transmission of malaria, was the only Englishman who had received a Nobel Prize for physiology. The times have changed since Burton wrote that "They can make fire it shall not burn, fetch back thieves, salve gouts, epilepsies, biting of mad dogs, make men young again, as the Spanish Marquess is said to have done and some which jugglers in China maintain still that they can do by their extraordinary skill in Physick and some of our modern Chemists by their strange limbecks, by their spells, Philosopher's stones, and charms," but the achievements of the Nobel prizemen, and, indeed, of modern science in general, will long make a wonderful tale. It is recorded that Nobel was a chemist and engineer. Was he a chemical engineer?

CO-ORDINATION AND ACIDITY

By Prof. T. M. LOWRY, F.R.S.

In my previous article (*Chem. & Ind.*, Oct. 19, p. 1004), I found myself in agreement with Dr. Main Smith in admitting that Werner's theory of co-ordination had been very slow in receiving the recognition it deserves, although I differed fundamentally in my diagnosis of the reasons both for the tardiness of this recognition and for the widespread popularity which this theory is now gaining. These opposing influences can be seen in the subject of the present article, in which an attempt is made to find a modern interpretation of an aspect of Werner's theory, which has been universally neglected, since (so far as my experience goes) it has not been adopted by any subsequent author, either in a text-book, or even in original papers dealing with the very same topic, namely, the origin of acidity and basicity.

1. *The Uniqueness of Hydrogen.* In an earlier article (*Chem. & Ind.*, p. 43) the view was advanced that the separation of a proton is the unique cause of acidity. On the other hand, basicity, as representing merely the power to capture a proton, was regarded as a more general property, which can in fact be found (i) in molecules, such as ammonia, which are capable of passing into kations by combination with a proton, (ii) in negatively charged anions, such as the $\overset{-}{O}H$ of the alkalis, which are reconverted into neutral molecules by a similar process.

The uniqueness of hydrogen has been emphasised still further by recent work on atomic structure. Thus, in the Faraday Society's discussion on "The Electronic Theory of Valency," Mr. R. H. Fowler stated that there was no difficulty in picturing *two* mechanisms to represent the electrovalence and covalence of chlorine, *e.g.*, in $\overset{+}{N}a\overset{-}{C}l$ and Cl—Cl; but in the case of the hydrogen ion, where the positively charged nucleus consists of a proton with no surrounding shell of electrons, it appeared to be impossible to devise a system in which the proton, when attracted by an ion of opposite sign, could be kept from falling inside the orbits of the outer electrons of that ion. In other words, in the case of hydrogen, a single type of valency appears to take the place of the two types which are met with in other elements. This recalls the old controversy as to whether univalent hydrogen should be regarded as a lower homologue of the univalent alkali metals, or of the univalent halogens. Hydrogen appears to be unique in that it shows analogies with *both* families of elements, with the ion-forming alkali-metals as well as with the bond-forming halogens. One may, therefore, use a certain amount of latitude in representing the link, *e.g.*, between hydrogen and chlorine, either by a bond, or by the $+-$ sign of an electrovalency, since in the unique case of hydrogen the two symbols may perhaps represent the same thing.

Fowler's conclusion, that a proton always tends to fall within the outer orbits of another atom until repelled by the nucleus, is also in intimate agreement with the familiar fact, to which attention was likewise directed in the earlier article, that "strong acidity is apparently developed only in mixtures and never in pure compounds." Thus hydrogen chloride only becomes an acid after being mixed with water. This was explained, in strict accord with Fowler's conclusions, by "the extreme reluctance of a hydrogen nucleus to lead an isolated existence, although it is quite willing to attach itself to any octet that is not too unfriendly, or too fully occupied by other atoms to leave room for an additional nucleus." The view that the ionisation of an acid is not a direct dissociation, *e.g.*,

$$HCl \rightleftarrows \overset{+}{H}+\overset{-}{Cl}$$

but a process of double decomposition, in which a pair of molecules gives rise to a pair of ions, *e.g.*,

$$HCl+H_2O \rightleftarrows \overset{+}{O}H_3+\overset{-}{Cl}$$

appears therefore to have a theoretical basis in the new conceptions of molecular structure which are gradually being developed from Bohr's theory of atomic structure.

2. *Co-ordination as a Factor in Promoting Acidity.* The influence of water in promoting the development of acidity is, however, by no means limited to the passive role of an "acceptor of hydrogen ions," since the theory of co-ordination enables us to assign to it an active part in the expulsion of a proton, which is after all the fundamental fact in acidification. In the somewhat analogous case of the ionisation of the chlorides, Werner pointed out that the addition of molecules of ammonia causes a progressive expulsion of chlorine ions from the co-ordination-complex. Thus, whilst the triammine

$$[CoCl_3{\cdot}3NH_3]$$

is a non-electrolyte, of which none of the chlorine can be precipitated by silver nitrate, the tetrammine, pentammine and hexammine, contain respectively one, two and three ionisable atoms of chlorine, as represented in the formulæ

$$[CoCl_2{\cdot}4NH_3]Cl \quad [CoCl{\cdot}5NH_3]Cl_2 \quad \text{and} \quad [Co{\cdot}6NH_3]Cl_3.$$

In the case of an acid, one might picture the hydrogen ions as being expelled by the addition of molecules of water to a co-ordination complex, just as the chlorine ions of cobaltic chloride are expelled by ammonia. This is, indeed, Werner's "Theory of Acids," which he sets up in contrast to the current definition of acids as "compounds of hydrogen which, on solution in water, dissociate, giving hydrogen ions."

The four definitions, which Werner uses to "describe the conception of an acid," owe their complexity to the fact that he finds it necessary to picture every acid as derived from an "anhydro-acid," *e.g.*, HCl or SO_3, which is only converted into a true acid on the addition of water. This has the great disadvantage of limiting the field of vision to water and aqueous solutions; whereas, when acidity is defined as "ability to give up a proton," one can picture precisely the same phenomenon as occurring in other solvents.

3. *Hydration of Multipolar Ions.* Werner's theory of acidity can be expressed in a more precise form, if an attempt is made, with the help of the electronic theory, to localise the electric charges on the various atoms. Thus. Werner represents the conversion of platinic hydroxide into an acid by the addition of two molecules of water by the equation :—

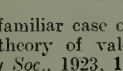
$$(HO)_4Pt+2H_2O=(HO)_4Pt(\overset{-}{O}H)_2+2\overset{+}{H}$$

In this equation four of the hydroxyl-groups are shown as neutral and two as carrying negative charges. Thus unequal treatment of the six hydroxyl-groups can scarcely be maintained, in view of the considerations of symmetry on which the theory of co-ordination is mainly based. It is, moreover, not satisfactory to represent the two negative charges as occupying an indeterminate position in the bivalent ion, as in the symbol $[Pt{\cdot}6OH]^{--}$. Sidgwick's theory of co-ordination (this vol., p. 412) allows us, however, to locate both negative charges on the platinum, as in the formula,

$$\overset{--}{Pt}(OH)_6,$$

the six hydroxyls being held to the platinum by covalent bonds, just like the hydroxyl in alcohol.

In the more familiar case of sulphuric acid, the electronic theory of valency enables us (*Trans. Faraday Soc.*, 1923, **18**, 289) to locate the electric charges on the sulphate ion as follows :—



This method of formulation makes it particularly easy to visualise the competition between molecules of water and free protons for a place in the nucleus, which forms the more picturesque version of Werner's theory of activity.* Thus, if we assume (following *Hantzsch.*, *Ber.*, 1917, **50**, 1422) that the proton tends to associate itself with *two* of the negative poles, the undissociated molecule of sulphuric acid may be formulated as in I. But these poles could also be bridged by molecules of water as in II, where the dotted lines indicate contiguous electrostatic charges which may perhaps be replaced by covalent bonds.

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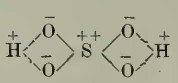
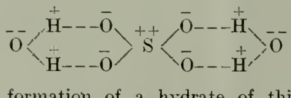
* Werner himself lays most stress on the ability of an anhydroacid to annex hydroxyl-groups from molecules of water, thereby releasing free hydrogen ions. The alternative view of a competition between water and protons is expressed in the statement of Morgan and Smith (*T.*, 1922, **121**, 1958) that in certain series of co-ordination-compounds "replacement of water of hydration by positive hydrogen takes place with acids of varying basicity and widely different strengths."

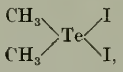
I



II



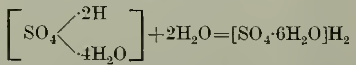
The formation of a hydrate of this type would be favoured by the greater stability of six-atom, as compared with four-atom, rings. It is, however, not easy to determine with certainty how many of these bridge-positions there are to be competed for. Thus, if the four oxygen atoms were arranged in one plane, like the three oxygens of CO_3 in calcite, or of NO_3 in the isomorphous crystals of sodium nitrate, giving rise to the same rectangular configuration as in



there would be only four of these positions. If, however, the four oxygens in the sulphate ion form a tetrahedron, like the four radicals in the sulphonium salts, or the four oxygens in silver molybdate,

$$Ag_2[MoO_4],$$

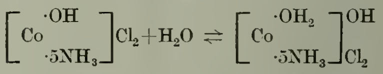
one might expect to find six bridge-positions, as in the tetrahedral basic beryllium acetate investigated by Morgan and Bragg (*Nature*, 1923, **112**,). If the latter hypothesis were correct, the final stage in the ionisation of sulphuric acid in aqueous solution might be represented by an equation of the type



$$\left[SO_4\begin{matrix}\cdot 2H\\ \cdot 4H_2O\end{matrix}\right]+2H_2O=[SO_4\cdot 6H_2O]H_2$$

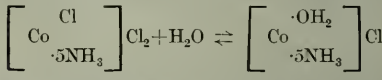
At the present stage, however, it is not necessary to discuss the exact formulæ of these hydrated anions, since the object of this article is simply to direct attention to the analogy between the progressive ionisation of cobaltic chloride as chlorine is expelled by ammonia, and the ionisation of an acid as a result of the expulsion of protons by molecules of water. It is, however, of interest to note that an explanation is thereby afforded of the hygroscopic character of so many of the strongest acids, and also that the hydration of the anion appears to be quite as important as that of the kation.

4. *Werner's Theory of Bases.* Werner's theory of bases had a more direct experimental foundation than his theory of acids, since much of the evidence in favour of the latter view has been obtained only since his death, as in the work of Morgan and Smith already cited. In the case of the bases he was able to quote, as evidence in favour of his views, the actual behaviour of a complex base which presents many points of similarity to the co-ordinated chlorides cited at the beginning of this article, i.e., hydroxo-pentammino-cobaltic chloride. This similarity was shown by writing the compound in two forms, thus :—



$$\left[Co\begin{matrix}\cdot OH\\ \cdot 5NH_3\end{matrix}\right]Cl_2+H_2O \rightleftarrows \left[Co\begin{matrix}\cdot OH_2\\ \cdot 5NH_3\end{matrix}\right]\begin{matrix}OH\\ Cl_2\end{matrix}$$

It will be seen that in the above scheme Werner postulates that the hydroxyl is expelled from the co-ordination sphere by a molecule of water, just as a third chlorine ion can be expelled from pentamminocobaltic trichloride by an additional molecule of ammonia or of water :—



$$\left[Co\begin{matrix}Cl\\ \cdot 5NH_3\end{matrix}\right]Cl_2+H_2O \rightleftarrows \left[Co\begin{matrix}\cdot OH_2\\ \cdot 5NH_3\end{matrix}\right]Cl_3$$

Whereas, however, the two chlorides could both be isolated, the two formulæ for the base were assumed to correspond with the non-ionised and the ionised constituents of an aqueous solution, from which only the former could be separated by crystallisation.

On the basis of his interpretation of the ionisation of these complex cobaltic salts, Werner defines bases in general as "*addition compounds with water which form hydroxyl ions in aqueous solutions.*" The substances from which addition-compounds of this kind are formed by the addition of water were described as *anhydrobases.*

5. *Lewis' Theory of Acids and Bases.* Prof. G. N. Lewis will, I hope, forgive me if at this stage I venture to direct attention to a further extension of Werner's theory of acidity which is contained in a forthcoming volume, of which he has very kindly allowed me to see the proofs. In order to get away from the limitation to aqueous electrolytes, which is characteristic of Werner's definitions, Lewis suggests that :—

> "An acid is a substance which gives off the cation or combines with the anion of the solvent ; a base is a substance which gives off the anion or combines with the cation of the solvent."

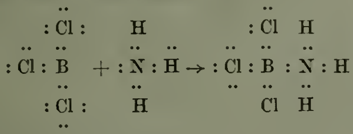
Potassamide, KNH_2, is therefore a base in liquid ammonia, whilst KCl would become a base if liquid hydrogen chloride were used as the solvent.

The idea that acidity and basicity are not inherent properties, but depend on the selection of a solvent, can, however, be got rid of by taking hold of the fact that in ordinary neutralisation, a proton makes use of a "lone pair" of electrons (*e.g.*, an unoccupied pair of electrons of the nitrogen-octet of NH_3 or of the oxygen-octet of $\bar{O}H$) to complete its own stable group, which in this case is not octet but a duplet. A generalised definition is, therefore, arrived at that :—

> "A basic substance is one which has a lone pair of electrons which may be used to complete the stable group of another atom ; and that an acid substance is one which can employ a lone pair from another molecule in completing the stable group of one of its own atoms."

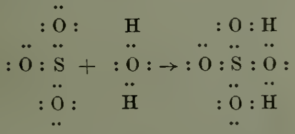
Interesting examples of this are the union of boron trichloride with ammonia, of sulphur trioxide with water, and of silicon dioxide with water. The two former substances each contain a sextet, instead of an octet of electrons, on the central atom of the group, and the process of "neutralisation" may be represented by electronic formulæ as follows :—

$BCl_3+NH_3 \rightarrow BCl_3{\cdot}NH_3$ or



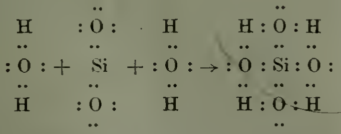
$$\begin{array}{ccccccccc}
 & \cdot\cdot & & & & & \cdot\cdot & & \\
 & :Cl: & & H & & & :Cl & H & \\
\cdot\cdot & \cdot\cdot & & \cdot\cdot\ \cdot\cdot & & \cdot\cdot & \cdot\cdot & \cdot\cdot & \\
:Cl: & B & + & :N:H & \rightarrow & :Cl: & B & :N:H & \\
 & \cdot\cdot & & \cdot\cdot & & \cdot\cdot & \cdot\cdot & \cdot\cdot & \\
 & :Cl: & & H & & & Cl & H & \\
 & \cdot\cdot & & & & & & &
\end{array}$$

$SO_3+OH_2 \rightarrow SO_3{\cdot}OH_2$ or



$$\begin{array}{ccccccc}
 & \cdot\cdot & & & & & \\
 & :O: & & H & & :O:H & \\
\cdot\cdot & \cdot\cdot & & \cdot\cdot & & \cdot\cdot\ \cdot\cdot\ \cdot\cdot & \\
:O: & S & + & :O: & \rightarrow & :O:S:O: & \\
 & \cdot\cdot & & \cdot\cdot & & \cdot\cdot\ \cdot\cdot & \\
 & :O: & & H & & :O:H & \\
 & \cdot\cdot & & & & \cdot\cdot &
\end{array}$$

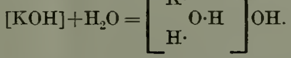
$SiO_2+2OH_2 \rightarrow SiO_4H_4$ or



$$\begin{array}{cccccccc}
 & & \cdot\cdot & & & & \cdot\cdot & \\
H & & :O: & & H & & H:O:H & \\
\cdot\cdot & & \cdot\cdot & & \cdot\cdot & & \cdot\cdot\ \cdot\cdot\ \cdot\cdot & \\
:O: & + & Si & + & :O: & \rightarrow & :O:Si:O: & \\
\cdot\cdot & & \cdot\cdot & & \cdot\cdot & & \cdot\cdot\ \cdot\cdot\ \cdot\cdot & \\
H & & :O: & & H & & H:O:H & \\
 & & \cdot\cdot & & & & \cdot\cdot &
\end{array}$$

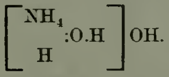
The former of the above definitions is difficult to apply to solutions in a medium such as liquid SO_2, since it is not easy to picture this as a fusible oxide of metallic sulphur. The solvents actually cited by Lewis are indeed all hydrides, in reference to which the current definition of acids and bases as substances which release or absorb protons still holds good. As regards the second definition, it will be observed that, whereas Werner transfers the meaning of the term acid and base to compounds which are commonly regarded as *hydrates*, Lewis' definition has the effect of transferring the term to unsaturated compounds which have been classed hitherto as *anhydrides*. My own inclination on this particular point is to maintain the current view that an acid must be a hydride since otherwise it cannot disgorge a proton ; but that it need not be a hydrate. As regards bases, I should side with Lewis, since he accepts as bases "all substances which have lone pairs of electrons capable of employment in *onium* formation," and so includes ammonia as a base, where Werner (see below) will only accept it as such after adding on two molecules of water.

6. *Co-ordination and Ionisation.* Werner's theory of acids leads to the conclusion that an acid always contains the group ($XH{\cdot}\bar{O}H$), since the anhydro-acid XH only becomes a true acid by annexing the hydroxyl (and thus setting free the remaining hydrogen) of a molecule of water. Similarly he suggests that even a hydroxide-base such as KOH must be regarded as an anhydride, which only becomes a true base by annexing a hydrogen ion from a molecule of water, and so setting free a second hydroxyl group, *e.g.* :—



$$[KOH]+H_2O=\left[\begin{array}{ll} K{\cdot} & \\ & O{\cdot}H \\ H{\cdot} & \end{array}\right]OH.$$

In the same way, he is not content to turn ammonia into ammonium hydroxide, but thinks it necessary to add on a second molecule of water in order to convert ammonium hydroxide into a real base of the formula :—



$$\left[\begin{array}{ll} NH_4 & \\ & :O.H \\ H & \end{array}\right]OH.$$

At this point Werner appears to "part company" from the majority of his chemical colleagues, who have not been attracted by this additional, and apparently unnecessary, complication ; but it is interesting to follow up the idea which he thus foreshadows—namely, that, from an entirely independent point of view, he arrives at a theory of hydrated ions in aqueous solutions.

Even if the modern view be adopted that the crystals of a salt are an orderly aggregate of ions, *e.g.*,

$$\begin{array}{cccccc} \overset{+}{Na} & \overset{-}{Cl} & \overset{+}{Na} & \overset{-}{Cl} & \overset{+}{Na} & \overset{-}{Cl} \\ \overset{-}{Cl} & \overset{+}{Na} & \overset{-}{Cl} & \overset{+}{Na} & \overset{-}{Cl} & \overset{+}{Na}\ \text{etc.} \end{array}$$

it still remains to discover why these ions are so easily separated from one another when the salt is dissolved by water, I have long advocated the view that in aqueous solutions this separation must be effected by the intrusion of molecules of water, and in conjunction with Mr. W. R. Bousfield I have published papers (*Trans. Faraday Soc.*, 1905, **1**, 197 ; 1907, **3**, 132) in which this idea of a "watery atmosphere" round the ion was developed. On general grounds it might be urged that gaseous ions do actually tend to condense moisture around them, as in the fascinating experiments of C. T. R. Wilson ; but even this would hardly account for the displacement of an oppositely charged ion by neutral molecules of water. Werner's theory brings into play, however, a definite chemical force, namely, that which under favourable conditions leads to the formation of co-ordinated ammines and co-ordinated hydrates. Thus it is at least clear that he would have us believe that a cobaltic ion in aqueous solution would immediately acquire an envelope of six water molecules. Since, however, ionisation is equally developed in salts of the alkali metals, one must suppose that the phenomenon is not confined to the narrow group of transition-metals, but that the co-ordination of water molecules to form a watery atmosphere must be a common property of positive and negative ions in solution. This suggestion implies, however, a definite break from the type of formula put forward by Werner, since he treats the *oxygen* as the central atom of the complex kation of potassium hydroxide, and of the hydrated ion formed by neutralising this with acids, and, moreover, writes a formula which assigns to oxygen the unusual co-ordination-number of three. He also appears to limit the hydration of the potassium ion to a single molecule of water, which could scarcely suffice to create a "watery atmosphere" around it. It will however, be of interest to see whether any experimental support can be found for the view, which is suggested by a perusal of Werner's book, that hydrated ions in aqueous solutions may tend to carry definite numbers of molecules of water, *e.g.*, 4, 6 or 8, etc., to correspond with the numbers that can be grouped symmetrically round the naked ion. If so, a definite link will be established between the physico-chemical study of hydrates in solution, and the more purely chemical study of molecular compounds, which is the principal feature of Werner's work.

7. *Summary.* (*a*) The uniqueness of hydrogen is emphasised by the difficulty of devising for a naked proton a stable electronic system corresponding with that used to represent the electrovalency of other ions. (*b*) Hydrogen ions may be expelled from an acid by the addition of molecules of water to a complex anion, just as chlorine ions are expelled by ammonia in typical penetration-compounds. (*c*) This relation between hydration and ionisation is in accord with the hygroscopic character of strong acids.

The General Chemical Company of New York has given $5000 to the Cavendish Laboratory, Cambridge, to promote research work, and the British Thomson-Houston Company has also given £250 for a similar purpose. Appreciative letters were sent with the gifts, recognising the valuable work which is being carried on under Prof. Sir E. Rutherford in the Cavendish Laboratory.

SOME ASPECTS OF THE FUEL PROBLEM*

By C. H. LANDER, D.Sc., M.I.Mech.E., A.M.Inst.C.E.
Director of Fuel Research

In these days, when knowledge is so highly developed, we are apt to concentrate on a single problem, and to lose our general balance in devotion to that problem. It is always helpful if one can look round and take a broad general survey of the whole fuel problem as it affects Great Britain at the present time. The sciences most intimately concerned in the broad fuel problems are engineering, chemistry and physics. No man exclusively a physicist, a chemist or an engineer can deal properly with these problems. Thus, for successful working, the chemist, important as he is, must have sympathy with, and insight into, the point of view of the engineer and the physicist.

Later on I shall consider a few of the problems which have been selected by the Fuel Research Board for immediate investigation. The Board always welcomes any suggestions for extension of these investigations, or constructive criticism upon the methods employed in attempting to solve them, and the results which have been obtained. I am glad to be able to lay before you some of the results of the recent work carried out by the Fuel Research Board, as it appears that there is some misapprehension as to the type of work being carried out and the results obtained.

Fuel is used for a large variety of purposes, but they all fall into two categories:—

(1) The development of mechanical power at some particular spot; or

(2) The introduction of heat into some substance, also at a particular spot. In no case can the whole of the energy contained in the raw fuel, as it occurs in its natural state, be utilised, and in most cases only a very small percentage can be utilised.

The problem of efficient utilisation depends not only on the efficiency of the conversion of the heat energy or of the transference of the heat to some object, but also on the cost of transporting the energy to the point of application, and in many cases on the ease of control. For example, the coal as it occurs in the seam underground is useless until it has been moved to some point where its energy can be usefully applied.

Before utilising the energy in the coal it may be desirable to convert it into some other form of fuel, such as gas, coke or oil, or into some other form of energy, such as electrical energy, the object being to increase the ease of transport or of application, or both. Incidentally, it may be possible in the process of conversion to recover by-products some of which are available as fuel, whilst others are valuable for other purposes, *e.g.*, as fertilisers. The same sort of considerations apply to other forms of raw fuel.

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* Contribution to the Discussion on the "Fuel Problem," held by the Birmingham and Midland Section on January 23 and February 6.

The value of any form of fuel or energy depends, therefore, on its "availability" in the broadest sense of the word, and this again depends upon the facility with which it can be transported to the point of application, and on the efficiency and convenience with which it can be utilised at that point.

The importance of the "portability" of the fuel naturally depends on the distance between the source (mine, carbonising plant, etc.) and the point of application, and the transport facilities available. The efficiency with which it can be utilised depends upon the purpose for which it is required and on the scale on which it is employed. As these factors may vary to almost any extent, there can be no "best" method for the utilisation of any given form of natural fuel or energy. The economic value of a process of conversion from one form to another depends not only on the thermal efficiency of the process, but also on the capital charges due to the plant, etc. required and the cost of the labour and supervision involved. It does not follow that the process which in any given case gives the highest thermal efficiency gives also the highest economic efficiency.

The value of the different forms of fuel either natural or derived, depends also on the convenience of use and ease of control during use. In providing illumination it does not follow that the most efficient conversion of the heat of the coal into light is the most economical method, as it may necessitate producing light when it is not wanted. The efficiency as usually measured deals only with the total light produced, and takes no account of whether all this light is actually required or not. Where intermittent power is required, heavy standing charges may be incurred with a method of conversion which is otherwise economical, and a less thermally efficient method may be advantageous, if it makes possible the storage of energy or the adoption of some method of distribution which enables the diversity factor of separate intermittent loads to be utilised.

In considering the utilisation of fuel, it must always be remembered that all the heat originally in the fuel appears again somewhere as heat, and the control of the points where this appears may be of considerable economic importance.

I will now consider some of the problems which the Fuel Research Board has selected for immediate investigation.

Coal Survey

The programme of the Fuel Research Board as laid down at its inception in 1917, followed two broad lines:—

(1) A survey and classification of the coal seams in the various mining districts by means of chemical and physical tests in the laboratory; and

(2) An investigation of the practical problems which must be solved if any large proportion of the raw fuel at present burned in its natural state is to be replaced by the various forms of fuel obtainable from coal by carbonisation and gasification processes.

It was at first believed that the survey might be carried out in advance of the second line of inquiry, but further consideration, and the trend of events, forced the Fuel Research Board to the conclusion that the two were absolutely interdependent, and must be dealt with side by side. In point of fact, owing to unstable conditions in the coal industry during and since the war, the work of the Survey has to a certain extent lagged behind the other branches of the programme of the Board. Although a survey of our national coal resources had been advocated for many years, the Board always believed that there was great danger that such a survey might result in an undigested mass of samples and chemical analyses which would be of little real assistance to those whose duty it is to utilise our strictly limited coal resources to their fullest extent. The Board, therefore, approached the subject from the point of view of both producer and user, and concluded that the more practical side of the work can be most effectively carried out with the help of local committees, in which colliery owners, managers and consumers are associated with the representatives of the Fuel Research Board and of the Geological Survey, together with outside scientific representation.

The first of these local committees is now actively at work in the Lancashire district, where the local association has been recognised for this purpose as the representative body in charge of the work in their district. The committee began work by the correlation of reliable information concerning one of the most important seams in the district. Where gaps have occurred in the information already available, experimental work has been carried out on a small scale.

The points brought out by this preliminary survey indicated the lines upon which work has been undertaken on a much larger scale, to determine the processes to which the coal can best be submitted in order to obtain certain results. Experimental work, involving the gasification of more than 500 tons of this coal in vertical retorts has recently been completed at H.M. Fuel Research Station. The commercial value of the work can be gauged from the fact that a group of firms commercially interested placed at the disposal of the Board, free of charge, some 300 tons of the seam, in order to assist the work. Having thus obtained some information as to the best method of carrying out such an inquiry, the local committee is now engaged in a similar inquiry into another well-known seam, which has hitherto presented great difficulties both as regards its working and marketing.

The Board is now about to form the second of these local committees in another coal mining area, where considerable interest has been shown in the work of the first committee.*

Methods of Sampling and Analysis

In preparation for the organisation of the first line of research work, it was decided that an experimental study was necessary of the methods of examination of coal samples usually adopted in laboratories. The scientific committee appointed to consider the question has been at work for some time, and is about to present an interim report, based on a large amount of experimental work, and recommending the methods they consider the best. These recommendations will be adopted by the Board for the survey work, and it is hoped that analysts and others interested in the sampling and analysis of coal will also adopt these methods as standard. This will make analyses carried out by various workers more comparable than they have been in the past.

The analysis of each coal which passes through H.M. Fuel Research Station is added to the permanent registry which is kept in the Survey Department of the Board. Maps and a filing system are provided, so that all samples sent to the Station, as well as all bulk samples passing through for experimental purposes, can be definitely located and registered.

The Fuel Research Board came to the conclusion at a very early stage that, apart from investigation into the generally accepted methods for coal analysis, it was necessary to work out some system for investigating the suitability of coal for low temperature carbonisation. A test was accordingly elaborated which, by direct weighing and measurement, gives the yields of the products which result from carbonisation at any definite temperature. (*Cf.* "The Assay of Coal for Carbonisation Purposes: A New Laboratory Method," Fuel Research Board, Technical Paper No. 1, 1921.) Experience on larger scale work shows that the results obtained with this small apparatus are comparable with those resulting from large scale working.

Gas Standards

In dealing with the work of the Fuel Research Board, reference was made to circumstances which rendered it desirable that the work coming under each of the two headings of the programme should be carried on side by side. This was partially brought about by the reference to the Fuel Research Board of the whole question of gas standards, by the Government Departments concerned in the administration of the various Gas Acts. The results of the investigation by the Fuel Research Board were given in the booklet recently issued by the Department of Scientific and Industrial Research and entitled the "Therm." It is hardly necessary to state the recommendations of the Board, and it will suffice to say that only by the system of selling gas by its thermal content was it possible both to protect the consumer and to afford to an industry using something like 20 million tons of coal per annum, a freedom which would render it possible to select in each case those methods which would produce the most economical results, both from the point of view of coal economy and cheapness of gas to the consumer, having due regard to the particular circumstances of each undertaking. That there is great scope for this development is evident from the fact that, according to practice which has been well established in the past, only some 21 to 24 per cent. of the total potential thermal units of the coal are sold in the form of gas. Whether it is actually desirable to increase this percentage in any particular case depends upon local conditions and upon the commercial value of the other products.

The interdependence of the two lines of inquiry outlined in the programme of the Board was also emphasised by a variety of other influences during the past 15 years. Amongst these have been the demand for cheaper and more ample supplies of electricity, home supplies of fuel oil for the Navy, motor spirit and oil for transport and air services, and for smokeless domestic fuel, the demand in the last case being due to the rapid growth of public opinion on the subject of smoke prevention.

Steaming in Vertical Retorts

The experimental work upon which were based the recommendations of the Fuel Research Board on Gas Standards naturally led to an inquiry into the proposal to convert more of the potential heat units contained in coal into a good and saleable gas. The direction in which general practice was proceeding was the utilisation of higher temperatures during carbonisation and the admixture of water gas made from a portion of the coke. The most recent step was to introduce steam at the lower end of vertical retorts and so convert some of the carbon into water gas within the retort itself. This method was, in fact, a resuscitation of work carried out by Sir George Beilby during his association with the Scottish shale industry in the early 'eighties, and which had recently come into prominence on account of the valuable test work which had been carried out by Mr. Blundell, Mr. West and others. Small percentages only of steam had, however, been used by the experimenters, since their aim had obviously been to keep the carbonic acid in the gas under 4 per cent. Accordingly, early in 1918, a setting of four retorts capable of carbonising 10 tons of coal daily was designed and erected by West's Gas Improvement Company at the Fuel Research Station. The results obtained were given in the first section of the Report of the Fuel Research Board for 1920–21. Further work on typical coals is being carried out at H.M. Fuel Research Station, these investigations having been undertaken at the direct request, and partially at the expense of, certain important gas companies. Work has also been in progress at the Station on the manufacture of water gas, the main results being that with a normal water-gas plant, it is possible to obtain a slightly greater thermal efficiency by working on the Dellwik system, where a thin fuel bed is used, with a blow to carbon dioxide, but that in a normal plant this gain in thermal efficiency is obtained at the expense of the output. If a plant were specially designed to obtain this higher thermal efficiency, it would require greater floor area for the same output. Hence it is not necessarily commercially economical.

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* The second local committee has since started work in the South Yorkshire area.

Low Temperature Carbonisation

The investigation of low-temperature carbonisation followed naturally upon the inquiry into the possible home sources of oil supply for the Navy, which were first exhaustively examined by Lord Fisher's Commission during 1912–13, while emergency inquiries were conducted during the war with the same object. None of these later inquiries added materially to the information collected and verified by the Fisher Commission, and the urgency of the question has been emphasised since the Armistice owing to the rapidity with which oil is replacing coal in the Navy and mercantile marine.

There are important considerations which cannot be ignored in dealing with the wider problem of the replacement of raw coal by other forms of fuel. The industries that manufacture gas and coke have for their primary object the supply of these products to definite bodies of consumers. Careful consideration will show that the present coal-distilling industries cannot be regarded as the source of greatly increased supplies of fuel oil. The only means by which fuel oil could be obtained in large quantities would be by the carbonisation of the bulk of raw coal used for domestic purposes. To do this it would be necessary that the domestic consumer should be supplied with an alternative form of fuel of suitable quality and price. The only means by which the maximum quantity of liquid hydrocarbons can be conserved in a carbonisation process is by the distillation of coal at a minimum temperature. One of the most important products is a coke containing from 8 to 10 per cent. of volatile matter. This material forms an excellent and absolutely smokeless fuel for domestic purposes, and can if required be burned under boilers or used as a fuel in suction gas producers. At a temperature of 600° C. the principal products of carbonisation amount to 70 per cent. coke, 6 per cent. oil and 9 per cent. gas. Put in another form—from each ton of coal we can obtain about 2½ galls. motor spirit (1½ from the gas and 1 from the tar oil), 13 galls. fuel oil, and between 3000 and 4000 cub. ft. of rich gas and 14-15 cwt. of semi-coke. In order to obtain trustworthy data for the method of treatment and the products obtainable from various classes of coal, the Fuel Research Board installed a bench of 9 horizontal steel retorts for experimental purposes. A large amount of experimental work has been carried out in these retorts, some of which has been published in the Second Section of the Report of the Fuel Research Board for 1920–21; and investigations have also been undertaken for some of the Colonies.

An important side of this inquiry has been the correlation of the results obtained from the retorts referred to and those yielded by the low-temperature assay. It has been found that, from the appearance of the coke in the low-temperature assay apparatus, it is possible to deduce the type of coke which may be expected on the large scale. The yields per ton of gas and coke are roughly the same. The yield per ton of oil as obtained from the low-temperature assay apparatus must be multiplied by a conversion factor of 0·6 in order to obtain the equivalent yield in the horizontal retorts. The shape of the rate of gasification curve is also similar in the two cases.

These retorts, having been installed purely for experimental purposes, could not be expected to produce low-temperature fuel and oil at a price which would render the process commercially sound. The chief cost lies in the labour, which is somewhat heavy. Having obtained trustworthy data, the possibility was examined of producing an apparatus which would do mechanically what was done by hand in the experimental horizontal retorts. During the last two years extensive experiments have been conducted in this direction, using a machine which consisted of a large oven, containing a cage made up of a number of shelves, one above the other. The trays of coal to be carbonised could be placed on these shelves by suitable charging apparatus. This method has, however, been abandoned for the time being, since other lines of inquiry have developed which appear to be more promising. The main difficulty was that the working parts exposed to the temperatures necessary for carbonisation tended to get out of register, and to make the upkeep cost rather heavy. The Fuel Research Board still believes, however, that for low-temperature work it is not necessary to provide expensive fireclay retorts.

Cast iron, or even mild steel if not too highly stressed, is likely to afford a material from which retorts for this purpose could be manufactured, and from which a long life might be expected. Other experimental work has been carried out at the station by carbonising at low temperature in the vertical retorts, from which interesting data have been obtained bearing upon the conduction of heat through masses of coal at lower temperatures than those generally adopted in gas practice.

Work on low-temperature carbonisation is being carried out by other outside groups, with which in many cases the Board is in close contact. The results are promising, but the Fuel Research Board would hesitate to say that commercial success has yet been obtained.

It may be of interest if I indicate briefly the lines upon which the Board are now working. These may be said to consist of the subjection of the crushed coal to a temperature which approaches the fusing point of the coal. At this stage the coal is briquetted and fed into simple iron vertical retorts whose design is based on Scottish shale practice.

Power Alcohol

The question of the use of alcohol as a fuel for internal combustion engines has been studied during the last few years, both in this country and in France.

Acting on the recommendation of the Interdepartmental Committee on Fuel for Motor Transport, which reported in June, 1919, an organisation in charge of Sir F. Nathan was established under the Fuel Research Board to investigate the production of alcohol within the Empire. The author is indebted to Sir Frederic Nathan for the following short account of the alcohol position within the Empire. At the present time the only methods of proved economic value for producing alcohol are fermentation processes which utilise sugar obtained directly from the plant, *e.g.*, molasses, or from starch, *e.g.*, grain of all kinds. Power alcohol is being made on a comparatively small scale in this country from molasses, and is used in conjunction with benzol and/or petrol as a fuel for internal combustion engines. Its production from vegetable materials in this country has been thoroughly investigated, and the conclusion has been arrived at that it would not be economically possible on any considerable scale, owing to insufficient acreage, the high cost of cultivation, harvesting and transport, the high cost of manufacture, and the fact that the most suitable raw materials are also important foodstuffs.

Atteution has also been paid to power alcohol production in the Dominions and Colonies, where most of the conditions are more favourable than those in the British Isles. Their liquid fuel requirements are relatively small, land is more generally available, labour is comparatively cheap and the climates are just what is required for growing very suitable vegetable raw materials. There are possibilities in this direction. There are, moreover, in the tropical and semi-tropical parts of the Empire vast quantities of vegetation of little or no commercial value, which might be commercially possible sources if alcohol could be produced from the cellulose of the plant by converting it into fermentable matter by cheap and simple chemical or bacteriological processes. The work on the direct production of alcohol from cellulose materials by the action of micro-organisms presents considerable difficulties, and progress has so far not been sufficient to enable any opinion to be expressed as to the possibilities of success.

The mechanism of the acid hydrolysis of cellulose is being studied with a view to determining the optimum conditions, and a method of fermenting the resulting products is being investigated, especially as regards the pentoses which comprise the bulk of the products of hydrolysis. If these products can be successfully fermented (and considerable progress has been made in this direction), it might result in the establishment of a commercial process for treating tropical or semi-tropical vegetation.

The Department of Scientific and Industrial Research has subsidised the work of the Engineering Sub-Committee of the Empire Motor Fuels Committee on the use of alcohol and other liquid fuels in internal combustion engines, and a valuable report by the Committee was published in the *Times Engineering Supplement*, on May 20, 1922.

The Department assisted the Commissioners of Customs and Excise in introducing sections into the Finance Acts of 1920 and 1921 giving legislative sanction to the use of alcohol for generating mechanical power, removing the surtax on imported spirits, increasing the drawback on home distilled spirits, and giving powers to the Commissioners to make regulations. Those already issued enable alcohol for power purposes to be imported and handled with the minimum of trouble and expense, and after it has been denatured and mixed with other liquid fuels in accordance with the regulations, to be sold and used without restriction.

As regards synthetic production, the possible raw materials are calcium carbide, the ethylene in coal gas from gasworks and coke-oven installations, and from water gas mixtures. Large scale production from calcium carbide is unlikely within the British Empire, and the processes for making it from ethylene and water gas mixtures are still in the experimental stage. Time does not permit me to deal with the remaining activities of the Fuel Research Board. Briefly, these activities relate to the winning and utilisation of peat, the suitablity of mixtures of fuels for internal combustion engines, investigation into the fundamentals underlying domestic heating, and the utilisation of special fuels in boiler furnaces.

FORTHCOMING EVENTS

Nov. 5. THE SOCIETY OF ENGINEERS, the Apartments of the Geological Society, Burlington House, Piccadilly, W., at 5.30 p.m. "Lubrication," by W. Lee.

Nov. 5. SOCIETY OF CHEMICAL INDUSTRY, *London Section*, in the Rooms of the Chemical Society, Burlington House, Piccadilly, W. 1., at 8 p.m. "The Use of Hydrogen Cyanide for the Fumigation of Ships," by Dr. G. W. Monier-Williams.

Nov. 7. THE INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. Inaugural address by E. H. Shaughnessy, O.B.E.

Nov. 8. THE CHEMICAL SOCIETY. Van der Waals Memorial Lecture to be delivered at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. 1., at 8 p.m.

Nov. 9. THE ROYAL COLLEGE OF SCIENCE CHEMICAL SOCIETY, South Kensington, S.W. 7, at 5 p.m. "Atomic Weights and Isotopes," by Dr. F. W. Aston, M.A., F.R.S.

Nov. 10. FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION. Twelfth Annual Dinner. The Engineers' Club, 39, Coventry Street, W. 1, at 7 p.m.

Nov. 12. INSTITUTE OF METALS, *Scottish Local Section*, The Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, at 7.30 p.m. "Nickel Alloys," by D. Turner.

Nov. 12. BIRMINGHAM UNIVERSITY CHEMICAL SOCIETY, Chemical Lecture Theatre, the University, Edgbaston, Birmingham, at 5.30 p.m. "Colour and Chemical Constitution," by V. E. Yarsley, B.Sc.

Nov. 13. INSTITUTE OF METALS, *Birmingham Local Section*, The Chamber of Commerce, New Street, Birmingham, at 7 p.m. "X-Rays and Crystal Structure," by H. B. Keene, D.Sc.

Nov. 13. INSTITUTE OF METALS, *North-East Coast Local Section*, The Electrical-Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. "General Scientific Brass Foundry Work," by P. Longmuir, D.Met.

Nov. 14. THE UNIVERSITY OF LONDON, W.C. 1, at 5.30 p.m. "The Physiology of Photosynthesis," by Sir Jagadis C. Bose, C.S.I.

Nov. 14. ROYAL INSTITUTE OF PUBLIC HEALTH, The Lecture Hall, 37, Russell Square, W.C. 1, at 4 p.m. "The Extravagance of a Smoke-Polluted Atmosphere," by W. B. Smith, O.B.E.

Nov. 15. THE INSTITUTION OF MINING AND METALLURGY, Burlington House, Piccadilly, W. 1, at 5.30 p.m.

Nov. 16. INSTITUTE OF METALS, *Swansea Local Section*, The Metallurgical Department, University College, Singleton Park, Swansea, at 7.15 p.m. "The Density of Alloys," by Prof. T. Turner, M.Sc.

SOCIETY OF CHEMICAL INDUSTRY

MEETING OF COUNCIL

The monthly meeting of Council was held on October 12, 1923, the President (Dr. E. F. Armstrong, F.R.S.) being in the chair.

A cordial welcome was given to the new members of Council attending for the first time.

A letter signed by the presidents and other officials of the Chemical Society and the Society of Chemical Industry regarding the proposed establishment of a Bureau of Chemical Abstracts, under the management of a joint committee consisting of four representatives of each society, was submitted. The proposal was approved, and Dr. E. F. Armstrong, F.R.S., Mr. Julian L. Baker, Mr. E. V. Evans and Sir Wm. J. Pope, F.R.S., were nominated as the Society's representatives on the joint committee.

A further letter signed by the same officials urging the desirability of giving facilities to the members of each society to acquire the publications of the other society, and of offering further inducements to chemists to join both societies, was also considered. The Council approved the principles involved, and remitted the discussion of details to a committee consisting of the President, the Hon. Treasurer, Mr. J. L. Baker, Mr. C. S. Garland, M.P., Prof. J. W. Hinchley, Sir Wm. J. Pope, F.R.S., Mr. Edwin Thompson and Mr. W. J. U. Woolcock.

It was reported that letters had been received from Prof. C. F. Chandler, Prince Ginori Conti, M. Paul Kestner, and Sir Dorabji Tata, expressing their gratification at being elected honorary members of the Society.

The report of the honorary treasurer was discussed, and for the purpose of fully considering all possible means of effecting economies certain suggestions were remitted for consideration to the committee appointed above.

The reports of various committees of the Council were submitted, and 36 new members (Home 25, Overseas 11) were elected.

The Publications Committee and the Executive Committee for *Chemistry and Industry* were continued in office until the end of the present year, by which time it is hoped that the proposed Bureau of Abstracts and other arrangements will have been decided upon.

The present representatives on outside bodies (see *Journal*, 1922, p. 560 R., and 1923, page 275 T) were all reappointed, except in the case of the British Association Fuel Economy Committee, now non-existent.

The British Empire Sugar Supply (Technical) Committee was re-elected, and Mr. Julian L. Baker agreed to act as chairman in place of Prof. A. R. Ling, resigned.

An application by the Birmingham Section to admit associates was agreed to.

A committee representative of the membership of the Society in India was appointed to consider fully the practicability of forming and carrying on proposed sections of the Society in Bombay and Calcutta.

With regard to the British Empire Exhibition, 1924, it was reported that considerable progress had been made with the Scientific Exhibit. The joint committee on which the Society is represented is working in co-operation with the committee of the Royal Society, and it has been agreed that the joint committee will undertake the exhibit of Pure Chemistry, and the Royal Society the exhibit embracing all the other sciences. A very comprehensive scheme of classification of the chemistry exhibit has been drawn up, and practically every scientist of note in the country has promised help. The work of the Publicity Committee under the chairmanship of the President has begun, and it has been arranged to publish a series of about 12 pamphlets written in popular language dealing with the scientific exhibit. It has also been agreed to publish a scientific record of the state of chemistry at the time of the Exhibition, as illustrated by the exhibit. It is estimated that the cost of the scientific exhibit will be about £5000, of which one-half has already been promised.

A preliminary report as to the arrangements for organising the Chemical and Physical Sections of the World Power Conference was received from the Chemical Engineering Group.

Arrangements for the dinner of chemists were reported; and the date of the next Council meeting was fixed for Friday, November 9.

YORKSHIRE SECTION

Dr. L. L. Lloyd occupied the chair at the opening meeting held at the Queen's Hotel, Leeds, on October 22, when Dr. N. M. Comber read a paper on "The Colloidal Constitution of Clays and Soils."

At the outset the author said that the conclusion arrived at in a previous communication that soil particles were protected by an emulsoid coating, had been confirmed by further experimental work. The facts that there was no characteristic rate of evaporation of moisture from clay, that lime alkalinity increased flocculation and that the only other substances capable of doing this were the phosphates of calcium, aluminium and iron, were held to support this conclusion. The increased solubility of clays after gentle ignition was explained by the fact that, owing to dehydration, an increased surface was presented to the attack of the acid. The fact that a neutral clay after gentle ignition showed increased absorptive power for lime was explained in a similar manner.

In discussing the absorption of electrolytes the facts that bases are absorbed very quickly, and that only acids like oxalic and phosphoric are capable of absorption, were examined. Lime absorption was increased by preliminary acid treatment, and if the results were plotted (absorptive power for lime and acid per cent.) it was found that a maximum amount was quickly reached which rarely exceeded seminormal, and then remained constant. This was explained on the assumption that lime was absorbed only at the surface. It was pointed out further that the only acids absorbed were those which formed insoluble salts of calcium and aluminium and this suggested that absorption was a precipitation effect. Russell and Prescott's work in this connexion was examined, and it was held that their results did not show conclusively that the effect was due to adsorption. The supposed amphoteric nature of clay was discussed, and the statement was made that this had never been proved, clay always behaving as electro-negative.

GLASGOW SECTION

The opening meeting of the session was held on October 26 in the Institute of Engineers and Shipbuilders, Elmbank Crescent, Glasgow, when the chairman, Mr. W. E. Moodie, F.I.C., read a paper entitled "The Industrial Chemist."

The speaker introduced his subject by saying that the works chemist was supposed to know something about everything and everything about something, and illustrated this by outlining the training and progress of the industrial chemist from the cradle to the grave, emphasising also the necessity for some knowledge of engineering and electricity. Regarding the allegation frequently made that the chemist was seldom if ever a competent business man, Mr. Moodie said, "Let us not take this lying down; it is not judgment the chemist lacks (in business matters), but application." He believed that the mind which could master and unravel the intricacies of complicated chemical changes was surely of sufficient calibre to comprehend and appreciate business principles; and if the chemist did not concern himself with financial aspects it was because at certain stages of his work these did not call for consideration.

Mr. Moodie referred to the need for constant and sustained study throughout the industrial chemist's career, and laid stress on the value to those starting on their post-college careers of membership of some chemical society such as our own.

In the course of the discussion Prof. G. G. Henderson expressed the opinion that most chemists could pick up enough engineering knowledge to carry them through, but it was extremely seldom that a man with a real bent for mechanical science could acquire even a passable practical knowledge of chemistry.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

The third meeting of the Société de Chimie Industrielle opened on October 21 in Paris by a brilliant reception followed by a social evening with artistic entertainment. The next day the formal opening was carried out by Monsieur Dior, Minister of Commerce. Prof. Menozzi, of Milan, spoke on the practical value of soil analysis in the light of our present knowledge, and the various technical groups began the work planned for them. The meeting ended with visits to factories and excursions. Amongst the foreign delegates were Prof. H. E. Armstrong, F.R.S., Sir J. Russell, F.R.S., Prof. J. T. Hewitt, F.R.S., Dr. S. Miall, Mr. Lomax, Mr. A. R. Smith, Dr. H. Levinstein and Mr. O. Lucas. The foreign delegates were received on October 21 by the "Bienvenue Française," which offered them a dinner, followed by an entertainment.

A more detailed account of the meeting will be furnished later by Monsieur M. Deschiens, general recorder of the meeting.

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS

The meeting held on October 9 at the Royal Society of Arts, was devoted to a paper presented by E. H. Cunningham-Craig, B.A., F.G.S., entitled "Recent Researches bearing upon the Origin of Petroleum." After discussing the inorganic and organic theories of the origin of petroleum, the author observed that the inorganic and volcanic theories of origin did not find much acceptance nowadays, and of the organic theories that of animal origin was chiefly supported by chemists, and that of vegetable origin by geologists.

It was becoming evident that coal and petroleum had definite relations to each other, as was shown in Trinidad, Venezuela, Burma, and particularly Rumania. Much evidence from Great Britain was also brought to light during the war when the D'Arcy well was drilled, on the theory that oil shale denoted petroleum that is dead and buried, but that beneath the oil shale series some free petroleum might still exist. The drill proved the theory was right, for free petroleum was found within ten feet of the depths predicted.

The author next considered the importance of the work of Bergius on the hydrogenation of coal, and said it was claimed that an oil "almost identical with crude petroleum" could be obtained by treating coal containing a fair percentage of volatile matter with hydrogen at a very high pressure, and at temperatures up to 850° F., with the result that an exothermic action began, and part of the solid fuel was liquefied. It would be of interest if some supporters of the animal theory of origin would try hydrogenation experiments with deposits containing, or supposed to contain, animal matter, to find whether liquids indistinguishable from petroleum could be obtained.

The bearing of the evidence afforded by the cannel coals upon the formation of petroleum was next considered, and an account was given of recent work on the torbanites, which were merely cannels containing sufficient colloidal inorganic matter that had been subjected to the necessary pressure. The evidence suggested that if oil shale denoted petroleum dead and buried, torbanites denoted petroleum still-born. The evidence for the origin of oil from vegetable matter was as clear as could be desired.

In the ensuing discussion, Dr. Dunstan could not admit that laboratory methods of producing hydrocarbons from fatty acids were applicable in nature; he did not agree that the liquids obtained from coal by the Bergius method were similar to petroleum and suggested that there were several modes of origin.

STREATFEILD MEMORIAL LECTURE

The Streatfeild Memorial Lecture was delivered by Mr. E. M. Hawkins, F.I.C., at the Finsbury Technical College on October 25 on the subject of "Analytical Chemistry."

After reference to the value of the training which he and his former fellow-students had received at the College under Meldola, Streatfeild and Castell Evans, the lecturer emphasised the importance of a knowledge of physics, mathematics and physical chemistry to the present-day analyst and consultant. First among the qualifications required in the analyst were accuracy and reliability, to which should be added the ability to decide to what degree of accuracy his results attained. He should also have a due sense of his responsibility in carrying out his work, especially when extensive repetition gave to it an appearance of drudgery. Secondly, there was the need for rapidity to be associated with accuracy, as few students realised the speed of manipulation which would be required of them when they obtained a post after leaving college.

Thirdly, it was of great importance that the student should cultivate the gift of expressing his results suitably in a report, for much good experimental work was marred by the inability of the chemist to write up his results in such a way that the bearing of the work could be properly appreciated by those who read the report. It was necessary that the chemist should not be easily moved from an opinion formed after careful consideration of results obtained by honest and patient investigation.

In conclusion the lecturer stated that of the three classes of men practising chemistry, works chemists, public analysts, consultants, the first-class would greatly outnumber the public analysts when trade revived, whilst consulting chemists would be men of wide experience and high attainments who would be called upon by manufacturers to solve their problems and should be highly remunerated for such work.

CORRESPONDENCE

ELLIS'S PRACTICAL BACTERIOLOGY FOR CHEMICAL STUDENTS

Sir,—In your issue of October 26, Prof. Ellis takes exception to a review of his book by me in your issue of October 5, 1923, and queries my right, as a medical man, to review a book written by a biologist for chemical readers. The fact that the editorial staff passed on this book to me for review is, I think, sufficient evidence of my experience as a bacteriologist to give an opinion in regard to it.

In regard to the question of malice alleged by Prof. Ellis I have never, to my knowledge, met Prof. Ellis, nor have I ever heard of him until his book appeared, so wherein can the question of malice arise? Prof. Ellis may yet come to regard me as his friend if he will read my criticism as it is meant and produce a book for which I believe an opening is present.

The author appears to think that my review was directed from a standpoint of purely human bacteriology. This, on the ground of wide bacteriological experience, I deny, but I would point out that bacteriological technique is very similar, whether it affects the works chemist, the botanist, the veterinary surgeon or the medical man, but in view of the life and death responsibilities dependent upon accurate diagnosis in human bacteriology no loose methods of technique can be considered. As an example, may be quoted the use of broth by Prof. Ellis as a basis for fermentation tests. Broth as usually prepared from meat contains glucose which has resulted from the breaking down of stored glycogen present in the muscles. This percentage of glucose always present will be quite sufficient to invalidate the reactions with other sugars and would lead to false classification.

Whatever Prof. Ellis' opinion may be about his princely *B. Megatherium* purchased for 1s. I deny that continual use with this organism would train a chemist into a bacteriologist. The difficulties of high-power manipulation are not met by using bacteria requiring low-power lenses, and it is a recognised fact that immersion lenses are a *sine quâ non* of bacteriological teaching other than by kindergarten methods.

Prof. Ellis is also wrong in stating that gelatin will grow 99·9 per cent. of organisms which a works chemist may be required to work with; and in certain climates it is practically impossible to use gelatin to any practical degree. Prof. Ellis states that a chemist must approach bacteriology from the biological side and that presumably a medical man does not do so. I should have thought that Prof. Ellis would have known that a medical student's training is biological from the outset and is biological to the finish, and if it is inadequate that is a fault of his biological teachers.

Prof. Ellis states that he has written his book with the idea in mind of a "young chemist deposited in a factory and having to tackle some trouble that has arisen owing to a microbe having run amuck in the works." Whatever Prof. Ellis may mean by microbes "running amuck in works" I must confess to a feeling of sympathy with that young chemist, if his only armamentarium consists of a low-power microscope, the media recommended by Prof. Ellis, and Prof. Ellis' book.

That I am not alone in this feeling is apparent by the opinion also of your other correspondent —Mr. R. F. Hunwicke—whose letter appeared as a footnote to Prof. Ellis's own letter.—I am, Sir, &c. Arnold Renshaw

Manchester
Oct. 29, 1923

THE BRITISH DYESTUFFS INDUSTRY

Sir,—Our attention has just been directed to a letter published in your issue of the 21st ultimo, from Mr. C. M. Whittaker, in which he states: "the Direct Cotton Colour Sky Blue FF. at 12s. 3d. is twelve times its pre-war price."

We beg to state that we were supplying this product at the date of his letter and are doing so to-day at less than half the price mentioned by him.—We are, Sir, &c.,

The Clayton Aniline, Co., Ltd.

Clayton, Manchester
Oct. 29, 1923

ANTI-KNOCK GASOLINE

Sir,—In your current issue a paragraph appears on p. 1029 advocating the addition of tetra-ethyl lead and carbon tetrachloride to motor fuel. The device may give excellent results as far as economy of fuel is concerned, but the possible danger to health caused by the emission of finely divided or volatile lead compounds in public thoroughfares ought not to be left out of account.—I am, Sir, &c.,

F. Shedden

Flint
Oct. 29, 1923

ON A PROPOSAL REGARDING CANAL CONSTRUCTION

Sir,—Possibly it is for shame of the sinful neglect of our waterways, natural and artificial, that the subject of internal water carriage in the country is hardly ever mentioned.

Whenever this problem is taken up it must be with a different outlook from that we should have had 25 or 30 years ago. If the canals are to be given life they must be organised for quick transit in keeping with other modes of carriage. This means that most canals must be wider and deeper and, more important still, constructed so as to resist the " wash " of propellers or other quicker means of traction than horse haulage.

I would venture to suggest that it would be an improvement in many cases, especially where widening is difficult or impracticable, to have a lining of sheet metal—complete or partial—so arranged at the bank, a little above water-level, that it curves over inwards towards the water to resist and throw back the " wash " wave of the boat. Moderately thin sheet iron, possibly protected by cement or pitch, would last a very considerable time, and would not be difficult to secure to the sides of the canal to the depth affected by the rush of water.

There are several details, as strength of sheet metal, means of protection of same against rusting, attachment of the metal lining and so on, which present no serious difficulties. The thing is, we must have quick and convenient water carriage and that soon. The comparison of the cost of water carriage per ton mile with that of any other form of carriage will settle this point.

The present time seems a favourable one to take this suggestion into consideration.—I am, Sir, etc., W. R. HODGKINSON

Blackheath

PERSONALIA

Dr. Earle F. Whyte, M.A., of Clark, has been appointed to succeed the late Dr. John Waddell as professor of analytical chemistry at Queen's University.

M. R. Walker has been appointed as special expert in charge of the Non-ferrous Division of the Metals Section of the U.S. Tariff Commission.

Monsieur J. L. Breton, director of the French National Office for Scientific and Industrial Research and Inventions, has been appointed president of the Higher Commission for Inventions in place of the late Monsieur Violle.

* * *

From Mulhaus the death is announced of Monsieur E. Dollfus, a well-known manufacturer.

On August 17 the death took place of E. Mattirolo, a well-known Italian geologist to whom was due the discovery of bauxite in Italy, and numerous chemical and micrographic researches on Italian rocks.

Prof. S. P. Sharples, who died on August 20 at the age of 82, was one of the chartered members of the American Chemical Society, as well as a member of the Society of Chemical Industry since 1884. His work covered a wide field, ranging from problems of spectrum analysis to questions relating to timber, fat and soap manufacture.

NEWS AND NOTES

GENERAL

New Potash Deposit in Czechoslovakia

According to the Gazette de Prague large deposits of potash, estimated to contain millions of tons, have recently been discovered in Czechoslovakia. The discovery is said to have been made by a geologist, Prof. Jahn, and a chemist, M. Prokes.—(*Cham. Com. J. Sept.* 14, 1923.)

Metallurgy in Belgium

In August 36 blast furnaces were alight, and the production reached :—198,929 metric tons of cast iron; 206,805 t. of steel; 5800 t. of castings; 173,148 t. of finished steel, and 17,320 t. of finished iron. During the same month the output of coal in Belgium was 1,926,000 t. compared with 1,856,570 t. in July. The production of coke was 364,930 t., which is about 71,000 t. higher than the pre-war average production of coke; similarly, the production of coal is about 70,000 t. higher than the pre-war average.

Investigation of Uranium Minerals in the Belgian Congo

It is announced that Prof. A. Schoep, of the University of Ghent, has identified several new uranium minerals, to which he has assigned the following formulæ :—Curite, $PbO \cdot 5UO_3 \cdot 4H_2O$; Kasolite, $3PbO \cdot 3UO_3 \cdot 3SiO_2 \cdot 4H_2O$; Dewindtite, $PbO \cdot 2UO_3 \cdot P_2O_5 \cdot 3H_2O$; Soddite, $5UO_3 \cdot 2SiO_2 \cdot 6H_2O$; Becquerelite, $UO_3 \cdot xH_2O$. A uranotitano-columbate of calcium containing small amounts of rare earth has been designated as Mendeleeffite; the chemical formula has not been established definitely, but the mineral contains approximately U_3O_8 23·5 per cent. and CaO 15 per cent. It is considered as a variety of Betafite but contains no water of crystallisation.

Tasmanian Mineral Yield for 1922

According to the annual report of the Tasmanian Secretary of Mines for the year ended December 31, 1922, the aggregate value of minerals raised during the year was £1,013,415, being an increase of £190,564 on the output of the previous year. The gold won was valued at £15,992; silver, £123,497; lead, £118,257 and copper, £391,535. The Mount Lyell Co. treated a total of 57,287 t. of ore and concentrates, which yielded 5661 t. of blister copper, valued at £416,017. On an average 942 men were employed during the year, and dividends paid by the company from its inception to December 31 totalled £3,894,469. The metal production of the company for the same period was 180,160 t. of copper, 13,083,297 oz. of fine silver, and 378,399 oz. of fine gold. Metallic tin raised in Tasmania in 1922 was worth £112,407, and the osmiridium won was valued at £36,512. The Electrolytic Zinc Co. produced 23,517 t. of slab zinc worth £706,390 at Risdon from 64,401 t. of Broken Hill calcines. The silver-lead output for realisation at Port Pirie contained 2780 t. of lead and 635,701 oz. of silver.

REVIEW

The Electron in Chemistry. *By* Sir J. J. Thomson, O.M., F.R.S. *Pp.* 144. *Philadelphia: The Franklin Institute,* 1923. *Price* $1·75.

Chemical journals are now so full of articles and reviews dealing with the electronic theory of chemistry that a discussion of the principles of the application of the theory is unnecessary. A review of such a book as this for a body of such readers cannot attempt to do more than indicate what sort of book this is, and the sort of information which may be found in it. All those who read chemistry are already familiar with the fact that the Master of Trinity can think clearly and express himself clearly. The book consists of five lectures delivered in April, 1923, at the Franklin Institute, Philadelphia. It is worthy of that memorial of a remarkable man who is credited with having snatched lightning from the sky and the sceptre from a king. The first lecture deals with the problem of arranging in space a number of electrons in stable equilibrium around a positive charge without describing orbits around it. It treats this subject from first principles and shows how the results agree with the evidence afforded by positive rays and Bragg's measurements of the radii of atoms. The second lecture deals with the octet theory and its application to various chemical compounds; the third with residual affinity and Werner's co-ordination numbers, with a short but highly suggestive reference to electrolytic dissociation. Sir J. J. Thomson shows how, in accordance with his conceptions, certain molecules may combine with such polar molecules as water, to form new compounds in which the atoms of the original molecule are driven further apart. His view is that in an aqueous solution of calcium chloride the positively electrified part of the calcium atom will have next to it the negative ends of polar water molecules the other ends of which would adjoin an oppositely charged chlorine atom, the direct attraction between the calcium and the chlorine being thus diminished but not, so your reviewer reads the argument, extinguished. It is not quite clear whether Sir J. J. Thomson has not framed an explanation which would harmonise the views on solution of Prof. Armstrong and of Prof. Findlay. If so, this is a remarkable achievement. The fourth lecture is on the mechanism of chemical combination; it gives an electrical explanation of the catalytic action of platinum black, an account of the production of ions when air bubbles through water, an explanation of the work of Baker and of Dixon on dry gases, of cataphoresis, of the combustion of cyanogen in dry oxygen, of enolic change, of the luminosity of the glow worm, of varying valency, of the paramagnetism of oxygen and a few other points. This chapter alone contains enough matter to provide a reader with thoughts for several periods of leisure. The fifth lecture is on the structure of solids, not merely the structure of crystals, but surface tension at solid surfaces, intermetallic compounds, and mixed crystals.

All this is contained in a handy book of a hundred and forty-four pages of good print, and written by Sir J. J. Thomson.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for Oct. 25)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Algeria	Iron and steel, laundry soap	458, 459
Australia	Heavy chemicals	412/7/1/1/ 167*
”	China, cut glass	412/7/1/1/ 160*
British India	Galvanised corrugated mild steel sheets	**
Chile	Earthenware	467
Cyprus	Paint, varnish, ironmongery, hollow-ware	444
Egypt	Paper (tender)	11642/F.E./ M.C.
Germany	Rubber goods, oils	451
Guatemala	Druggists' sundries	468
Latvia	Wrought iron tubes	852/10/F.G/ E.C./2
New Zealand	Olive-oil soap, olive oil	445
” ”	Builders' hardware	†
Norway	Lubricating oil and grease, rubber	453
Rumania	Zinc sheets (tender)	11706/F.E./ E.C./2
South Africa	Asphalt, galvanised corrugated iron	447, 448
Spain	Chemicals, enamel ware	454, 455
Switzerland	Dyes	457
United States	ides, skins, chamois leather	461, 462

* The Official Secretary, Commercial Branch, Australia House, Strand, London, W.C. 2.

** The Director-General, India Store Department, Belvedere Road, Lambeth, S.E. 1.

† P.O.3, c/o High Commissioner for New Zealand, New Zealand Government Offices, 415, Strand, London.

TARIFF CUSTOMS EXCISE.

Australia.—Steel, hyposulphite of soda, Portland cement, calcium carbide, salicylic acid, scientific instruments, aneroid and mercury barometers, have been brought under the operation of the Industries Preservation Act.

Colombia.—An import duty has been levied on salt.

Italy.—The present issue contains a note of the import duties on certain essential oils.

Paraguay.—Importation of pharmaceutical specialities has been prohibited.

Poland.—Increases have been made in the duties on lubricating oil, asphalt, tar, and paraffin wax.

Rumania.—New rates of export duty have been levied on gypsum and glassware.

Spain.—Regulations have been issued controlling the importation of pharmaceutical specialities.

COMPANY NEWS

BRITISH CELLULOSE AND CHEMICAL MANUFACTURING COMPANY, LTD.

The chairman, in addressing the fourth ordinary general meeting, said that the loss actually due to trading was no worse than had been expected. During the twenty months covered by the accounts the processes of manufacture in almost every direction were undergoing changes, with the object of improving the quality and cheapening the cost, of the material. Intensive efforts had resulted in the making each month of sufficient profits to cover all charges, including debenture interest, but not depreciation. Some loss had been incurred in the depreciation in value of various forms of stock, which arose chiefly through improvements which had cheapened production. The erection of a power house to meet war requirements had created a loss which was now covered, the figure being £114,000. Additional capital had been secured from the Cellulose Holdings and Investment Co., Ltd., who agreed to take up a further £400,000 of debentures. With this sum the extension of the numerous manufacturing departments had been completed, so that a production of 4½ to 8 tons per day, according to the varieties of the yarn required by the trade, was possible. Weaving plant of various kinds was also under installation, and a specialist in Lyons had already produced with celanese over 100 different fabrics. Much had been done with regard to dyeing, and the technical advisers of the company believe that they can produce any colour, shade, or standard degree of fastness, as required.

In referring to the future outlook, little doubt was felt in the company's ability to make profits under reasonable trading conditions.

ENGLISH BEET SUGAR CORPORATION

In addressing the Seventh Annual General Meeting, held on October 23, the chairman of the Corporation mentioned the assistance rendered by the Government in the remission of excise duty on home-grown sugar. The climate and soil of these islands were eminently suitable for the cultivation of first-class sugar beet, and if carefully fostered, this new industry could not fail to be beneficial to the country generally and to lead to the revival of agricultural prosperity. The cost of home-grown sugar was no greater than that of imported sugar, and its quality was, he said, better than most grades of the imported article; imports into the United Kingdom amounted, on an average, to about 1,800,000 tons annually. The home-production of even one-fourth of this tonnage, involving as it would the erection, equipment, and working of fifty factories, would be of enormous advantage to the country from the commercial point of view. It is the practice of the Corporation to issue each year with the grower's contract general recommendations in regard to beet cultivation, and this co-operation with the grower had resulted in the production in the Eastern Counties of roots above 18 per cent. sugar content. Further payment was made on a sliding scale, according to the sugar content. If the industry was to achieve success, the Government must continue its assistance until the industry is firmly established, and the British sugar beet manufacturers must avail themselves of foreign technical assistance until British technicians have thoroughly mastered the various processes of beet sugar cultivation. Progress in this direction had been made in the Cantley factory, for whereas in the early days 200 foreign operatives were brought over for each campaign, only ten were now needed. The proposal to amalgamate with Home Grown Sugar, Ltd., the owners of the Kelham sugar factory, was still under consideration.

The net profit for the year was £103,981, and after deducting this amount from the previous accumulated losses of £118,940, there remained a debit of £14,958. It was hoped this may be settled during the current year, and to reduce, if not extinguish, the £20,952 which stands in the balance sheet under the heading of maintenance account, administration and interest charges to March 31, 1920. It was not possible to pay any dividend on the Ordinary shares for last year; neither was a dividend on the Cumulative Preference shares recommended. The debenture holders, however, would receive an additional 2½ per cent. under the terms of the debenture trust deed.

The total capital amounted to £233,900, which, however, did not represent anything like the amount of money actually sunk in the business. To date £675,000 had been expended, and a modern factory like that at Cantley could not be erected for less than £460,000. The report and accounts for the year were adopted.

REPORT

Report on the Commercial, Industrial, and Financial Conditions in Japan, 1922 and up to June 30, 1923. *By* Sir, E. T. F. Crowe, C.M.G., *H.M. Commercial Counsellor, and* H. A. F. Horne, *H.M. Commercial Secretary, Tokyo. Department of Overseas Trade. Pp.* 64. *H.M. Stationery Office.* 1923. *Price* 2*s.*

The tendency so noticeable in recent years (*cf.* J., 1922, 539 R) for the Japanese to assimilate western customs becomes more and more marked. In general there is now hardly any article which would be marketable in Europe which does not find a demand in Japan. This is very noticeable in the case of sporting goods. Trade has continued to increase and, though the profits of importing merchants are not now so great as during the war boom period and prices are lower, the actual bulk of trade in 1922 constituted a record. British trade in Japan, though maintained in textiles, did not form so high a proportion of the total as before the war, and instead of being greater than that of America, is now only half as great.

The principal agricultural product of the country is rice; in 1922 the harvest was slightly above normal. Most of the minerals of the country were produced in larger quantity in 1922 than in the previous year. Among the items were gold, 100,071 oz. troy; platinum, 62 oz. troy; silver, 1,642,031 oz. troy; copper, 54,550 metric t.; lead, 3265 t.; tin, 289 t.; sulphur, 34,642 t.; sulphur ore, 42,089 t.; chromite, manganese, arsenic, phosphorus and other ores are also obtained.

Imports into the country have shown a tendency to increase, though towards the end of 1922 there was a slight decrease in imports and an increase in exports. The principal import is raw cotton. The big boom in construction materials showed some abatement, though many fine buildings were erected in the large towns. The fertiliser trade showed signs of recovery from the 1921 slump; 52,000 t. of sodium nitrate were imported in 1922. Three of the largest phosphate companies have amalgamated. The rather dull conditions in the petroleum industry continued, though hopes were entertained of cheap oil from America leading to increased use of the fuel. Trade in chemicals and drugs decreased heavily, largely owing to the practical disappearance of imports of cocaine and opium. Soda ash and caustic soda formed the principal business in heavy chemicals, 130,000 t. being imported; the United Kingdom has recovered some of this trade, though American and African competition is keen. Shellac was intensively imported to supply the gramophone record and aeroplane industries. Germany has practically recaptured the monopoly of imports of dyestuffs, over 90 per cent. of the total of 10,000,000 lb. coming from this source.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

No material changes have taken place in the heavy chemical market either in demand or prices. Considering the general state of trade chemical products are in satisfactory request, although of course very considerably below what would be expected in more normal times. The home trade is steady but quiet, and the main features in export lines continue to be the "heavier" classes of alkalis.

Acetic Acid, 40% tech. ..	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric ..	3s. 3d. per carboy makers' works.
Acid Nitric 80° Tw. ..	£21 10s. per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 65s. f.o.r. makers' works, with slight variations up and down.
Acid Sulphuric, 94% Arsenical	£6 per ton makers' works.
Ammonia Alkali ..	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder ..	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime ..	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride ..	£5 17s. 6d. per ton d/d. In slightly better demand due to weather conditions.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate ..	6¼d. per lb. d/d.
Potass. Chlorate ..	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76% ..	£17–£19 10s. per ton, according to quality. Prices reduced by £2 per ton.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98% ..	£24 per ton.
Sod. Bicarbonate ..	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96% ..	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.

Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Business in this section is generally on the dull side.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb. Reduced 1s. per lb. following drop in metal.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

The general outlook of the wood distillation industry is encouraging.

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d. Demand steady.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£10 per ton, according to grade and locality of market.
Iron Liquor	1s. 7d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d. per gall. 60% O.P. Steady market.
Solvent	6s. 3d. per gall. 40% O.P. Steady.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead	£41 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 1½d.—1s. 2d. per lb. Fair inquiry. Good business for prompt delivery.
Crude 60's	3s. 6d.—3s. 8d. per gall. Market steady.
Acid Cresylic—97/99	2s.—2s. 5d. per gall. Firm, with a fair amount of business.
Acid Cresylic	
Pale 95%	1s. 11d.—2s. 4d. per gall.
Dark	1s. 6d.—2s. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.
Anthracene Oil—	
Strained	8½d.—10d. per gall. Plenty of enquiries.
Unstrained	8½d. per gall.
Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 6d.—1s. 7d. per gall. Little business passing.
Pure	1s. 9d—1s. 11d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8½d.—9½d. per gall. according to grade and district. Good business being done.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 2d.—1s. 3d. per gall. Market sluggish.
Solvent 90/190	1s. 2d.—1s. 3½d. per gall. Very little business.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Demand increasing.
Whizzed or hot pressed	£9 10s.—£11 per ton.
Naphthalene—	
Crystals	£19 10s. per ton.
Flaked	£19 10s. per ton.
Pitch, medium soft	132s. 6d.—140s. per ton, according to district and time of delivery. Several inquiries. Market firm and price tending to advance.
Pyridine—90/140	22s.—22s. 6d. per gall. Demand good. Supplies short.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

Dyestuffs business has been steady during the week.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 9d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Quieter.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—10d. per lb. naked at works.
Aniline Salts	9½d.—10d. per lb. naked at works.

Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 9d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Better demand.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d.—1s. 3d. per lb. naked at works.
Dinitrochlorbenzol	£85 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	6d.—7½d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	2s. 7½d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
Toluidine	4s. 6d. per lb. d/d.
-Toluylene Diamine	5s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The shortage of spot supplies is beginning to be felt seriously and prices are in consequence considerably higher for a few of the pharmaceutical chemicals which are in regular demand.

Acid, Acetic 80% B.P.	£47 10s. per ton.
Acid, Acetyl Salicylic	3s. 3d.—3s. 8d. per lb. Large export orders.
Acid, Benzoic	2s. 9d. per lb. Higher prices paid for good B.P. quality, which is scarce.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Citric	1s. 4½d. per lb., less 5%, for ton lots. Poor demand.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	5s. 9d.—6s. per lb.
Acid, Salicylic	2s. 6d. per lb.—with 2s. 3d. for ton lots. Firm market. Prices advancing.
Acid, Tannic	3s. 3d. per lb. for B.P. quality.
Acid, Tartaric	1s. 1¾d. per lb. less 5%. Home trade poor. A good demand is reported from Japanese market, but little business has been done with English acid.
Amidol	9s. per lb. d/d.
Acetanilide	2s. per lb. being asked for spot supplies. Market firmer.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	3s. 6d. per lb. for English make.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz. for English make. Demand very poor.
Barbitone	17s. per lb. Neglected.
Benzonaphthol	4s. 9d. per lb.
Bismuth Salts	A steady market. Carbonate 13s., Nitrate 6s. 11d., Salicylate 10s. 5d., Subgallate 9s. 6d., Citrate 11s. 7d., Oxide 14s. 5d., Subchloride 12s. 8d., Subnitrate 11s.
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	
Potassium	7d. per lb. Considerably firmer.
Ammonium	8d. ,, ,,
Sodium	7½d. ,, ,,
Calcium Lactate	2s. 6d. per lb. for best English make.
Chloral Hydrate	4s. 3d. per lb. Position very firm.
Chloroform	2s. per lb. for cwt. lots. Very steady.
Creosote Carbonate	9s. per lb. Little demand.
Guaiacol Carbonate	Spot supplies exhausted. Present value would be 11s. 6d.—12s. per lb.
Hexamine	4s. per lb. Higher prices anticipated.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	Reduced by 2d. per lb. 2s. 3d. per lb. for cwt. lots. 2s. 4d. for 28 lb. lots.
Magnesium Carbonate—	
Light Commercial	£36 per ton net.
Magnesium Oxide—	
Light Commercial	£80 per ton, less 2½%.
Heavy Commercial	£27 per ton, less 2½%.
Heavy Pure	1s. 6d.—2s. per lb., according to quality and quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 72s. 6d. per lb.
Methyl Salicylate	2s. 10d. per lb. for carboys. An active market.
Methyl Sulphonal	14s. 6d. per lb. No demand.
Morphine and Salts	Prices again advanced owing to dearness of opium. Alkaloid: Cryst. 14s. 8d., Precip. 14s. 5d., Acetate 11s. 6d., Hydrochlor. 11s. 6d., Sulphate 11s. 6d., Tartrate 14s. 5d. per oz.

Paraformaldehyde ..	.. 3s. 9d. per lb.
Paraldehyde ..	.. 1s. 5d. per lb.
Phenacetin ..	.. 6s. 9d. per lb. Higher in price and in strong enquiry.
Phenazone ..	.. Great activity has been shown. 8s. 3d. per lb. has been paid and some holders are quoting 8s. 9d.
Phenolphthalein	.. 7s. 6d. per lb. Very firm.
Potass. Bitartrate—99/100% (Cream of Tartar) ..	.. 90s. per cwt., less 2½%. Fair business passing.
Potass. Ferricyanide	.. 3s.—3s. 6d. per lb.
Potass. Iodide ..	.. 15s. 8d.—15s. 11d. per lb. Good steady market.
Potass. Permanganate ..	10d. per lb. for B.P. crystal.
Quinine Sulphate	.. 2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	.. 6s. per lb.
Salol	.. 4s.—4s. 6d. per lb. Very scarce.
Sod. Benzoate ..	.. 2s. 9d. per lb. Supplies on the short side.
Sod. Citrate, B.P.C. 1923	2s. per lb. for cwt. lots.
Sod. Hyposulphite—Photographic	.. £15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Potass. Tartrate (Rochelle Salt)	.. 82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate ..	.. Powder 2s. 7d.—2s. 10d. per lb., and Crystal at 2s. 9d. —3s. per lb. Firm and active.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal ..	.. 15s. per lb. In very small demand.
Thymol	.. 13s. 6d. per lb. quoted for synthetic and 14s. 6d. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone ..	.. 11s. 6d. per lb.
Aubepine ..	.. 14s. ,, ,,
Amyl Acetate ..	.. 3s. ,, ,,
Amyl Butyrate ..	.. 7s. 3d. ,, ,,
Amyl Salicylate	.. 3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 6d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol ..	.. 3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine ..	.. 3s. 3d. ,, ,,
Benzaldehyde free from Chlorine ..	.. 3s. 3d. ,, ,,
Benzyl Benzoate	.. 3s. 6d. ,, ,,
Cinnamic Aldehyde Natural ..	.. 20s. ,, ,,
Coumarin ..	.. 20s. ,, ,,
Citronellol ..	.. 19s. 6d. ,, ,,
Citral	.. 9s. 6d. ,, ,,
Ethyl Cinnamate	.. 10s. ,, ,,
Ethyl Phthalate	.. 3s. 9d. ,, ,,
Eugenol	.. 10s. ,, ,,
Geraniol (Palmarosa)	.. 37s. 6d. ,, ,,
Geraniol	.. 6s. 9d. to 13s. 6d. per lb.
Heliotropine ..	.. 8s. per lb.
Iso Eugenol ..	.. 15s. 9d. per lb.
Linalol ex Bois de Rose ..	18s. 6d. ,, ,,
Linalyl Acetate ..	.. 18s. 6d. ,, ,,
Methyl Anthranilate	.. 8s. 6d. ,, ,,
Methyl Benzoate	.. 6s. ,, ,,
Musk Ketone ..	.. 47s. 6d. ,, ,,
Musk Xylol ..	.. 13s. 6d. ,, ,,
Nerolin	.. 4s. ,, ,,
Phenyl Ethyl Acetate	.. 10s. ,, ,,
Phenyl Ethyl Alcohol	.. 16s. ,, ,,
Rhodinol.. ..	.. 55s. ,, ,,
Safrol	.. 2s. ,, ,,
Terpineol ..	.. 3s. ,, ,,
Vanillin	.. 22s. 6d.—23s. per lb. Firm and steady demand. Raw material dearer.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	.. 14s. 6d. per lb.
Anise Oil.. ..	.. 1s. 10½d. ,, ,,
Bergamot Oil ..	.. 13s. 3d. ,, ,, spot.
Bourbon Geranium Oil..	37s. ,, ,,
Camphor Oil ..	.. 80s. ,, ,,
Cananga Oil, Java	.. 9s. 6d ,, ,,
Cinnamon Oil, Leaf	.. 4¾d. per oz.
Cassia Oil 80/85%	.. 11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	.. 4s. 9d. ,, ,,
Ceylon ..	.. Very little on offer, too many parcels arriving containing spirit. These have been seized by the Customs.
Clove Oil.. ..	.. 8s. 6d. per lb.
Eucalyptus Oil 70/75% ..	2s. 9d. per lb.
Lavender Oil—French 38/40% Esters	26s. per lb.
Lemon Oil ..	.. 2s. 10d. per lb.
Lemongrass Oil ..	.. 2¾d. per oz.
Orange Oil, Sweet	.. 12s. 6d. per lb.
Otto of Rose Oil—	
Bulgarian ..	.. 34s. per oz.
Anatolian ..	.. 26s. per oz.
Palma Rosa Oil	.. 24s. 6d. per lb.
Peppermint Oil—	
English ..	.. 70s. per lb. Market very unsteady.
Wayne County	.. 15s. per lb. Market very unsteady.
Japanese ..	.. 12s. per lb. Market very unsteady.
Petitgrain Oil ..	.. 8s. 9d. per lb. Dearer.

TRADE NOTES

German Exports of Alizarin, 1923

The following table shows the distribution of exports of alizarin from Germany in January and February, 1923, compared with the same months of 1922:—

Destination	Jan. & Feb., 1923 Metric tons	Jan. & Feb., 1922 Metric tons
Great Britain	14·0	2·9
Italy	10·8	4·0
Netherlands	6·7	12·2
British India	81·8	128·7
Czechoslovakia	0·6	12·8
Japan	4·3	1·2
Dutch Indies	12·4	2·8
United States	25·8	7·6
Other Countries	47·1	34·1
Total	203·5	206·3

German Indigo Exports, 1923

The following table shows the exports of indigo from Germany in January and February, 1923, and in the same two months of 1922:—

Destination	Jan. & Feb., 1923 Metric tons	Jan. & Feb. 1922 Metric tons
Netherlands	87·2	35·3
Austria	13·5	36·2
Czechoslovakia	4·0	20·7
Hungary	8·9	23·8
Spain	2·3	15·8
Egypt	14·3	19·9
British India	43·0	36·7
China	1763·9	1479·9
Japan	108·8	66·1
Dutch Indies	43·0	101·3
Other Countries	64·4	53·4
Total	2148·3	1889·1

German Exports of Potash, 1923

The following table shows the exports to various countries of potash fertilisers in January and February, 1923, and in the same two months of 1922:—

Destination	Jan. & Feb., 1923 Metric tons	Jan. & Feb., 1922 Metric tons
Danzig	15·0	1060·0
Memel	904·0	580·0
Saar	95·0	270·8
Belgium	4922·5	1205·0
Denmark	725·0	—
Great Britain	939·8	2730·0
Netherlands	26048·6	2113·5
Norway	5780·0	15063·1
Austria	2035·5	2657·5
Jugoslavia	90·0	3410·0
Czechoslovakia	510·0	477·5
Hungary	105·0	4602·1
Western Poland	19885·0	365·0
Lithnania	30·0	—
Finland	—	1156·0
Sweden	6834·5	6490·0
Switzerland	90·0	520·0
United States	18642·9	45937·0
Other Countries	5278·1	525·0
Total	92930·9	89392·9

The distribution of exports of potassium chloride during the same periods was as follows:—

Destination	Jan. & Feb., 1923 Metric tons	Jan. & Feb., 1922 Metric tons
Belgium	15·0	15·5
Great Britain	701·0	3643·0
Italy	195·0	190·1
Netherlands	825·1	850·1
Austria	305·5	351·0
Czechoslovakia	156·5	2429·0
Sweden	15·0	0·1
Spain	1413·3	709·1
Ceylon	101·6	304·8
Japan	0·2	60·0
Brazil	41·3	25·6
United States	5675·3	27236·4
Other Countries	606·7	910·9
Total	10051·5	36725·6

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EDITORIAL

THE dinner of chemists on October 31 was a great success; all seem to have enjoyed it: some because it was a good dinner, some because they sat near bright and chatty people, some because they enjoyed the music, some because they liked the speeches, some for all these reasons. There is something stately about a large banquet, the idle gossip before the various presidents arrive, the greeting of friends whom we have not seen for some months. "But, hark! the portals sound and pacing forth with solemn steps and slow, high potentates and dames of royal birth and mitred fathers, in long orders go." The only mitred father we had was the Vice-Chancellor of the University of Cambridge, whose amusing anecdotes were really too frivolous for a dignatory of the Church, so some of the audience said. For our part we agree with the saying that a man who is good enough to go to heaven is good enough to be a clergyman, and there is surely something charitable about a Vice-Chancellor who can be merry after a speech in which perhaps the merits and demerits of a University education have been indicated with but scant gilding of the pill. As for the feast itself, we found a table richly spread in regal mode, with dishes piled and meats of noblest sort and savour; beasts of chase or fowl or game in pastry built, or from the spit or boiled; after such meats and the appropriate fluids, we listened to speeches, some of which definitely and some of which vaguely indicated the co-operation amongst chemists, which is necessary and therefore will be accomplished. During the last two years there has been a considerable though quiet effort towards co-operation. The publication of a weekly journal by the Society of Chemical Industry was the first essential step, and the Chemical Society has encouraged this venture in a notable manner, especially by the publication in it of summaries of the papers read before the Chemical Society.

* * *

We are gratified to announce that the Institution of Chemical Engineers also has given us its encouragement and assistance. We are appointed as their official organ to publish a number of their papers in full, to furnish their Fellows with advance proofs, and to supply to such of their Fellows who are not members of the Society of Chemical Industry copies of *Chemistry and Industry*. The conclusion of this treaty, combined with the arrangement with the Chemical Society for a joint system of abstracts, involves certain changes in the details of publication. In view of the altered circumstances a complete revision of the plans of the Society of Chemical Industry becomes necessary, and those who control its destinies must rapidly decide on a number of points so that effect may be given to them at the commencement of the New Year. The support of the Institution of Chemical Engineers will give us what we have so far lacked and deplored, the latest and most authoritative information on this great branch of knowledge essential to industrial chemists. We trust with the assistance of some of the chemical engineers to publish at the end of this month the first of a series of articles dealing with this department of the science. Nor can we remain content with the successes in co-operation already announced; there are other bodies who may find that the Society of Chemical Industry and this Journal may be able in the future to afford some assistance without interfering with that independence of thought which each society so highly and so rightly values.

* * *

It is beginning abundantly to be recognised that there is an urgent need for co-operation among chemists, whether for economy, or to prevent undue duplication. But the ultimate aim of such co-operation must be, if not to make the name of the chemist a power in the land, at least to make his work understood and respected. The builder of bridges or railways and the man who works in the machine shop are both known as engineers to the public, yet their respective functions are, we imagine, but rarely confused. It is true that there is something spectacular about engineering that appeals to the lay mind, whereas the chemist's work is more subtle, not so immediately obvious, but there is no reason why the amazing powers of chemistry should not be appreciated more fully. The suggestion has been made to us that the present lack of understanding is due to the chemist himself, and that he should emerge from his laboratory or lecture room and consort with all manner of men, carrying with him the chemical point of view into council rooms, local associations, or any other forms of public service. Such a course would undoubtedly strengthen the position of the individual, and this again would react on the strength of the mass. The pace of an army is that of its weakest unit, and this applies none the less truly to the chemical profession. If each chemist occupied his proper place as a citizen, he would act as a catalyst and stimulate the whole of public opinion, so that chemistry could not but occupy a greater place in the general esteem. Then would the attainment of our ideals be greatly facilitated, for as the action of the unit became more effective, so would that of the whole body chemical. We are told that, in the United States, chemists are frequently to be found serving with distinction in public offices, and chemistry in that great country does not altogether lack public appreciation. Let us draw the moral and apply it.

* * *

Lord Exmouth has testified his belief in the value of Chemical Clubs both in America and in Great Britain. The Chemists' Club in New York and the Chemical Industry Club in London have both been conspicuous successes, not only as clubs, but as a means of bringing together the many interests of the science and the industry. The Club in London owes its formation and its success very largely to the enthusiasm and good sense of Mr. H. E. Coley, who to the regret of all has found that he is unable to spare the large amount of time he has hitherto devoted to his congenial task of Honorary Secretary. It is in great measure due to his tact, his sociability and his determination that chemists naturally go to the Club whenever they can spare the time, knowing that they can be sure of finding there some men whom they know and are glad to meet. He has in this way rendered a valuable service to the chemical world, and the best way we have of showing our gratitude to him is to encourage in every way the institution in which he has so just and worthy a pride. Not that this is the only or even the main reason for such encouragement, there are more cogent ones; the dining-room, the smoke-room and even the billiard-room in Whitehall Court have enabled us all, whether we are chemists or merely those who live in a chemical atmosphere, to know ourselves and our associates better. Conscious as we are of each others infirmities—as the Committee is stated to have begun its report—we shall more easily and quickly make progress.

DINNER OF CHEMISTS

The dinner arranged under the joint auspices of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry was held at the Edward VII Rooms of the Hotel Victoria, London, on October 31. Sir William Pope, K.B.E., F.R.S., was in the chair and there was a company of 198, including many ladies.

After the usual loyal toasts, Lord Wargrave, P.C., proposed the toast of "Chemistry and the Nation," and coupled with it the name of Sir William Pope. The science of chemistry, he said, had done most remarkable things. At the outbreak of the war tremendous leeway had to be made up in the chemical industry and in chemical research, because previously we had been willing to depend upon the foreigner and, more curious than all, upon our chief antagonist in the war, for many essential chemicals. The chemists of this country were able to produce all that was required for the conduct of the war, and the position which the chemists were able to achieve in wartime—if we were going to be true to ourselves and to our countrymen—we were determined to maintain in peace time. Surely with all the present unemployment and the necessity for keeping up our industries it would be crass folly for us to allow those industries to be dependent upon foreign production. He sincerely hoped that the great experience which had been gained by chemical manufacturers during the war was not going to be lost, but that we should see security was given to chemical industry to enable chemists further to develop the discoveries which they made during the war period.

Sir William Pope, replying to the toast, said that those who had listened to Lord Wargrave's eloquent speech would realise that outside purely chemical circles there were enlightened people who appreciated and understood how much chemistry means to the nation. During the war we heard a great deal of the importance of chemistry to the nation. Even after the Armistice, we heard echoes of this, but he was afraid that appreciation of the importance of chemistry to the nation was becoming more and more feeble and that we are dropping back into the old way of letting things run on and trusting to luck that they would right themselves at the proper moment. But chemistry at present was not quite so much on the horizon as it was before; it may even have gone below the horizon a little, and it was the duty of public men like Lord Wargrave, just as much as it was the duty of chemists themselves, to see that this state of affairs was not perpetuated. It seemed to him that the main function of a gathering of this nature, at which chemists belonging to many sections of the chemical community were gathered together, was for them to take counsel together and to discuss what can be done in the future in order to push the interests—first of their own special subject, chemistry, and secondly the interests of the nation with respect to its concern with science generally. He hoped that a function of this sort would be held at quite frequent intervals so that they could consider what had to be done.

Mr. W. J. U. Woolcock, C.B.E., proposing "Our Chemical Organisations," coupled with it the name of Prof. W. P. Wynne, F.R.S., president of the Chemical Society, and said that chemical science and technology in this country was very well served with Associations. One thought, of course, immediately of the Chemical Society going back to 1841, with some 4000 or 5000 members; one also thought of the Institute of Chemistry, also founded before he was born, having fellows and students and so forth of well over 5000, and there was the Society of Chemical Industry with a membership of over 5000. There were all these big general societies, and there were also a number of special societies and associations. There were many societies—he hoped nobody would say too many—but he was not quite sure whether some of these societies might not be able, in the interests of economy of effort and of efficiency, to find some form of combination, some form, perhaps, even of loose linking up, which would enable them to work in much closer touch with the more general societies to which he had referred. (Applause.) A considerable amount of co-operation and linking up had taken place. The presence of Dr. Herty reminded him that recently the American Chemical Society and our own Chemical Society had arranged to co-operate in producing the *Journal of Physical Chemistry*, which was all to the good; a sign of the times. After all, what was this dinner? It was a dinner of the chemical Allies and the toast he was proposing was the toast of the chemical Allies. They might not yet put it in that form. We were typically British whatever else we were, and we did not propose to do anything in a hurry. Therefore, at this first joint meeting the toast was discreetly put down not as the toast of the chemical Allies, but as the toast of "Our Chemical Organisations." If to-day was the day of anything, it was the day of co-operation and co-operative effort. Everybody in every sphere of life was trying to see whether any economy could be effected by working together; whether there was any increased efficiency to be gained by such effort; and to-day the members of chemical organisations of various kinds had met together to see what were the possibilities in that direction. There was one body to which he wished specially to refer and that was the body presided over by Sir William Pope, the Federal Council. He supposed everybody present had watched the Federal Council and its formation very closely indeed. He did not, himself, think that it was the business of the Federal Council to act independently; he did not detect on that Council a desire to usurp the position of any of the other bodies; but he did think there was room for the Federal Council to act, perhaps in two ways. The first was that the Federal Council might quite easily be a forum, so that ideas with regard to progress among the various societies could be offered to it for consideration. There was also one thing which the Federal Council had set out to do, but had not yet accomplished, although he believed it would ultimately be accomplished, viz., the establishment of a central home for chemical organisations. Ultimately, perhaps, that would be the first great achievement of the Federal Council. He was inclined to think that there is a far greater movement taking place around us than we are conscious of in that linking up of chemical industries and the scientists who are working with them. It was rather a triumph for the Society of Chemical Industry to be able to start a weekly paper. It was rather a triumph that the Chemical Society should come in and assist in the manner they did, and also, from the industrial point of view, that the Association of British Chemical Manufacturers should also have come in. That was a mere beginning, and there was also a project for the publication jointly of scientific and technical abstracts. All these things proved that progress to-day with the societies was by no means slow.

Prof. W. P. Wynne, F.R.S., acknowledging the toast, said that without doubt the number of chemical organisations was considerable, and Mr. Woolcock had rather suggested that there were too many. Whether that be so or not, it would not be suitable that he should discuss it on this occasion. Without doubt, these associations served a very useful purpose, but when considering them it was impossible not to be struck by one fact, that only two of them possessed homes of their own. One of them was the Institute of Chemistry which had built its own house within recent times, so that it might be supposed to be ample for its purpose. The other, was the Chemical Society, which was merely a tenant in its own house, and in that house accommodation was severely restricted. The Chemical Society offered hospitality to all the other societies which were able to make use of its rooms, but the accommodation was very small. They had been told that within a year they would not be able to find room for their books in the library, which was the most important chemical library in this country. The Chemical Society had been told, on taking up this matter with the Government, that it must either try to find accommodation with the other societies in Burlington House—which themselves were severely pressed for room—or else go out into some remote part of London where rents are cheap, and find a home for themselves. That was the position which, in the opinion of certain Government departments, chemistry holds five years after the war. (Shame.) What was required at the present time—and Mr. Woolcock was doing good work in that connexion—was a campaign of publicity.

Chemists had got to explain themselves to an unbelieving country. The country did not understand the chemists or their work, and until some progress had been made in that direction he was afraid they would always be open to the difficulties to which he had referred. If, in the days to come, they succeeded in getting a home for all the chemical organisations, then, perhaps, the country would believe in chemists. Therefore, it seemed to him that they had in Mr. Woolcock a leader whom they should follow to the best of their ability. The work he was doing in connexion with the big exhibition was all to the good, and they should back him up to the best of their ability, and so hasten the day when that sun of chemistry, to which reference had been made, had arisen above the horizon and had dispelled the mists which now hide from the minds of our countrymen the supreme importance of chemistry to a nation like this, which depends upon its industries for its very existence.

Dr. E. F. Armstrong, F.R.S., President of the Society of Chemical Industry, in proposing "The Universities," and coupling with it the name of the Rev. E. C. Pearce, the vice-chancellor of the University of Cambridge, said he supposed he had been selected to propose this toast because he was in part a renegade. Having been trained in connexion with Universities he had deserted and had gone over to industry—he spoke now as a representative of industry, as a convert to industry, and as a believer in industry. It was our habit to attribute unemployment to every cause under the sun; the war, the inefficiency of our politicians, and particularly to the gross incapacity of those who led our industries and our chemical industries in particular. The text he was going to preach from, however, was faith. There was a very great man in this world once, not an Englishman, but an American representative, Robert E. Lee, to whom there came, perhaps the greatest choice of all, the choice between his honour as a soldier and his love for his country, and he, just as a simple gentleman would, chose his country. Perhaps they would remember the words of his choice. The words were, "Argument is over; faith begins"; a very honourable sentiment. To-day they were holding a joint meeting of a number of the chemical societies; they had noble ideas, but they had a feeling of grievance that they had been left in the rut. They got up and talked and blamed everybody excepting themselves, but what he wanted to suggest was that they should have more faith in themselves, and in those whom they chose as their leaders if they were going to deserve success. If they did not deserve success then they would never achieve it. Faith was what they must have. Unfortunately the whole education of the chemist was that he was brought up to analyse, to criticise and to argue, and he never lost those horrible habits. As chemists they must cast this trait out of their characters if they were to work together and achieve great things. They must not criticise, they must not analyse; they must have faith. A profession that was critical, carping and niggardly and had any faults of that description could not hope to attract into its ranks big open-hearted men such as the English nation had been only too proud to possess.

The Rev. E. C. Pearce said that he agreed with Dr. Armstrong that what is wanted is not only a trained chemist, but a man with vision. He himself had always thought that the great advantage of the older universities was that they produced not mere machines, but men who could be entrusted with a job and who knew what to do when they were in a tight fix. Personally, he believed the older universities were able to produce men with the technical knowledge and also with this power of vision and decision, and although he did not want to blow the trumpet of Cambridge too loudly he must say that there is no chemical school in the country at the present time which was better housed or better staffed than that over which Sir William Pope now presided.

Lord Exmouth, who received a cordial welcome, said he had gone to America when a boy of nine, and went to the School of Mines at Colombia University. In his third year he came to Europe to study some special aspect and on his way to England stopped at a man's house. During an after-dinner discussion, he was told that to have given up the classics to study science was an absolute degradation, and when later he said he intended to study chemistry, his host was horrified, and seemed to think that he would be rolling pills all his life in an apothecary's store. He impressed upon those people, however, even then his belief that the country which had the most chemists and the best chemists would be the one that would win out in the future. Manufacturers generally were now beginning to appreciate the importance of having a first-class chemist in their works. This was the case to some extent in America, but it was not done to the extent it ought to be. At the same time, all the great firms had their laboratories, and industry in America to-day was based very largely on chemistry. Something had been said during the evening about co-operation of the different chemical societies and of the manufacturers. In America the greatest possible advantage from this point of view had been obtained from the Chemists' Club. At this club meetings were held at which chemists and all those interested in chemists were welcomed, not only from New York, but from all over the country. It was for this reason that he had been interested to find in London a Chemical Industry Club of which, thanks to Sir William Pope, he had been elected a member. He concluded by expressing the hope that the Chemical Industry Club in London would grow into one of the great central organisations of the world for chemists.

THE BOHR ATOM

By Dr. J. D. MAIN SMITH

The extension of the frontiers of scientific knowledge into domains, regarded a very few years ago as unknowable or remote from any possibility of experimental demonstration, has perhaps been nowhere so great or so rapid as in the sciences overlapping the borders of chemistry, which to-day merges indistinguishably into the newer profundities of physics and mathematics, to an extent almost inconceivable even a decade ago. The atom, which had been for nearly a century merely a hypothetical primary particle of chemistry, is now known with certainty not merely to have reality, but to have detailed structure, and to consist of small particles, electrons, of almost inconsiderable mass, and a yet smaller central nucleus, possessing almost the whole mass of the atom. The electrons in the neutral atom are further known to carry equal negative electric charges, the nucleus carrying a positive electric charge equal to the sum of the electronic charges.

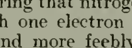
As no components of atoms are discernible, other than electrons, nuclei, and electric charges, it can hardly be doubted that in this grained and electric structure lies the cause of the difference in the physical and chemical properties of the elements, and much research has been devoted to the elucidation of the possible, probable, and actual nature of the atomic structural arrangements and governing forces. The probing has been so deep and the results so extensive and suggestive, that direct application to the experimental facts of chemistry has become possible, and several theories, based on electronic structural systems and claiming to give a more or less adequate interpretation of the broad outlines and fundamental principles of chemistry, have been propounded within the last few years.

The accumulation in chemistry, however, of a vast detail of exact and abstruse knowledge, has made the average chemist necessarily a specialist, not merely in one science, but even in one small section of a science, and he can seldom keep abreast of the advances in real knowledge in his own science, much less in the overlapping sciences. The multiplicity of these atomic theories is, consequently, an embarrassment, and renders it difficult to come to a decision as to which, if any, of the theories can usefully be applied to the practical and theoretical problems of chemistry. Instinctively, and perhaps properly, the chemist tends to be sceptical of the validity of chemical conclusions drawn from purely physical and mathematical considerations, and such conclusions are seldom accepted until they have been examined by chemists generally, and demonstrated to accord with the established chemical facts and principles.

Of the various atomic theories that have been put forward, only two can be said to have survived critical examination by chemists. These two theories are associated with the names of Langmuir and Bohr, respectively, and, though similar in regard to the division of the atom into numerically fixed groups of electrons round a central nucleus, differ fundamentally as to both dynamics and derivation. The Langmuir theory, which extends the earlier theories of Thomson and of Lewis, interprets the general and periodic properties of the elements in terms based on a series of postulates, formulated solely for the purpose of the interpretation, and assumes that the electrons of an atom are fixed in more or less static configurations, in small areas of concentric shells of electrons with the nucleus as centre. The Bohr theory, on the other hand, explains the specific properties of elements in terms based on an interpretation of the optical and X-ray spectra of elements, assumed as originating in electrons, possessing *kinetic* energy in virtue of their revolution around the nucleus according to definite mathematical and dynamic laws. The Langmuir theory has enjoyed almost a vogue in many chemical circles, despite that its application to chemistry requires special assumptions for nearly every element and for many classes of compounds, and is definitely irreconcilable in many cases with the chemical evidence. Bohr and others have further pointed out that, if the only forces within the atom are due, as the evidence indicates, solely to electric charges, then a static configuration of the electrons is impossible. It therefore appears that the Langmuir theory, however chemically attractive a static theory may be, has no sound foundation, and its title to application to chemistry must be held to be dubious.

In his "Theory of Spectra and Atomic Constitution," 1922, page 93, Bohr states: "My main purpose will therefore be to consider the fitness which the configuration of the electrons in the various atoms offer for the formation of *ions*." It is not therefore to be expected that the theory can offer any adequate explanation, in its present form, of the vastly more difficult problems of organic and co-ordination chemistry, relating entirely to complex compounds in which the atoms are non-ionisable. Dr. Sidgwick has, however, in papers read recently before the Chemical Society and the British Association (*J.C.S.*, 1923, **123**, 725, and this vol., page 901), elaborated an extension of Bohr's theory to the electronic constitution of the atoms in co-ordination compounds, by utilising part of Langmuir's theory. This extension will be dealt with later, and it is proposed firstly to examine in some detail the application of Bohr's theory to some of the simpler experimental facts of chemistry, for if it be incapable of interpreting the simpler facts, its claim to apply to more difficult problems must be discounted.

Restricting, for a moment, the application of the Bohr theory to matters of ionisation, to which it mainly relates, it is remarkable that, though full provision is made for the existence of atomic ions carrying one positive charge, and two, three, and four positive charges, no cognisance appears to be taken of the much more important fact that no atomic ions are capable of existence carrying more than one *negative* charge. Further, the phenomena of oxidation and reduction, the basis of the whole chemical theory of valency, are explained by Bohr as very simple matters of gain or loss of electrons by ions. When, however, it is realised that the great bulk of these phenomena relates to atoms incapable of furnishing ions and to compounds in which the atoms are non-ionisable, it is obvious that the field of the actual application of the electron valency theory is thereby restricted to dimensions quite inconsiderable in chemistry. Moreover, it is practically certain that the ions of all bi-, ter-, quadri- and quinque-valent elements, and some univalent elements, are not simple atomic ions, but complexes of metal and solvent molecules. No account is taken of this almost universal hydrolysis (ammonolysis, etc.) of simple salts to form non-ionised basic salts, non-ionised hydroxides, or complex salts having non-ionisable components, and the theory is therefore applied in misapprehension of the facts.

No provision is made for the fact that boron has practically no basic properties, unlike its congeners aluminium, scandium, etc., and that, though a tervalent non-metal, it is incapable of forming any compounds with the contra-valency of five, unlike nitrogen, also a tervalent non-metal, which readily exerts the contra-valency of five. When account is taken of the extremely symmetrical structure assigned to carbon to account for its physical inertness and its chemical idiosyncrasies, no explanation seems possible of the existence of carbon monoxide, the difficulty attending its decomposition, and its feeble additive properties. Considering that nitrogen is assigned a structure in which one electron appears in a 2_2-quanta orbit, and more feebly bound than the other four electrons in 2_1-quanta orbits, it is difficult to understand why this single electron should not be readily available and nitrogen thus be definitely univalent. It is impossible to claim that nitrous oxide contains univalent nitrogen. Its formation from NH_4NO_3 is precisely analogous to the formation of azoxy-compounds in the reaction between aromatic amines and nitro-compounds, in which the product has the structure  $Ar{-}N{=}N\begin{smallmatrix}\nearrow O\\ \searrow Ar\end{smallmatrix}$ nitrous oxide therefore having the structure $N{\equiv}N{=}O$. It is similarly difficult to understand why nitric oxide, NO, and nitrogen peroxide, NO_2, exist. No provision is made for the inability of nitrogen to combine with fluorine, in view of the existence of chlorides and iodides of nitrogen, nor for the existence of NO_2F, and non-existence of NOF_3. There appears to be no reason why oxides of fluorine and bromine should not exist, in view of the existence of oxides of chlorine and iodine, nor why chlorine should not combine with fluorine or bromine, in view of the fact that oxygen combines readily with all the members of the family to which it belongs.

Though both thallium and indium in the third periodic group have univalency, neither boron nor aluminium is ever univalent. This is the less understandable in view of Bohr's admission that, on the spectral evidence of sodium, magnesium and aluminium, the latter has the 13th electron in a 3_2-quanta orbit, despite that only two instead of the four required tetrahedrally arranged electrons can be in 3_1-quanta orbits. If all three electrons are in 3_2 orbits, they will be less firmly bound than in 3_1 orbits, and aluminium be a stronger base than magnesium, which is untrue. If only one electron is in a 3_2 orbit, aluminium should be definitely univalent, which is also untrue. Many inferences are possible: that 3_2 orbits do not correspond to a feebler binding than those of 3_1, that the more feebly bound electrons are not the last built into the atom, that two of the valency electrons of aluminium are neither in 3_1 nor 3_2 orbits, or that the spectral evidence is wrongly interpreted. Each of these inferences vitiates Bohr's general theory, yet no other is possible. Overriding the difficulty, Bohr goes on to assume that the valency electrons of silicon are in 3_1 orbits, and similar in configuration to the 2_1 electrons of carbon. This arrangement leaves no loophole to account for the fundamental difference between carbon and silicon, in that quadrivalent carbon atoms have their chemical affinity completely satisfied, whereas quadrivalent silicon atoms are still capable of further chemical combination. SiF_4 combines with two ammonia molecules, to form $Si(NH_3)_2F_4$, and with two fluoride ions to form the complex ion SiF_6, whilst $SiCl_4$ combines with six ammonia molecules to form $Si(NH_3)_6Cl_4$.

Similar examples of the inadequacy of the Bohr theory to explain the structure or the existence of simple compounds or to account for the chemical activity of elements, could be multiplied almost indefinitely, despite the provision in the theory of vague and complicated suggestions (hardly schemes) to account for the three sets of transition elements and their neighbours in the periodic classification, and for the family of the "rare earths." The theory must be held to be incapable of general application in chemistry, but, undoubtedly, it is applicable to all cases of simple atomic ions, and throws much light on the probable structure of atoms both in the elementary and combined states, on the probable cause of their reactivity, and on the stability of their compounds. The fact that it is based largely on the chemical facts summarised in the periodic classification, on the experimental facts of spectrum analysis, and on mathematical and dynamic laws, encourages the belief that the Bohr atom is largely a reality, and an admissible chemical expedient.

In Dr. Sidgwick's extension of the Bohr theory to co-ordination compounds, a relationship is developed between atomic structures and the co-ordination numbers of Werner's theory. The postulates required by this relationship have no mathematical or dynamic necessity consequent on the electronic configurations of the suggested Bohr atoms, but are extraneous assumptions arising from the absence in Bohr's theory of any provision for combination between atoms without ionisation. They relate, consequently, to the electronic links between non-ionisable atoms and to the distribution of the electrons in the atomic structures. In how far these postulates are derivable from provisions in Bohr's theory or are in partial or complete disagreement with certain features of this theory, which they are claimed to extend, will be indicated later, but it may be stated here that they scarcely furnish a sufficient basis on which a consistent explanation of chemical problems can be built.

The first postulate concerns atomic linking, and is identical with that originally formulated by Lewis, and largely utilised by Langmuir in his elaboration of Lewis's theory. It is that *two* electrons are necessary in the junction between non-ionisable atoms for every chemical valence, the electrons being simultaneously portions of both atomic structures. With regard to this linking, known as a co-valency, Dr. Sidgwick states: "How this sharing of electrons is effected is still uncertain. Each electron certainly forms part of the constitution of both the atoms which it joins." It might be supposed from this that the existence of co-valencies was a proven fact. Actually there is no evidence to support it. The necessities of an applied scheme of co-valency makes it plausible, particularly in the realm of organic chemistry, but in inorganic chemistry the postulate of only one shared electron is probably as useful, and would certainly appear to be a more logical extension of Bohr's theory. It is certain that chemical valency is measurable in all classes of compounds, whether or not ionisable, in identical terms, oxidation or reduction equivalents, and is identified in Bohr's theory with singly transferred electrons. It yet remains to be proved that there is any fundamental difference in the nature of the essential reaction of atoms, to produce ionisable and non-ionisable compounds. Take the case of the typically co-ordinated compounds, the silicofluorides, in which the fluorine atoms are somehow bound to the silicon atom, so that the SiF_6 radicle reacts as a complex ion. With barium salts, simple double-decomposition occurs, and $BaSiF_6$ is quantitatively precipitated. With calcium salts, particularly if an excess be used, CaF_2 and silicic acid are almost instantly precipitated, the fluorine atoms being evidently almost as readily available as in an ordinary ionic double-decomposition with a simple fluoride, such as NaF. On this fact, indeed, are founded the two most reliable methods for the estimation of fluorine, the CaF_2 being weighed when calcium acetate is used, and the HCl liberated being titrated when $CaCl_2$ is used. If any inference relative to electrons may be drawn, it is that the electronic link between fluorine and silicon is practically indistinguishable from the electronic link between ions, such as NaF. It may further be remarked that, in the case of the metal amines, every stage between complete ionisation and complete non-ionisation of a co-ordinated atom, such as a halogen, has been experimentally realised. It is not suggested that the co-valency postulate does not represent a reality. It may be the real bond in all chemical reactions involving non-ionisable atoms, but it is not a necessary conception for inorganic chemistry. An exhaustive application of the conception of *one* electron per bond to all classes of chemical compounds breaks down only in the case of straight chains of atoms containing more than three *carbon* atoms, *i.e.*, only on entering the realm of undoubted aliphatic and aromatic chemistry.

The second postulate concerns the number of co-valencies (or non-polar links) that can be associated with an atom. It is that the maximum number of co-valencies is equal to twice the principal quantum number of the group to which the valency electrons are assigned in the Bohr atom. This number is further identified with the number of electrons in the sub-group to which the valency electrons belong, and with the maximum co-ordination number. The last two identifications do not accord with the facts. From Na to Cl, the valency electrons are in sub-groups having the principal quantum number 3; nevertheless, the completed Bohr atom has only 4 electrons in each of two of three possible sub-groups. Twice 3 is not 4, even in the Bohr atom. The majority of the elements from atomic number 29, Cu, to 92, U, deviate similarly from this rule, owing to the fact that, though principal quantum numbers increase systematically, the number of electrons assigned by Bohr to the "outer" or valency orbits is usually 4 and occasionally 6. From what follows it will be seen that the co-ordination number, admitting even the most doubtful cases of highest number, is not equal to twice the principal quantum number for most of the elements in the periodic classification. The origin of this postulate is not difficult to see, for Bohr utilises the idea to find room for the transition elements and the rare earths, the inert gases having invariably 4 electrons in the "outer" orbits, whilst the structures of intermediate stability, Ni, Pd, and Pt, have some or all of the corresponding orbits with a number of electrons equal to twice the principal quantum number. The numbers in Bohr's groups are based on real experimental evidence, optical spectra and the periodic properties of the elements. The numbers in Dr. Sidgwick's groups have no necessity beyond a desire to obtain an inert gas structure or, failing that, any structure that looks symmetrical. The number of electrons in co-valencies, involved by the attempt to identify co-ordination number with number of co-valencies, compels the abandonment of the invariable inert gas type, and a new type is proposed, every atom having at least one such type, and some atoms several types. This lack of provision of even a few standard types cannot be regarded as a satisfactory general solution of co-ordination problems, and their multiplicity appears unnecessary. A single example will illustrate the point. The AlF_4 group contains $13+36+1=50$ electrons. If the F atoms have the neon structure of 10 electrons, 40 in all, 10 are left, which with the 8 in 4 co-valencies, make 18, the argon structure, for Al. On the other hand, the AlF_6 group contains $13+54+3=70$ electrons. If, as before, the F atoms have neon structures, 60 electrons are required, and 10 are left, which with the 12 in 6 co-valencies make 22 for Al, the atomic number not of an inert gas but of titanium, one of the most chemically reactive elements known, yet the type to which we are asked to believe the inert substance, cryolite, Na_3AlF_6, is to be referred.

It is claimed that this postulate enablse the maximum co-ordination number to be predicted. From Li to F, the principal quantum number for the valency electrons is 2, and the co-ordination number should be $2\times2=4$. Dr. Sidgwick states: "Here therefore the co-ordination number cannot exceed 4; this fact is generally admitted by the Werner school." This *fact* may be disputed, on the grounds that the Werner theory is not concerned with theoretical maximum co-ordination numbers, but with the numbers experimentally realisable, and that the number 4 is apparently frequently exceeded in this group. The number 6 for beryllium and the numbers 5 and 6 for boron are apparently possible, *e.g.*, $Gl(NH_3)_6Cl_2$, Na_2BF_5, $B(NH_3)_3F_3$, and H_3BF_6, and the hexa-borotungstates. The number 5 is known for nitrogen, the penta-alkyl derivatives having recently been isolated, and no compound is known in which a *greater* co-ordination number than 2 can be assigned to fluorine. Further, from Na to Cl the principal quantum number is 3, and the co-ordination number should be 6, which is more than doubtful for Na (4 is a probable maximum in practice), untrue for Al and Si (K_4AlF_7, K_3SiF_7, and $Al(H_2O)_{20}F_3$ are known), and for P and Cl, the known maxima for which are 5 and 4 respectively. It thus appears that 9 of the 14 valent elements from Li to Cl do not accord with the postulate.

Further, Bohr has shown that K and Ca have their valency electrons in 4_1 orbits, thus involving co-ordination numbers of 8. This may be admitted for Ca, but is certainly untrue for K, for which the number is in practice usually zero. From considerations of the arc and spark spectra of K and Ca, Bohr states that, from this point onwards to Ni, the binding of a 3_3 electron is firmer than for a 4_1 electron, and the valency electrons from Sc to Ni must be regarded as in 3-quanta orbits, and the co-ordination numbers should in consequence be 6. Nevertheless, a common co-ordination number for titanium is 7, and 8 is not infrequent, *e.g.*, TiF_7x_3, $TiO_2F_5x_3$, TiF_8x_4, $Ti(NH_3)_4F_4$, $Ti(NH_3)_6Cl_4$, and $Ti(NH_3)_8Cl_4$. It is evidently not correct to state that "the 4-quantum group begins to be filled up after we have got past nickel (28), and though a co-ordination number of 8 is rare . . . we find it as early as zirconium" (40). The facts are that the 4-quanta group is in evidence as early as potassium (19), and co-ordination numbers of 8 are by no means rare and are found as early as titanium (22) and probably as early as magnesium (12).

Bohr's theory provides for 4-quanta orbits from Cu(29) to Br(35), and from Y(39) to Pd(46), for 5-quanta orbits from Ag(47) to I(53), in Rb(37) and Sr(38), and from La(57) to Pt(78), for 6-quanta orbits in Cs(55) and Ba(56), and from Au(79) to Po(84), and for 7-quanta orbits from Ra(88) to U(92). This involves that co-ordination numbers of 8, 10, 12, and 14 should be common in chemistry. Nothing could be further from the facts, for numbers higher than 8 are decidedly rare, and, where they do occur, cannot be foretold from Dr. Sidgwick's postulate. Osmium should have a maximum of 8, but $OsCl_{12}Na_6$, and $OsCl_{12}K_6$ are both known. Columbium should also have a maximum of 8, but $CbF_{10}x_5$, and $CbF_{12}x_7$ are well known types. Uranium should have a maximum of 14, but the highest known is 11 in $UF_{11}x_8$. Tantalum should have a maximum of 10, but cases of 12 are common, and even 20 appears possible in $TaF_{20}x_{15}$. If the postulate is claimed to govern only ideal maxima it is irreconcilable with the fact that such ideal maxima are frequently much exceeded in known compounds.

A closer examination of the postulate, however, seems to indicate that it is inconsistent with the fundamental feature of Bohr's theory that every electron, having a particular quantum number, must actually execute the orbit round the nucleus, in a path determined by the principal and subsidiary quantum numbers, which limit the major and minor axes of revolution. As the electrons in co-valencies are derived from considerations of the principal quantum number of the orbits of the valency electrons, the co-valent electrons must by inference be characterised by this quantum number. In the case of the cobalt-amines an obvious discrepancy arises, for the valency electrons have quantum number 3, and the co-valency electrons therefore the same. The cobalt atom has 14 electrons in 3-quanta orbits and $3 \times 6 = 18$ is the most that can be placed in such orbits, *i.e.*, 4 more than the atom possesses. These could be supplied by 2 co-valencies, but the co-ordination number of cobalt is 6, thus involving 6 co-valencies or 12 electrons, 8 more than the orbits can accommodate. Dr. Sidgwick assigns the 8, without comment, to 4-quanta orbits, thus violating the conditions on which the postulate claims relationship with Bohr's theory. It is peculiar, though perhaps only accidental, that cobalt is used as one of Dr. Sidgwick's illustrations, and that the structure arrived at is 2, (44), (666), (44), identical with that of the inert gas krypton. Had chromium been chosen (its amines are almost indistinguishable from those of cobalt in most of their properties) no such coincidence could have occurred, nor, indeed, for almost any other element.

The new types of atomic structures, other than the inert gases, are based on what is termed " the effective atomic number," which is the " actual number of electrons, shared or not, which are attached to the atom in the particular compound. It is attained by adding to the actual atomic number one for every substitution link and two for every link where the two electrons are taken from another atom . . . and allowing for the electrons added or removed by ionisation." This number is then to be resolved " on the Bohr system " into the most probable groups and sub-groups. It is pertinent to enquire how one is to decide when a link is a substitution link and when it is some other kind, and when two electrons are to be taken from another atom. For example, in the case of the acetylacetones of zirconium, three electrons per acetylacetone residue are to be added, but can three be added for the acetylacetones of thallium and of *all* the alkali and alkaline earth metals ? If so, no explanation appears possible for their instability to hydrolytic agents and rise of temperature. If not, the rule ceases to be applicable, as the exceptions are too numerous to be disregarded. The resolution of the " effective atomic number," moreover, cannot in any event follow the " Bohr system," for groupings are frequently obtained which have no meaning in Bohr's theory. Too much stress cannot be laid on the fact that the Bohr electronic groupings are conditioned, not by what any particular person may consider the most probable groupings, but by mathematical, dynamic and chemical considerations, based in the main on real experimental evidence. The " effective atomic number " may mean anything or nothing, for the " actual number of electrons " attached to an atom is quite indeterminate at present, except perhaps for atomic ions. The resolution of such numbers into groups is, therefore, admissible only when equal to Bohr's ionic numbers, and, if not equal, the groups obtained by any process of resolution can have no necessary reality, being dependent only on personal predeliction, within the limits of the first four even numbers.

The position of the first element, hydrogen, in the extended Bohr theory, is decidedly anomalous, for the postulate necessitates that it have a maximum co-ordination number of two, or two co-valencies consisting of 4 electrons. As the quantum number for hydrogen is unity, the maximum number of electrons that can be accommodated in such quantum orbits is 2. Consequently, two of the co-valency electrons must be assigned to orbits to which their quantum number does not relate. This appears impossible, for in the Bohr atom an electron cannot have two principal quantum numbers, *i.e.*, cannot revolve in two different orbits simultaneously.

It is proposed to increase the valency of co-ordinated atoms in proportion to the number of electrons held in co-valencies. It appears to be time to raise at least a mild protest against the misuse of the fundamental chemical conception of valency, which is not merely an abstract idea, but the name for a real quantity, measurable in the ordinary terms of oxidation or reduction equivalents. NH_4Cl must contain *ter*-valent nitrogen and *uni*-valent chlorine, because, however it be synthesised, only four equivalents of hydrogen are necessary for the complete reduction of both the nitrogen and chlorine atoms from the free to the combined state, conclusive chemical evidence that the nitrogen atom cannot be *quadri-* or *quinque*-valent so long as the chlorine is accepted as *uni*-valent. Purpureo-cobalt chloride $Co(NH_3)_5Cl_3$, contains *ter*-valent cobalt, as was proved experimentally by both Gregory and Gibbs over 70 years ago. To assign to the cobalt atom a valency of 9 is to misunderstand the meaning of valency. It may have 9 electrons associated in its periphery, or any other number that any other electron theory may require, without any alteration in the chemical fact of its measurable *ter*-valency. Dr. Sidgwick and others agree in assigning to metallic atoms *negative* valency, in spite of the certain chemical knowledge that metallic atoms are oxidised, not reduced by chemical combination. This inversion of the chemical facts makes the practical application of such ideas very difficult, and does not appear to advance the solution in the slightest.

The difficulties attending the application of the co-valency postulate and the theories based on it in its present form, all appear to take their rise from idea that two shared electrons can be simultaneously effective in two atomic structures. It is doubtful if the facts or the electrons are so simple or lie so close to the surface. The mechanism is too simple to be capable of interpreting the multitudinous facts of the chemistry of non-ionisable complexes and organic compounds. It seems imperative that the shared electrons must react as if only one at a time were effective in any one quantum orbit, and provision must therefore be made in each atom for a harmonic reaction between the shared and unshared electrons bearing the same quantum number, resulting in mutual deformation of the electronic orbits, so that the continuous path of the shared electrons lies between and round the nuclei of both atoms. The fact that this problem, which is the astronomical problem of the twin-sun system, is not completely soluble by the present-day mathematics, need not necessarily be discouraging. The enormous mass of chemical facts, derived from co-ordination and organic chemistry, must contain the materials for at least a tentative solution of the problem, and it is probable that a very close solution will be provided on chemical grounds before the mathematics of the twin-sun system are sufficiently developed to be of use. This may be inferred from the fact that the precise constitution of many co-ordination compounds had been deduced on chemical grounds, before the methods of X-ray analysis and the mathematical interpretation of the results existed, and the same may be said in organic chemistry. Bohr's theory itself, for example, is conditioned from end to end, less by the necessities of mathematics and dynamics than by the periodic properties of the elements, and it is certain that, had the periodic classification not existed, no theory of atomic structure could have been developed.

The electron structure of atoms seems destined to play a large part in the future development of chemical science, and every suggestion and postulate that may help towards a coherent general theory of electronic chemistry must be welcomed. It is evident, however, that the present theories are not generally applicable to the facts. They are valuable, nevertheless, in provoking discussion and research and generally in clearing the chemical atmosphere, but it is equally evident that none of them is sufficiently well-founded and developed to constitute a bridge between the structure of the atom and the chemistry of molecules.

Chemistry Department,
The University, Birmingham

Prof. F. C. Lea, professor of Civil Engineering in Birmingham University, has succeeded Prof. Ripper in the Chair of Engineering, Sheffield.

FORTHCOMING EVENTS

Nov. 13. Society of Chemical Industry, *Edinburgh and East of Scotland Section*, in the Pharmaceutical Society's Hall, 36, York Place, Edinburgh, at 7.30 p.m. "The Constitution of Kojic 'Acid,' a γ-Pyrone Derivative formed by *Aspergillus Oryzae* from Sugar," by Dr. T. Yabuta. "The Reduction of the Mono-halogenated Phenols," by J. B. Shoesmith, M.Sc., and R. H. Slater, B.Sc. "Polarity Effects in the Isomeric ω-Bromo-toluid Acids," by J. B. Shoesmith, M.Sc., and A. C. Hetherington, B.Sc.

Nov. 13. Institution of Petroleum Technologists, at the Royal Society of Arts, John Street, Adelphi, W.C. 2, at 5.30 p.m. "Galician-Canadian Pole Tool Fishing Methods," by A. Millar.

Nov. 13. Royal College of Science Chemical Society, College of Science, South Kensington, S.W. 7., at 5 p.m. "Some Large Metallic Crystals and their Properties," by Prof. H. C. H. Carpenter, F.R.S.

Nov. 14. Institute of Chemistry, *Leeds Area Section*, Queen's Hotel, Leeds, at 7 p.m.

Nov. 16. Institution of Rubber Industry, Hotel Victoria, Northumberland Avenue, London, S.W. 1. Annual Meeting at 6.30. Dinner at 7.30 for 8 p.m.

Nov. 16. Society of Chemical Industry, *South Wales Section*, The Technical College, Mount Pleasant, Swansea, at 7.15 p.m. Paper to be read by E. A. Tyler, M.A.

Nov. 16. The Society of Dyers and Colourists, *Manchester Section*, 36, George Street, Manchester. "Investigations into the Changes which occur in Cotton Fabrics during Calendering and Beetling," by J. Huebner and V. Malwin.

Nov. 16. The University of London, W.C. 1, at 8 p.m. "The Fundamental Concepts of Natural Science," by Prof. G. Dawes Hicks. (Lecture 3.)

Nov. 16. Society of Chemical Industry, *Liverpool Section*, The Overseas League, 14, Elliott Street, Liverpool, at 6 p.m. "Our Water Supplies," by E. Thompson.

Nov. 19. British Museum Swiney Lectures on Geology. A Course of Twelve Lectures on "Gem Minerals and their Uses in Art and Industry," by W. T. Gordon, M.A., D.Sc., in the Large Theatre, King's College, Strand, W.C. 2, at 5.30 p.m. Also on every Monday, Wednesday, and Friday until December 14.

Nov. 19. Royal Society of Arts, John Street, Adelphi, W.C. 2. (Cantor Lecture), at at 8 p.m. "The Cultivation of Cocoa in British Tropical Colonies," by S. H. Davies, M.Sc.

Nov. 19. The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, at 7 p.m. "Power in Telephone Exchanges." Discussion to be opened by A. B. Eason.

SOCIETY OF CHEMICAL INDUSTRY

EDINBURGH AND EAST OF SCOTLAND SECTION

The opening meeting of the winter session was held in the Hall of the Pharmaceutical Society, Edinburgh, on October 30, 1923, when the chairman, Dr. Alexander Lauder, gave his opening address, entitled "Old and New Problems in Agricultural Chemistry."

Dr. Lauder referred to Liebig's Report on Organic Chemistry in its application to Agriculture and Physiology presented in 1840, and to Gilbert's Presidential Address to the British Association in 1880, and he traced the development of agricultural chemistry since these days, dealing in particular with researches on the supply of nitrogen to the plants. He then outlined the present position of the theories regarding absorption of salts by the soil and the question of soil acidity. This was followed by a discussion of Hoagland's recent work on the relation of "Soil Solution to Plant growth."

Dr. F. D. White also read a paper on "Galegine—an alkaloid from *Galega officinalis*."

MANCHESTER SECTION

The third annual joint meeting of the Manchester sections of the Society of Dyers and Colourists, the Society of Chemical Industry, the Institute of Chemistry and the Manchester Literary and Philosophical Society, was held on November 2, at the Textile Institute. The chairman of the Society of Dyers and Colourists, Mr. Wm. Marshall, J.P., F.I.C., took the chair, There was an attendance of about 270.

Prof. W. D. Treadwell, Ph.D., Professor of Analytical Chemistry at the Federal Technical High School, Zurich, gave an address on the recent developments of electrometric methods in analytical chemistry.

These methods were first used in chemical research about thirty years ago, in a form, however, which proved to be too complicated for technical chemical analysis. During the last few years a rapid development of electrotitrations has been brought about, consisting mainly in the application of the above-mentioned electric indicators to all kinds of chemical titrations. Prof. Treadwell described the simplifications which had been devised in the necessary equipment, so that these methods could now be used even in the most primitive technical laboratory.

The lecturer indicated the lines along which further systematic study of the behaviour of titration-electrodes was required. In numerous cases the phenomena of activity awaited explanation. In spite of the very considerable literature on surface reaction, an exact knowledge of these phenomena, based on the electrostatic attraction of the effective atoms and molecules had hardly begun to be obtained. Much work was now being devoted to these problems, and progress might be expected in the near future, which would surely help also to extend the possibilities of electrotitrations.

Electrometric methods were predestined to be carried out in the form of microtitrations. It would be interesting to try them also with molten electrolytes. Finally, electrometric methods were of value as they constitute the most reliable means for the scientific criticism of our common titrations.

SOUTH WALES SECTION

The first meeting of the session at Swansea was held jointly with the South Wales Section of the Institute of Chemistry on October 19, being preceded by a tea. Mr. F. J. Bloomer, who was in the chair, remarked that he hoped the meeting would prove to be the first of many joint ones, and called upon Mr. J. R. Green to open the discussion on "Short Cuts in Analysis."

Mr. Green described a very rapid method for the volumetric estimation of tin in solders, etc., giving results correct to at least 0·1 per cent. in 15 to 20 minutes. In contrast to the iodine method it was practically independent of large variations in volume or acidity, and the presence of a great excess of lead had no influence. It involved the use of ferric chloride, but differed from the usual process in being done in the cold, and in requiring a special indicator. This method could also be used as a rapid qualitative test for tin in presence of other metals. Mr. Green also described the "bullet-mould" test for alloys such as tin-lead and lead-antimony. This consisted in casting a series of "bullets" in a special mould, weighing several when the mould had become thoroughly heated, and, taking the mean, obtaining the percentage composition by comparison with a table of weights of "bullets" of known composition, an accuracy of 0·2 per cent. being claimed. The use of the small direct-vision spectroscope for rapid detection of traces of impurities in alloys, such as zinc in soft solders, was also mentioned. Traces of zinc, in presence of a very large excess of tin and lead, were not easy to detect chemically, but a few seconds' work with a small direct-vision spectroscope and an old arc lamp would save much tedious work and would just as effectively decide the acceptance or rejection of a consignment of metal.

Mr. C. A. Seyler remarked that he was much interested in the "bullet-mould" method of arriving at the compositions of alloys; did it originate in Germany? He could testify to the speed and accuracy of the ferric chloride method for the determination of tin. Mr. E. A. Tyler, M.A., pointed out the danger of indiscriminate use of "short cuts"; they should only be used by those familiar with the longer, standard methods. Mr. C. M. W. Grieb observed that much work had been done during the war on selective solvents for explosives, the use of which had simplified analytical methods considerably. He believed there was a big field for such methods in inorganic as well as organic chemistry.

Next, Mr. A. Grounds described a rapid and accurate colorimetric method for the estimation of pitch in fuel briquettes—a matter of great importance when the price of pitch was high. The method depended on matching the red tint obtained by extraction with carbon disulphide. The titanous chloride method for estimating iron was very little used, but it was worthy of much more general adoption.

A rapid method of estimating free hydrogen cyanide in the air was described by Prof. J. E. Coates, O.B.E., D.Sc. Some such method became a necessity in connexion with a certain process during the war, and depended upon the reaction : $I_2+HCN=ICN+HI$. The proportion of HCN varied inversely as the number of squeezes of a rubber bulb necessary to decolorise a fixed volume of standard iodine solution, the air being bubbled through it. The method, though perhaps not quite accurate, was invaluable and very rapid.

As one of the outstanding "short cuts" of recent years, Mr. J. H. Wells instanced the dimethylglyoxime method for nickel. Personally he referred the volumetric estimation of tin by iodine to that by ferric chloride, but he knew of one works where the percentage of tin in crude tin was ascertained by the ferric chloride method as described by Mr. Green, the titration being completed with a weaker solution in order to obtain greater accuracy. He endorsed Mr. Grounds' remarks as to the value of the titanous chloride method for iron.

Mr. Green, replying briefly, emphasised that "short cuts" should only be used when their accuracy had been proved by the regular methods of quantitative analysis. The indicator mentioned was made by boiling 100 g. potassium iodide and 33 g. cuprous iodide in 100 c.c. water, adding 100 g. hydriodic acid (s.g. 1·75) and a few pieces of bright copper wire, avoiding contact with air as much as possible. The titration was performed in an atmosphere of carbon dioxide, a few drops of the indicator and 5 c.c. of starch solution having been added, and the end-point was shown by the appearance of the usual blue colour. Works chemists should not be too tied down to purely chemical methods, and they should as far as possible make their own apparatus ; it was usually cheaper and often more effective than that purchased ready-made.

The meeting on November 16 has unavoidably been cancelled. Members of the Section will be duly notified of further arrangements.

CHEMICAL SOCIETY

An ordinary meeting was held at 8 p.m. on Thursday, November 1, 1923, the President, Prof. W. P. Wynne, F.R.S., occupying the Chair.

The President referred to the death of Dr. J. E. Stead, F.R.S., and spoke of the importance of his chemical and metallurgical work.

The mechanism of the combustion of hydrocarbons was dealt with by Mr. W. E. Garner, in the following paper :—

The rapid admixture of hot combustible gases with air. F. M. Cray and W. E. Garner.

The minimum temperature at which hot combustible gases will ignite, when mixed with air at high speeds, must be higher than the normal ignition temperature. It should be possible to demonstrate the cooling effect of the air if sufficiently high speeds of projection of the hot gases be attained.

Experiments have been carried out in which high explosives in steel containers, and acetylene and oxygen mixtures in glass bulbs, have been exploded in a limited volume of air. It is shown, in the case of high explosives, that the occurrence of ignition is to some extent determined by the volume of air into which the hot gases are projected, ignition occurring only when the ratio of weight of explosive to volume of air exceeds a definite value.

In the experiments with acetylene and oxygen, the velocities of projection were not sufficiently high for this phenomenon to be observed, and partial ignition occurred whatever the ratio of explosive mixture to the surrounding air. However, it was shown that the ignition was the less complete the higher the velocity of projection. Thus the greatest conversion of acetylene to carbon monoxide was attained with mixtures containing acetylene and oxygen in equal proportions, this mixture, as was shown by Dixon, possessing the highest velocity of explosion of any acetylene-oxygen mixture.

Although carbon monoxide was present in the products from the explosion of all of the mixtures investigated, including that of three parts of oxygen to one part of acetylene, free carbon was found only in those experiments where the ratio of oxygen to acetylene exceeded unity. This behaviour is in agreement with the views of Bone on the mechanism of the processes occurring during the combustion of hydrocarbons.

Sir Robert Robertson, F.R.S., made some remarks on the after-ignition of combustible gases from explosives used in mining, as propellants, and as high explosives, and gave some examples of the interval of time which had been observed and measured between the occurrence of the initial flame, proceeding from the detonation of an explosive, and the after-flame, due to ignition in air of the combustible gases, carbon monoxide and hydrogen. Referring to the work of Messrs. Cray and Garner, in which they employed explosive mixtures of gases instead of high explosives, he agreed as to the significance of the authors' observation correlating the velocity of propagation of explosion with the proportion of carbon monoxide in the gases produced. He asked whether in the case of the most rapidly-exploding mixture the fragmentation of the glass vessel was observed to be more complete than in the case of the others.

Mr. Garner, in reply, said that no difference in the character of the fragments in the bomb was observed. In some cases, however, when the explosion did not reduce the glass to powder, the amount of carbon monoxide produced was negligibly small.

The investigations covered by the following two papers were described by the author :—

The determination of surface tension from the maximum pressure in bubbles. Part II. Samuel Sugden.

An improved form of apparatus for the measurement of surface tension by the method of maximum bubble pressure is described. The method of calculation (*T.* 1922, **121**, 858) has been simplified, and it is shown that the equation

$$\gamma=\mathrm{AP}\left(1+0{\cdot}69\mathrm{r}_2\frac{\mathrm{gD}}{\mathrm{P}}\right)$$

may be used for the sizes of tubes usually employed. Here A is a constant for a particular apparatus, P dynes per cm. is the difference between the pressures required to liberate bubbles from the two tubes, r_2 cm. is the radius of the wide tube, D is the density of the liquid, and g=981 cm./sec.^{2}

To facilitate calibration a table is given showing the surface tension of benzene at each degree from 10° to 30°.

The variation of surface tension with temperature, and some related functions. Samuel Sugden.

The variation of surface tension with temperature is known to be represented with fair accuracy by an equation of van der Waals (1894),

$$\gamma=\mathrm{K}_1\theta_c\mathrm{V}_c^{-\frac{2}{3}}(1-\mathrm{m})^{\mathrm{B}} \quad \cdot \quad (1)$$

in which B is a universal constant. On the other hand, Ferguson (1916) allowed this exponent to vary slightly in order better to express the data of Ramsay and Shields (1893). Recently (1) has assumed a new interest since Ferguson has shown that the simple relation, discovered by Macleod (1923), between surface tension and density can be deduced from the modified Ramsay-Shields law and equation (1) if B is constant and equal to 1·20.

The data of Ramsay and Shields are now known to be in error owing to their correction for capillary rise in the outer vessel having been inadequate. The author now calculates the necessary correction by applying the theory worked out two years ago (*T.* 1921, **119**, 1483), and uses also the data of Walden and Swinne after correcting the Ramsay-Shields value for benzene on which these were based.

From a consideration of the available figures it is shown, for six non-associated liquids, that :—

(*a*) The variation of surface tension with temperature can be represented accurately by the formula $\gamma=\gamma_0(1-\mathrm{m})^{1\cdot20}$ where γ_0 is a constant for the substance and m is the reduced temperature :

(*b*) Macleod's relation, $\gamma=\mathrm{C}(\mathrm{D}-\mathrm{d})^4$, where C is a constant and D, d are the densities of liquid and vapour respectively, holds with remarkable accuracy up to within a few degrees of the critical temperature ;

(*c*) Van der Waals' relations connecting γ_0 with the critical constants are only approximately true ; in his equation

$$\gamma_0=\mathrm{K}_1\theta_c\,\mathrm{V}_c^{-\frac{2}{3}}=\mathrm{K}_2\theta_c^{\frac{1}{3}}\,\mathrm{p}_c^{\frac{2}{3}},$$

the "universal constants" K_1 and K_2 vary by several units per cent. among different substances.

Prof. J. C. Philip, F.R.S., enquired whether the author offered any explanation of the anomalous values quoted for the "constants" K_1 and K_2, in the case, for example, of ethyl acetate. He also asked what differences of pressure were actually measured in the apparatus described.

Dr.. Irvine Masson invited the author's observations on the fact that he had measured the surface tension of a liquid not in the presence of its vapour alone, but in that of a foreign gas. The fact that benzene was found to have the same surface tension whether wet or ordinarily dry might lend support to the speculation that any water molecules present in the benzene may be confined to the surface film.

Dr. N. V. Sidgwick, F.R.S., said that the definite effect of the presence of water on the freezing point of benzene indicated that the water molecules could not entirely be present on the surface film.

Replying, Mr. Sugden said that the pressure readings usually corresponded with about 5 to 6 cm. on an alcohol gauge, and they were read to a fraction of a millimetre ; on occasions, however, larger differences had been obtained. Referring to the constancy of values of K_1 and K_2, he mentioned that the latter, involving pressures, were (as would be anticipated) in better agreement than the former, which involved comparisons of volumes. In the case of ethyl acetate, he suggested that instability near the critical temperature might conceivably account for the anomalous results. The effect of gases on the surface tension of liquids had been examined by other workers subsequently to Ramsay and Shields ; the large differences observed by the latter had not been detected, such differences as had been measured being probably within the errors of experiment. Incidentally Mr. Sugden remarked that in investigations involving determinations of surface tension he had repeatedly found the ordinary methods of purification of organic materials to be sufficient.

Dr. R. H. Pickard, F.R.S., threw out the suggestion that with ethyl acetate pseudo ring formation was not inconceivable.

Mr. E. H. Farmer next read a paper entitled :—

Muconic and hydromuconic acids. Part III. Valency interchange in the hydromuconic system. E. H. Farmer.

In Part I of this series (*T.*, 1922, **121**, 2015) dealing with the addition of sodiomalonic and sodiocyanoacetic esters to ethyl muconate it was shown that the products possessed the general structure $RO_2C\cdot CH_2\cdot CH_2\cdot CX{:}CH\cdot CO_2R$ and not $RO_2C\cdot CH{:}CH\cdot CHX\cdot CH_2\cdot CO_2R$ as might have been expected. This constituted *in effect* addition of a 1:3-type; and in view of the difficulty in accounting for such a movement of the double bond as is necessitated if 1:2-addition be supposed to take place, it was suggested that the muconic system was to some extent comparable in mobility with the glutaconic system.

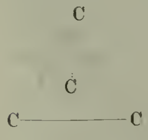
Subsequent work has shown, however, that this view is incorrect. The muconic system is static, conforms to stereo-chemical theory, and adds the components of esters at the 1:2-position. The substituted dihydromuconic esters thus produced represent in their configuration interesting instances of the effect of an equilibrium subsisting between $\Delta\alpha$- and $\Delta\beta$-dihydromuconic esters in the presence of sodium alkoxide. This equilibrium, which favours the $\Delta\alpha$-form in the dihydromuconic esters themselves, results in the conversion of the additive products under consideration into β-substituted glutaconic esters.

Prof. J. F. Thorpe, F.R.S., in congratulating the author on his experiments, remarked how elusive were the positions of double bonds when attemps were made to determine them by means of chemical reagents.

Mr. E. H. Farmer also gave an account of

Experiments on the synthesis of substances possessing the Ladenburg Formula. Part I. Derivatives of cyclo*propyl*cyclo*propane.* E. H. Farmer.

The synthesis by Beesley and Thorpe of a closed associated ring system of type I. suggested a method for the synthesis of substances possessing the Ladenburg formula. It seemed that any such synthesis must proceed by way of one of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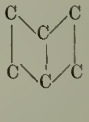
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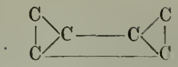
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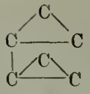
IV

the carbon-skeletons II, III or IV.

The present paper records the result of experiments connected with the synthesis of substances of these types, but particularly with those of type IV. The production of considerable quantities of various derivatives of *cyclo*propyl*cyclo*propane is described.

Prof. Thorpe said that it would be extremely interesting to see whether this preliminary work would eventually lead to the synthesis of substances having a Ladenburg formula. If it turned out to be possible to obtain benzene in this way, the situation would be peculiarly interesting.

ACADÉMIE DES SCIENCES

On October 15, Monsieur Lacroix described a new method of classifying rocks, and Monsieur Joubin pointed out the importance of exploring the sea from the point of view of cod and tunny fishing, the production of which affects the output of important industries. Researches on the radiochemistry of fluorescence were described by Prof. Perrin, who showed that the part played by temperature in the rapidity of action of light which he had already described in relation to methylene blue could also be traced with fluorescent blue, although the latter was 1000 times more sensitive than the former. Uranine and eosine were found to be insensitive to the effects of temperature. Monsieur d'Arsonval communicated a paper by MM. Benoit and Hellbronner, showing the existence of both physical and physiological antagonism between ultra-violet and infra-red rays. This antagonism of the infra-red was also found in respect of X-rays. Prof. Le Chatelier communicated a note by Monsieur Bonnier on the condition of decomposition of ammonium bicarbonate in the presence of water.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

There was an attendance of over 800 at the third annual meeting held in Paris, a fine result for an organisation only in existence for six years.

The meeting began on October 21 with the reception of the foreign delegates at the Hotel Majestic, followed by an afternoon devoted to music and other entertainments. The delegation sent by Great Britain, in response to the invitation of the Société, was one of the largest present, and consisted of Dr. Levinstein, who represented the Society of Chemical Industry, Profs. H. E. Armstrong, F.R.S., and J. T. Hewitt, F.R.S., delegates of the Chemical

Society, Dr. S. Miall, delegate of the Federal Council, Mr. A. R. Smith, delegate of the Institute of Chemistry, Sir John Russell, director of Rothamsted, Mr. Lomax, delegate of the Institution of Petroleum Technologists, and Mr. O. D. Lucas, of the Vickers Co.

On October 22, M. Dior, Minister of Commerce, opened the meeting formally in the great theatre of the Conservatoire des Arts et Metiers. M. Kestner, President of the Société, welcomed M. Dior and pointed out that the Congress united some of the most eminent representatives of world science and industry. After M. Dior had spoken upon the social as well as the scientific value of such meetings, M. Kestner introduced Prof. Menozzi, director of the Royal Higher School of Agriculture of Milan. In his address on "The Present State of our Knowledge of Soil Analysis and its Practical Value," Prof. Menozzi said that during the second half of the last century it was thought that by simple analysis the content of nutritive substances in the soil could be accurately determined, thus giving an exact method for determining the degree of soil fertility. This theory proved inaccurate, as soils rich in potash did not furnish sufficient potash for the plants, which grew vigorously when potassic fertilisers were added to the same soil. It was then realised that the state of the combination of the nutritive substances had to be determined, and research has since been directed towards the estimation of the substances assimilable by plants. Many solvents were tried in the effort to reproduce natural conditions, but the analytical results were too often discordant with those of practical experience. Present experience tends to suggest that inorganic food material present in the form of absorption compounds is most readily assimilable by plants, but whether it is possible or not to establish an exact method for determining the content of assimilable substances for all soils or crops, it is certain that chemical analysis gives results corresponding to practical needs by indicating the minimum quantities of nutrients that a soil should contain to be sufficiently fertile for some particular crop.

The afternoon was devoted to the meetings of the fourteen technical groups of the Congress, and later on Prof. Lindet delivered a discourse on the reconstitution of the sugar factories, distilleries and breweries in the devastated regions. Out of 213 sugar factories, 148 were destroyed, representing two-thirds of the prewar production (68,000 m. t. out of 100,000 t. of beets per 24 hours), and in 1918 only 32,000 t. of beet was available per day. Of the factories destroyed, 110 have either been rebuilt or grouped with other factories, their pre-war production now being distributed among 51 reconstructed factories. These factories are only able to produce 40,000 to 42,000 t., which, with the 32,000 t. produced by the factories that were not destroyed, makes the total 25,000 t. short of the pre-war production of 100,000 t. Out of 300 distilleries, 152 were destroyed, corresponding to two-thirds of the pre-war production. Reconstitution is slow, for industrial alcohol is monopolised by the State, and the producers wish to make sure that the sales of "National Fuel" will be sufficient to ensure a return for rebuilding their works. At present about 50 distilleries await reconstruction. Roughly, eight-tenths of the 2570 breweries were destroyed, but whereas 78 per cent of the productive capacity has been restored, the consumption still remains low.

Speaking before Group V. (Heavy Chemicals), Dr. Levinstein described the progress made by chemical industry in Great Britain, and showed the efforts made by British industry since 1914 to meet German competition. Before the same Group, M. G. Claude described new methods for obtaining cheap fertilisers. The first day was terminated by a dinner, offered by the "Bienvenue Française" to the foreign delegates and members of the Council of the Société.

On October 23 Dr. Levinstein also spoke before the Dyestuffs Group (VII) on the dyestuff industry in Great Britain, showing the great progress that had been made since 1914, and describing the steps which led to the foundation of the British Dyestuffs Corporation and the present situation. The afternoon concluded with an address by Prince Ginori Conti on the utilisation of natural steam for the production of power (*cf. Chem. & Ind.*, p. 1022).

The work of the different Groups finished on October 24, the presentation of over 150 papers having given rise to most interesting and valuable discussions, and at 4.30 of the same day the closing meeting was held under the presidency of M. Sarront, Minister of the Colonies. After various speeches had been made, Sir John Russell delivered an address on "The Influence of Micro-organisms on Soil Fertility," in which the author traced the history of the subject, starting with the work of Boussingault and outlining the valuable contributions of Pasteur and Schloesing. The enormous variations in the number of soil organisms was indicated and the reason for this discussed, and the speaker showed that the proportion of nitrates in the soil varied equally. There were two possibilities, either the absorption of nitrates by micro-organisms could be reduced or favoured, or the rate of production of nitrates could be increased. It was for this reason that partial sterilisation was developed. Antiseptics have been applied on a large scale in France for this purpose by Truffaut, but in England nitrogenous fertilisers are cheaper than antiseptics, and no substance had been found which increased the proportion of nitrates in the soil more cheaply than nitrogenous fertilisers.

At 8 p.m. 300 members met at a banquet held at the Palais D'Orsay, under the presidency of M. Roux, who replaced the Minister of Agriculture. During the speeches, Prof. H. E.

Armstrong pointed out the value of the Congress and of collaboration between the chemical societies of France and England, after which M. Roux thanked the foreign scientists who had attended the Congress. The evening was then devoted to conversation and dancing.

Visits to factories commenced on October 25, when the members visited the factory of Felix Potin at Pantin, where they saw different methods of treating wine. After refreshments, the members drove to the Chateau de Noisiel, where Monsieur G. Menier entertained them to dinner. Various speeches were made emphasising the importance of chemistry to modern industry, and M. Menier described the development of the Menier chocolate works since their foundation in 1816 to the present production of 65,000 kg. of chocolate per day. The members were then conducted round the works, where all the different stages of the manufacture of chocolate were inspected.

A visit to Rheims was paid on October 26, the visitors being received by Cardinal Lucon, who described, in moving terms, the martyrdom of the town and cathedral from September, 1914, until its liberation in 1918. Prof. Matignon, in thanking the Cardinal for receiving them, delivered a discourse in which he showed that modern research workers continued the great traditions of the thirteenth century, a period of expansion during which the intellectual development took place of which the cathedral of Rheims was a symbol. Subsequently visits were paid to the antique cellars of the well-known firm of Pommery, and after the various processes for producing champagne had been explained to the visitors, Messrs. Pommery entertained them to a lunch, presided over by M. G. Vidal, the Under-Secretary of State for Technical Education. After lunch the members motored to the establishments of Heidsieck, whose products they were able to appreciate whilst enjoying a magnificent view. The excursion terminated with a visit to the Pompell Fort, where an officer of the War Ministry outlined the history of this field of battle, thus ending the Congress on a heroic note.

BRITISH ASSOCIATION OF CHEMISTS

The sixth annual general meeting was held at the University of Birmingham on October 27, Dr. H. Levinstein presiding.

The Council reported that the membership had declined from 1095 to 912 owing to the economic situation. It was decided not to take definite action in respect of legal redefinition of the term "chemist," as it was felt that no useful purpose would be served until there was greater co-operation between the various chemical organisations, coupled with the education of the general public by chemists themselves. The report was adopted, and the following were elected officers for the ensuing year:—President, Dr. H. Levinstein; vice-presidents, Mr. W. E. Kay and Mr. F. Scholefield; hon. treasurer, Mr. H. E. J. Cory; hon. general secretary, Mr. I. Boodson; hon. registrar, Dr. D. Bain; and hon. editor, Mr. A. Merrick.

The members were entertained to tea by the Chemical Department of the University, and then inspected an exhibition of specimens and apparatus from the Research Section. The annual dinner, which was held in the evening at the Queen's Hotel, Birmingham, was attended by a representative company.

In proposing the toast, the "B.A.C.," the president observed that if new industries were developed and a bid made to secure the world's markets there would be an opening for chemists which hitherto did not exist, and the great work which was being done at universities would find its due reward in the creation of positions for chemists.

Mr. E. R. Redgrove, in submitting the toast, "Kindred Societies," said the Society of Chemical Industry came nearer to the class of chemists they represented than any other; and it did splendid work in letting them know what was happening. The Chemical Society, which was the more academic, also helped them considerably. The Institute of Chemistry, with which he hoped they would always be friends, had definite functions which were entirely separate from theirs. Dr. E. B. Maxted, responding, remarked that no matter what society they belonged to, they all felt the ties of kinship and of interdependence of one society on the other.

Dr. F. W. Kay proposed "The Universities and Seats of Learning," and coupled the names of Prof. Morgan and Dr. Friend. He said he believed that, unless they could speak for the profession as a whole, progress would be slow. As a society they looked to the Universities to maintain the supply of highly-trained chemists. Prof. Morgan, in reply, observed that the success of the Association was bound up with that of the Universities. If the chemical industries dwindled, then our chemical schools would disappear to some extent. That was why it was so important that the Association should do its best to maintain the dignity of the chemical profession. Dr. J. Newton Friend also replied.

Mr. N. P. Booth, proposing the toast of "The Guests," said that the Association supplied the means by which it could do things for chemists which the Institute was unable to perform. Dr. Miall replied briefly.

We regret that through inadvertence the name of Mr. J. L. Baker is given on page xvi of *Chemistry and Industry* of November 2 as vice-chairman of the London Section of the Society. Mr. Baker's period of office recently expired and Mr. E. V. Evans was elected to succeed him.

CORRESPONDENCE

THE CHEMIST AND THE PUBLIC

Sir,—We have been told repeatedly, and we were told again at the Chemists' dinner held on Wednesday last at the Hotel Victoria, that one of the chief difficulties with which the professional chemist has to deal is the indifference, and even the ignorance, of the general public, and of public authorities, with regard to the social value and industrial importance of chemistry. Such a function as was held on Wednesday last, under the joint auspices of the Chemical Society, the Institute of Chemistry, and the Society of Chemical Industry, might reasonably have been expected to have been of some value as an aid towards explaining and overcoming this difficulty. No doubt something was accomplished from the mere fact that the Dinner was arranged and held, but those who hoped for some evidence of real progress towards a fuller public recognition of chemists and chemistry must have come away somewhat saddened. The vocal musical entertainment provided was excellent, but the unassisted vocal contributions can only be described as in this regard disappointing.

The pharmacists may accept with justifiable pride, as Mr. Woolcock did on their behalf in his witty address, the tribute to the advances made of recent years in their developments of chemical knowledge and practice paid by the right honourable gentleman who proposed the toast of "Chemistry and the Nation." Neither the academic nor the industrial chemist, surely, will be disposed to feel jealous of any recognition given to pharmacy. It seemed strange, however, that it should have been left to Sir William Pope, in replying, and to Mr. Woolcock, in proposing another toast, to point out that there are other equally vital and important provinces of chemistry, and that the great contributions of chemists to the country's war effort were not mainly, or even largely, the compounding of new and more easily absorbed varieties of various medical remedies.

Can we feel other than saddened and disappointed to realise, as all who attended the dinner must have done, that even the proposer of the toast of "Chemistry and the Nation" was apparently neither familiar with nor impressed by the vital social importance of chemistry, both for peace and for war ?

None of the other speeches of the evening afforded much opportunity, even had the speakers been inclined to form a mutual admiration chorus, of stressing this importance ; unfortunately neither did they do much to formulate positive suggestions for steps to secure that recognition which is felt in some degree to be due to chemists, but in a much greater degree to be necessary to our national safety and prosperity. If criticism of our leaders be permissible, it may be said that more than one of the speeches of the evening indicated rather a trace of mutual recrimination than a large measure of that wholesome confidence and co-operation which is so essential if chemists are to secure that place in the public estimation which their works justify. The University-trained chemist, fresh from the receipt of his academic honours, may not possess all the qualities necessary to fit him for the immediate control of a big industrial undertaking ; but is it reasonable of Dr. Armstrong to complain of what is surely only obvious, and indeed proper, and to blame the University for having turned out a well-trained chemist rather than a man possessed of some smattering of chemistry, some similar smattering of economics, and various doubtful business qualifications ? By their works will chemists be known, but they must speak with one voice in calling attention to those works. We must have trust in ourselves before we can expect trust from others, and workers in every department of chemical science and industry must realise the importance and necessary place of other departments if we are to build up such an harmonious structure of co-ordinated chemical activity as will of itself secure for us the recognition and confidence of the general public.—I am, Sir, etc.,
S. I. Levy

59 and 60, Broad Street Avenue,
London, E.C. 2
November 1, 1923

THE CHEMICAL ENGINEER

Sir,—The re-opening of the discussion as to the nature and properties of the chemical engineer, who he is and what he is, which has followed Mr. Gray's article in your issue of October 5, prompts me to lay before you some views on this subject, which have been crystallising slowly in my mind, and have only recently reached something approaching the solid state. Let me say at once that I agree with nearly everything that Mr. Gray said, and a little more.

Prof. Donnan, in the Faraday Society discussion in 1917, gave an admirable summary of the kind of knowledge which a person who intends to interest himself in the erection or running of chemical factories should try to acquire. His attainments should include a knowledge of applied mechanics, engineering drawing, thermochemistry, thermodynamics and a long list of other matters. How much knowledge of these things he is to possess is not very clear. Prof. Donnan describes this individual as an engineer-chemist.

Now, Sir, the man with a real working knowledge of all these things is, and is likely to remain, a rarity. If he could be found, it would be difficult to know what to do with him. Probably the best thing would be to form a company with a large capital to finance the working out of his ideas. If, in addition to the attainments mentioned, he possessed common sense, he would no doubt, if necessary, form the company himself. But I do not think he would describe himself as an engineer. I suggest that Prof. Donnan's advice is rather of the nature of a counsel of perfection, whilst heartily agreeing that any man in a responsible position in a chemical factory should have some acquaintance with these things.

Turning, however, to those ordinary mortals who insist on calling themselves chemical engineers, I think the first point to notice about them is that *they baptised themselves*. No one would worry about them if they would do their work quietly. That is my first point.

My second point is that, *taken as a whole*, the engineering element in a chemical factory is of secondary importance and secondary difficulty. It is indispensable in the sense that everything that forms part of the factory is indispensable, but most of it is not difficult, and the attainments which it requires are not of a very high order. Let us consider what they amount to.

The first step in starting a chemical manufacture is the design of the process, and this must be done by a chemist. It bristles with real difficulties, and demands considerable attainments. The chemist, if he has any common sense at all, will certainly design the process from the point of view of commercial practicability. That is to say, he will be guided first of all by the existence of markets for the products and the necessity of producing them at a cost which renders the commercial position advantageous. That is the *raison d'être* of the business. It is merely common sense, and requires no knowledge of engineering, unless a rough acquaintance with the cost and life of plant be reckoned as such. Information as to the kind of plant available for a given purpose without special design may be acquired readily by making enquiries of plant manufacturers. This is a matter for the draughtsman, who can always obtain it in a few days, and very often can give it at once.

The next step is the design of the plant, and here sometimes, but not always, considerable difficulties arise. I submit that these, in so far as they affect the engineering side of the question, are generally connected with one or both of two factors, namely, choice of materials and heat transmission. The choice of materials has to be made by the chemist, and the chemist, if he is a knowledgable person, probably knows as much about heat transmission as the engineer. He is, at least, as well able to find out about it.

What, then, are the duties of an engineer in a chemical factory? I suggest that they are as follows (assuming that the site has been chosen) :—

(1) To design and erect the buildings.
(2) To provide any power that may be required.
(3) To design, if necessary, and erect the plant to the instructions of the chemist.
(4) To superintend repairs and maintenance.
(5) To possess common sense, and a general acquaintance with chemical nomenclature.

Now, none of these duties requires any exceptional knowledge or attainment. All that is required of the chemical factory engineer is that he shall be able to lay foundations and erect buildings, boilers and plant.

Mr. J. H. West, in your issue of October 28, says that the chemical engineer is the chemist's best friend, but I think it would be more accurate to describe the chemist as the best and all-necessary friend of the chemical factory engineer, as I prefer to call him. The latter, when he is a reasonable being, occupies a place of importance and some honour in the chemical factory. But if he becomes infected with militant ideas, arms himself with a bookshelf of makers' catalogues, and represents himself as the *deus ex machina* of the chemical industry, he becomes the "compleat" example of the gentle art of "swank."

There is, however, another type of chemical engineer, who requires to be taken much more seriously. I refer to the inventor of *really new* forms of plant. He is a rare bird, and not to be pigeon-holed. He may be a chemist or a physicist, or an engineer. Occasionally he hails from an office. Whether, collectively, he calls himself a chemical engineer, I do not know.*—I am, Sir, etc., A. Jaques

Liverpool,
Nov. 3, 1923

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* The above was written before the appearance of the Editorial in your issue of November 2, with its very suggestive question as to whether Nobel was a chemical engineer.

THE DIFFICULT ENGLISH

M. the Editor,—I read your first note, so complimentary to our language and to the French, then I turn me to your first article and read the beginning sentence and ask myself what means, "I find myself in agreement with 'X' in admitting that Werner's theory of co-ordination had been very slow in receiving the recognition it deserves." I think of my school-time, when I was taught the rhetoric, as we call it—how to use grammar and to express myself in the way correct. I ask me how a theory can be slow to receive or receive at all. It is, as you have well said, the writers they seem so often to leave the expression of their thoughts to chance. It is very difficult for us strange people to know what they mean, when they write in this way and—do you not call it or is it the Professor Bone?—"activate" the passives. It is the way of your good contributor, I think; is he so much gazing at the beautiful, naked, proton of the hydrogen—fortunately for our *Garçonnes* this is not yet come to Montmartre—that his eyes are blind and he does not look at the words, the shine is so much in his eyes ? I would ask, as well, what he mean when he write—" none of the chlorine can be precipitated by silver nitrate." I have not suppose chlorine is made of ones.

It is sometimes very funny how you write. I see, in the second article in your beautiful journal, the gentleman say: " It is always helpful if one can look round." Perhaps some of your chief chemists think so, but in France we cultivate the sport to keep the spare figure. Thank you, Sir, for your try to make the English that it can be understood. It can be very beautifully wrote. For example, if you read the English of M. Lafcadio Hearn, of the Crime of Sylvestre Bonnard, it is as beautiful as the French of Anatole France, the most perfect of the French writers, is it not so ?—Your servant much devoted,

PARISIAN

PERSONALIA

The Board of Trade has appointed Dr. A. T. de Mouilpied, of the British Dyestuffs Corporation, Ltd., to be a member of the Dyestuffs Industry Development Committee, in place of Dr. Herbert Levinstein, who has resigned.

Prof. W. H. Perkin, F.R.S., who for some time has controlled the research work of the British Dyestuffs Corporation at Oxford, has undertaken to advise and supervise the company's research staff at headquarters.

The Nobel Prize for Medicine for 1922 has been divided between Prof. A. V. Hill, University College, London, and Prof. O. M. Meyerhof, of Kiel University. Prof. Hill has devoted particular attention to the nature of nervous excitation, the carriage of oxygen and carbon dioxide by the blood, and the physiology of muscular movement. It is also announced that the Nobel Prize for Medicine for 1923 has been awarded to Dr. Banting and Prof. Macleod, of Toronto, for the discovery of insulin. According to a press communication Dr. Banting regrets that there was no mention in the award of Dr. Best, as he had an intimate part in the discovery of insulin. Dr. Banting, therefore, declares he will share the award with Dr. Best.

Professors Moureu and D'Arsonval have been promoted to Grands Officiers of the Legion of Honour, on the occasion of the centenary of Pasteur.

* * *

The following deaths are announced from Germany: Prof. A. Böttcher, formerly director of the Thuringian State Technical Institute; and P. Bartel, director of the Deutsche Keramische Gesellschaft. From Austria the death is recorded of Dr. A. Kutiak, well known in chemical circles.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Nov.* 1)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia . .	Iron and steel	471
„ . .	Alloy steel couplings . .	12434/E.D./ E.C./2
„ . .	Fibre for insulators . .	12428/E.D./ C.C.
British India	Carbonic paper, paper, copper plate, iron, steel paint, varnish (tender)	*
„ . .	Spring steel, metals . .	**
Chile . .	Iron piping	497
„ . .	Tiling	6814/F.L./ M.C./2
Cuba . .	Galvanised corrugated flat sheets	498
Denmark	Surgical dressings . .	479
Netherlands	Iron and steel, fertilisers	485
Spain . .	Silk	489
Switzerland	Leather goods, hollow-ware	492
United States	Leather	495
Uruguay . .	Paper, rubber belting, druggists' supplies . .	8893/F.L./ G.P.

* The Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E.1.

** The Secretary, The Madras and Southern Mahratta Railway Co., Ltd., 25, Buckingham Palace Road, London, S.W.1.

TARIFF CUSTOMS EXCISE

Argentina.—The use of salicylic and boric acid in foodstuffs and beverages is prohibited.

Australia.—A dumping duty has been placed on German potassium permanganate crystals.

Canada.—Canada has adhered to the Industrial Property Convention as from September 1, 1923. A copy of the Order in Council applying the relevant provisions of the Patents and Designs Acts may be seen in the Patent Office Library.

Dominica.—Reduction has been made in the import duty on soap.

Finland.—The import duty on silk has been reduced, and the export duty on paper abolished.

Germany.—A list of goods subject to increased import duties is given in the current issue.

Gilbert and Ellice Islands.—An export duty at the rate of £1 per ton is payable on copra.

Rumania.—No special permit is required for the export of glassware and gypsum.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

No material changes have taken place in the heavy chemical market either in demand or prices.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 9d.—4s. 3d. per carboy d/d.
Acid Nitric 80° Tw.	£21 10s. per ton makers' works.
Acid Sulphuric	Average national price for Crude Tower Acid 140° Tw. is 65s. f.o.r. makers' works, with slight variations up and down.
Acid Sulphuric, 94% Arsenical	£6 per ton makers' works.
Ammonia Alkali	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	5¾d.—6d. per lb.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Prices in this section are unchanged.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

The general outlook of the wood distillation industry is encouraging.

Acetate of Lime—	
Brown	£11 5s.—£11 10s. per ton d/d. Demand steady.
Grey	£21 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£10 per ton, according to grade and locality of market.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. 3d. per gall. 60% O.P. Steady market.
Solvent	6s. 3d. per gall. 40% O.P. Steady.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead	£41 per ton.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 1½d.—1s. 2d. per lb. Fair inquiry. Good business for prompt delivery.
Crude 60's	3s. 6d.—3s. 8d. per gall. Market quieter.
Acid Cresylic—97/99	2s.—2s. 5d. per gall. Firm, with good demand.
Acid Cresylic	
Pale 95%	1s. 11d.—2s. 4d. per gall.
Dark	1s. 6d.—2s. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.
Anthracene Oil—	
Strained	8½d.—10d. per gall. Plenty of enquiries.
Unstrained	8½d. per gall.

Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 5½d. per gall. d/d. buyer's works.
Pure	1s. 9d—1s. 11d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8½d.—9½d. per gall. according to grade and district. Good business being done.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 2d. per gall. Market sluggish.
Solvent 90/190	1s. 2d.—1s. 3d. per gall. Very little business.
Naphthalene Crude—	
Drained Creosote Salts	£8 per ton. Demand increasing. Market scarce.
Whizzed or hot pressed	£9 10s.—£11 per ton.
Naphthalene—	
Crystals	£19 10s. per ton.
Flaked	£19 10s. per ton.
Pitch, medium soft	132s. 6d.—140s. per ton, according to district and time of delivery. Several inquiries. Market firm.
Pyridine—90/140	22s.—22s. 6d. per gall. Demand good. Supplies short.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

Dyestuffs business has been better during the week.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 9d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Quieter.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 9d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Better demand.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	9d. per lb. naked at works.
Dinitrochlorbenzol	£83 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	5¾d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	2s. 7½d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
o-Toluidine	7d.—8d. per lb.
p-Toluidine	4s. per lb. d/d.
m-Toluylene Diamine	5s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The shortage of spot supplies is beginning to be felt seriously and prices are in consequence considerably higher for a few of the pharmaceutical chemicals which are in regular demand.

Acid, Acetic 80% B.P.	£47 10s. per ton.
Acid, Acetyl Salicylic	3s. 6d.—3s. 9d. per lb. In strong demand.
Acid, Benzoic	2s. 9d. per lb. for ordinary quality. No B.P. quality on offer.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Citric	1s. 4½d. per lb., less 5%, for ton lots. Poor demand.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	7s. 6d. per lb.
Acid, Salicylic	2s. 4d.—2s. 7d. per lb. Firm market.
Acid, Tannic	3s. 3d. per lb. for B.P. quality. Very firm.
Acid, Tartaric	1s. 1¾d. per lb. less 5%. Home trade poor. Raw material slightly dearer.
Amidol	9s. per lb. d/d.
Acetanilide	Advanced to 2s. 3d. per lb. Small stocks and large orders from abroad.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	3s. 6d. per lb. for English make.
Ammon. Carbonate B.P.	£32 15s. per ton.
Atropine Sulphate	12s. 6d. per oz. for English make. Demand very poor
Barbitone	17s. per lb. Neglected.
Benzonaphthol	5s. per lb. Quiet.
Bismuth Salts	A steady market. Carbonate 13s., Nitrate 6s. 11d., Salicylate 10s. 5d., Subgallate 9s. 6d., Citrate 11s. 7d., Oxide 14s. 5d., Subcholride 12s. 8d., Subnitrate 11s.
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.

Bromides—		
Potassium	7d. per lb.	Remain very firm.
Ammonium	8d. ,, ,,	
Sodium	7½d. ,, ,,	

Calcium Lactate	2s. 6d. per lb. for best English make.
Chloral Hydrate	4s. 3d. per lb. Position very firm.
Chloroform	2s. per lb. for cwt. lots. Very steady.
Creosote Carbonate	9s. per lb. Little demand.
Guaiacol Carbonate	Spot supplies very scarce. Present value 12s. per lb.
Hexamine	4s. 3d. per lb. Steady market.
Homatropine Hydrobromide	30s. per oz.
Iron Ammon. Citrate	2s. 2d. per lb. for cwt. lots. 2s. 3d. for 28 lb. lots. Prices recently reduced.
Magnesium Carbonate—	
Light Commercial	£36 per ton net.
Magnesium Oxide—	
Light Commercial	£77 10s. per ton, less 2½%.
Heavy Commercial	£27 per ton. less 2½%.
Heavy Pure	2s.—2s. 3d. per lb., according to quality and quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 72s. 6d. per lb.
Methyl Salicylate	2s. 10d. per lb. for carboys. Very scarce. Higher values expected.
Methyl Sulphonal	14s. 6d. per lb.
Morphine and Salts	Prices again advanced owing to dearness of opium. Alkaloid: Cryst. 14s. 8d., Precip. 14s. 5d., Acetate 11s. 6d., Hydrochlor. 11s. 6d., Sulphate 11s. 6d., Tartrate 14s. 5d. per oz.
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 5d. per lb.
Phenacetin	7s. 6d. per lb. Supplies short. Market excited.
Phenazone	8s. 9d. per lb. Remains very scarce.
Phenolphthalein	7s. 6d. per lb. Very firm. Shortage imminent.
Potass. Bitartrate—	
99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Fair business passing.
Potass. Citrate	1s. 11d.-2s. per lb. Recently reduced.
Potass. Ferricyanide	3s. per lb.
Potass. Iodide	15s. 8d.—15s. 11d. per lb. Good steady market.
Potass. Permanganate	10d. per lb. for B.P. crystal.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	6s. per lb.
Salol	4s. per lb. In better supply.
Sod. Benzoate	2s. 9d. per lb. Little inquiry.
Sod. Citrate, B.P.C., 1923	1s. 11d. per lb. for cwt. lots. Recently reduced.
Sod. Hyposulphite—	
Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 9d. per lb., and Crystal at 2s. 11d. per lb. Firm and very active.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	15s. per lb. In very small demand.
Thymol	13s. 6d. per lb. quoted for synthetic and 14s. 6d. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 9d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine	3s. 3d. ,, ,,
Benzaldehyde free from Chlorine	3s. 3d. ,, ,,
Benzyl Benzoate	3s. 6d. ,, ,,
Cinnamic Aldehyde Natural	20s. ,, ,,
Coumarin	20s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	10s. ,, ,,
Geraniol (Palmarosa)	37s. 6d. ,, ,,
Geraniol	6s. 9d. to 13s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. 9d. per lb.
Linalol ex Bois de Rose	18s. 6d. ,, ,,
Linalyl Acetate	18s. 6d. ,, ,,
Methyl Anthranilate	8s. 6d. ,, ,,
Methyl Benzoate	6s. ,, ,,
Musk Ketone	47s. 6d. ,, ,,
Musk Xylol	13s. 6d ,, ,,
Nerolin	4s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	16s. ,, ,,
Rhodinol	60s. ,, ,,
Safrol	2s. ,, ,,
Terpineol	3s. ,, ,,
Vanillin	22s. 6d.—23s. per lb. Firm and steady demand. Raw material dearer.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 10½d. ,, ,,
Bergamot Oil	13s. 3d. ,, ,, spot.
Bourbon Geranium Oil	37s. ,, ,,
Camphor Oil	80s. ,, ,,
Cananga Oil, Java	9s. 6d ,, ,,
Cinnamon Oil, Leaf	4¾d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.

Citronella Oil—	
Java 85/90%	4s. 9d. „ „
Ceylon	Very little on offer, too many parcels arriving containing spirit. These have been seized by the Customs.
Clove Oil	9s. per lb.
Eucalyptus Oil 70/75%	2s. 9d. per lb.
Lavender Oil—	
French 38/40% Esters	26s. per lb.
Lemon Oil	2s. 10d. per lb.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	11s. 9d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	26s. per oz.
Palma Rosa Oil	24s. 6d. per lb.
Peppermint Oil—	
English	70s. per lb. Market very unsteady.
Wayne County	15s. 6d. per lb. Market very unsteady.
Japanese	12s. per lb. Market very unsteady.
Petitgrain Oil	8s. 9d. per lb. Dearer.

TRADE NOTES

State Aid for the Chilean Iron and Steel Industry

A Bill has been presented to the Chilean Congress with the object of providing State aid to the iron and steel industry in Chile and encouraging foreign companies to work Chilean iron-ore deposits. A translation of the Bill may be seen by British firms at the Department of Overseas Trade, 35, Old Queen Street, London.—(*Ref.* 8704/*F.L.*)

Iron Production in Europe

The recent changes of boundary between Germany and France have greatly changed the positions of these countries compared with that obtaining before the war. In 1913 Germany produced 16,764,000 t. of pig iron, Great Britain 10,425,000 t., and France 5,207,000 t. If the present boundaries, however, had been in force, these figures would have become 10,916,000 t., 10,425,000 t., and 9,071,000 t. respectively, omitting the output of the Saar region. Thus France has a capacity practically equal either to that of Great Britain or Germany. Moreover, taking into consideration iron works controlled by French capital in the Saar region, Luxemburg, Belgium and Czechoslovakia, the total output of pig-iron under French control is 18,000,000 t., and if the productive capacity of the occupied area is included this figure becomes 26,000,000 t., or three-fifths of the total productive capacity of Europe.

Unemployment in Germany

According to a report of the United States Commercial Attaché, Berlin, dated October 10, industrial production in Germany was then less than at any time since 1919. Total unemployment was then estimated unofficially at 1,200,000, and part-time was being worked by between two and three million, of which 40 per cent. were working only 24 to 33 hours per week.

Developments in Germany

A correspondent informs us that important factories are being built in the neighbourhood of Essen, where Hugo Stinnes is building a large window-glass factory, which will utilise an American patent for the production of window-glass by means of rolling machines. In connexion with this factory works are being erected to utilise a new method described as the turning drum system for distilling coal.

German Potash Production

Sales of potash during the first nine months of this year were 788,900 m.t., or roughly 200,000 t. less than in the same period of last year. In October exports were reported to have diminished further as the German mines were feeling the competition of the Alsatian producers. It is proposed to amalgamate the four potash consortiums, *i.e.*, Winterschell, Gluckauf, Deutsche Kaliwerke and Ronneberg, under one group.

Japanese Heavy Chemicals and Dyestuffs Market in 1922

The Japanese market for heavy chemicals and dyestuffs improved considerably during 1922 because the comparative prosperity of the textile industries maintained the demand for dyestuffs and the large surplus stocks of industrial chemicals carried over from the post-war speculative period became depleted. For heavy chemicals, other than ammonium sulphate, Japan is now turning to England and Germany in preference to the United States, as better prices can be had from these countries. The United States, however, supplied over 90 per cent. of the crude ammonium sulphate imported at Kobe in 1922, and the market of this chemical is now practically confined to the United States. England supplied about 75 per cent. of the imports of soda ash, the remainder coming from South Africa. The bulk of the carbolic acid used in Japan is now being supplied by Great Britain. Germany has recaptured from the United States most of the trade in aniline dyes, and even in artificial indigo, which has not been so completely overshadowed by German supplies. Germany supplied over 50 per cent., the remainder coming from Great Britain and the United States. It is expected, however, that when the exchange becomes more normal in Germany, and the high *ad valorem* duty on imported dyes has been reduced, it will not be so difficult to sell dyestuffs in Japan.—(*U.S. Comm. Rep.*, *Aug.* 20, 1923.)

Trade Notes from France

The consequences of the Japanese disaster are being felt by various branches of the French trade and industry. The market for silk is very uncertain and prices of camphor, menthol, peppermint oil and agar have almost doubled. It is not yet possible to foresee what the effect will be on the export trade.

It is announced that the Société de la Soie Artificielle de Tubize proposes to increase its capital in order to establish a factory for the manufacture of cellulose-acetate silk at Petit Quevilly, near Rouen.

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to application for licences under the Dyestuffs (Import Regulation) Act, 1920, made during September has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 457, of which 311 were from merchants or importers. To these should be added the 34 cases outstanding on September 1, making a total for the month of 491. These were dealt with as follows:—

Granted—342 (of which 300 were dealt with within 7 days of receipt). Referred to British makers of similar products—79 (of which 65 were dealt with within 7 days of receipt).

Referred to Reparation supplies available—30 (all dealt with within two days of receipt).

Outstanding on September 30, 1923—40 (all dealt with at meeting of the Committee held on October 5).

Of the total of 491 applications received, 395, or 80 per cent. were dealt with within 7 days of receipt.

PUBLICATIONS RECEIVED

Coke and its Uses, in Relation to Smoke Prevention and Fuel Economy. *By* E. W. L. Nicol. *Pp. xii*+132. *London: E. Benn Bros., Ltd.*, 1923. *Price* 19*s*. 6*d*.

Oil Analysis. *By* A. H. Gill, S.B., Ph.D. *Tenth edition, revised. Pp.* 223. *London:* J. B. *Lippincott*, 1923. *Price* 10*s*. 6*d*.

Chemistry Applied to Home and Community. *By* P. G. Berry, A.M. *Pp. xvi*+534. *London: J. B. Lippincott*, 1923. *Price* 15*s*.

Coal-Tar Distillation and Working up of Tar Products. *By* A. R. Warnes. *Third edition, re-written and enlarged. Pp. xv*+511. *London: E. Benn Bros., Ltd.*, 1923. *Price* 45*s*.

Valence and the Structure of Atoms and Molecules. *By* G. N. Lewis. *Pp.* 172. *American Chemical Society, Monograph Series. New York: The Chemical Catalog Co., Inc.*, 1923. *Price* $3.0.

La Lavande Francaise, sa Culture, son Industrie, son Analyse. *By* C. Mourre. *Pp. xxii*+150. *Paris: Gauthier-Villars et Cie.*, 1923. *Price* 10 *frs.*

L'Industrie du Gaz: Distillation de la Houille. *By* R. Masse *and* A. Baril. *Encyclopédie Léauté. Pp. vii*+292. *Paris: Gauthier-Villars et Cie.*, 1923. *Price* 20 *frs.*

Quicksilver in 1922. *By* F. L. Ransome. *With a supplementary bibliography by* I. P. Evans. *No.* I:11. *Pp.* 113—124.

Auszüge aus der Literatur der Zellstoff-und Papierfabrikation. *Edited by* Verein der Zellstoff und Papier Chemiker und Ingenieure. *Chemical, Part I. Pp.* 36. *Mechanical, Part II. Pp.* 48. *Berlin: O. Elsner*, 1923.

Die Atome. *By* Prof. J. Perrin. *Authorised translation by* Prof. A. Lottermoser. *Third edition, revised. Pp. xx*+207. *Dresden and Leipzig: Theodor Steinkopff*, 1923. *Price* 5*s*.

Konduktometrische Titrationen. *By* Dr. L. M. Kolthoff. *Pp.* vi+94. *Dresden and Leipzig: Theodor Steinkopff*, 1923. *Price* 2*s*. 9*d*.

Organische Chemie, Vol. III. *By* Prof. R. Pummerer. *Second edition, revised and enlarged.* Wissenschaftliche Forschungsberichte. Naturwissenschaftliche Reihe, *edited by* Prof. E. Liesegang. *Pp. xii*+210. *Dresden and Leipzig: Theodor Steinkopff*, 1923. *Price* 4*s*.

Kurzes Lehrbuch der Chemie in Natur und Wirtschaft. By Prof. C. Oppenheimer. *With an introduction to general chemistry by* Prof. J. Matula. *Pp. xix*+862. *Leipzig: G. Thieme*, 1923. *Price, bound* 29*s*., *paper* 25*s*.

A Study of Colour Systems, Colorimeters, and Spectrophotometers, *with notes on their possible application in the paint industry. By* H. A. Gardner *and* H. C. Parks. *Circular No.* 191. *Scientific Section, Educational Bureau of the Paint Manufacturers' Association of the United States and the National Varnish Manufacturers' Association. Pp.* 58—140. 1923.

The Manchester Steam Users' Association for the Prevention of Steam Boiler Explosions, and for the Attainment of Economy in the Application of Steam. *Memorandum by* The Chief Engineer for the year 1922. *Pp.* 32. *Manchester: Taylor, Garnett Evans and Co.*, 1923.

Publications of the United States Geological Survey. *Department of the Interior. Washington: Government Printing Office*, 1923:—
Clay in 1922. *By* J. Middleton. *No.* II:12. *Pp.* 73—80.
Potash in 1922. *By* G. R. Mansfield. *No.* II:14. *Pp.* 87—107.
Silver, Copper, Lead and Zinc in the Central States in 1922. *By* J. P. Dunlop *and* F. Begeman. *No.* I:13. *Pp.* 137—168.
Talc and Soapstone in 1922. *By* E. Sampson. *No.* II:13. *Pp.* 81—86.
Tin in 1922. *By* B. L. Johnson. *No.* I:14. *Pp.* 169—172.

The Steaming of Wigan Arley Coal in Vertical Gas Retorts. *Department of Scientific and Industrial Research. Fuel Research Board. Technical Paper No.* 8. *Pp. iii*+18. *London: H.M. Stationery Office*, 1923. *Price* 9*d*.

Rapport sur le Commerce et l'Industrie de la Suisse en 1922. *Published by Le Vorort de l'Union Suisse du Commerce et de l'Industrie. Pp.* 423. *Zurich: Imprimerie Berichthaus.*

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EDITORIAL

IT is pleasant to watch for many years the progress of really high-class work carried on for the benefit of humanity, to see from the early days the improvements which are the result, to notice the gradual growth of the esteem which the leaders of the work inspire, and at length—often after an unduly long interval—to find signs of that recognition which is valued by modest and retiring men. About a quarter of a century ago the Home Office was gravely concerned by the amount of industrial disease, and many people of every variety of political faith urged that steps should be taken to protect the health of the workpeople; Sir Charles Dilke, Mr. and Mrs. H. J. Tennant, Miss Tuckwell, Miss Mona Wilson and some other devoted workers spent a very great deal of time and energy in this cause. The appointment of Dr. T. M. Legge as Chief Medical Inspector at the Home Office was a fortunate choice, and his efforts were immediately successful. The medical staff at the Home Office has always been and still is very small, but Dr. Legge is recognised throughout the world as one of the most learned and reliable of those who have studied industrial disease and dangerous trades. It is, therefore, most appropriate that he should have been awarded the Bisset-Hawkins Memorial Medal given by the Royal College of Physicians triennially to the medical practitioner who has most signally distinguished himself in promoting sanitary science and public health. The medal has in the past been awarded, amongst others, to Sir Ronald Ross, Sir Patrick Manson and Sir Arthur Newsholme. Dr. Legge has frequently attended meetings of the Society of Chemical Industry and taken part in the discussions. When he has done so, he has displayed the tact, caution and sincerity which are characteristic of him, and all who have come in contact with him or his work know that the honour he has received is really well deserved.

* * *

A few months ago, Professor A. Smithells, F.R.S., resigned the chair of chemistry at the University of Leeds which he held since the retirement of the first professor there, Sir Edward Thorpe. It is intended to commemorate his services by the establishment of a Fellowship or Scholarship at that University, and Professor J. W. Cobb, one of his old students, will be glad to hear from chemists who wish to take a part in the establishment. Professor Smithells played an important part in the development of the University, in organising its social activities, in interesting the citizens of Leeds in the work of the University, as well as in teaching chemistry; these pursuits occupied practically his whole time and left him few opportunities for that research which he and other chemists so much value. But much important spade work has to be done in the formation of a University College and its growth into a modern university, and those who remember the earliest days of science at Leeds—and we are old enough to count ourselves in the number—know that much of the work is of a nature which makes no obvious impression on the public, whether lay or academic. The growth of modern universities is an interesting problem and dates back to a period when there was a great revival of intellectual activity, partly due to the exceptional controversial interest occasioned by Darwin and Huxley. That stimulus is now spent and is not likely to arise again, but the necessity for science in industry has, to a large extent, taken its place as a factor in scientific education.

* * *

Not the least of the many signs of the growth of a more corporate feeling among chemists is the readiness and interest with which our readers have discussed affairs of importance to their profession in our correspondence columns. Reading, it has been said, maketh a full man, conference a ready man, and writing an exact man; so it may be surmised that the discussion of topics of importance to chemistry will bear the ripest of fruit in due season. In a letter which we publish in this issue, Mr. Foster Sproxton suggests that the Sections of the Society of Chemical Industry should consider any proposed legislation that appears likely to affect the interests of chemists or chemical industry. Some action is eminently desirable, but it seems rather excessive to require our members to read the five bulky numbers of "Hansard" which appear every week during session time, or even the smaller, but much less entrancing, monthly list of Stationery Office publications. It may be of interest to point out that a modest effort has long been made to present a digest of material in the Parliamentary Debates that may interest our readers, and that impending legislation is noticed as completely as is possible. Discussion such as Mr. Sproxton advocates is certainly needed, but for any proposal to be effective it would require the support of the whole profession. We welcome the suggestion that such proposals should be criticised constructively in these columns, and if we refer to the fable about the man who investigated the breaking strain of a bundle of sticks, it is in no carping spirit but with a genuine desire for the unity of the profession of chemistry.

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It seems from the club gossip and the remarks in the daily newspapers that we are threatened with a General Election. Alas, what exertion is stirred up for candidates and electors! How many Members of Parliament will have an unfortunate fate! Even now Lloyd George gets ready his statistics, his Rolls-Royce and his wrath. Can you not see Baldwin and Asquith and Ramsay MacDonald hard at it, and fearless Birkenhead, skilful in the fight, *sive opus est imperitare equis, non auriga piger?* Which seems to allude to some earlier prowess. Alfred Mond, you will also come across, and Austen and Neville, the sons of a famous warrior. But this election perturbs us not. Do not ask us, for it is no business of ours, what end is fated for this party or for that. Whatever party is returned to power, we must put up with it and it will hardly come up to our expectations. Whether this is the last General Election we shall see, or whether many others will in the future interfere with all trades except printers and bill-stickers, let us be happy and wise, sip our Volnay and cut down our hopes of prosperity, which our portion on earth is too brief to realise. Even as we write, time flies; let us make the best of this weekly number and hold over as little as possible for the next. Let no one be afraid that we shall make use of this column or allow other contributors to desecrate this journal for political purposes; Horace says somewhere, if we err not, that you should have infinite confidence in those who attain the ripe age of forty and we have done this and more. Far removed from the ignoble, political strife, we aspire to literary fame, the memorial more enduring than brass and loftier than the pyramid in its royal site. We shall not die, our reputation will grow, so long as Cambridge professors assist the Girton graduates up the steep path of science, *dum scandet cum tacita virgine Pontifex.*

SCIENTIFIC METHODS OF MAKING CONCRETE

BY PROF. DUFF A. ABRAMS[*]

INTRODUCTION

No other type of structural material has such a wide appeal as concrete. Practically every variety of engineer comes into contact with some phases of its uses. The almost innumerable uses of concrete constitute one of the most remarkable features of our modern industrial life. If we wish to build a foundation deep under the ground to support a sky-scraper, concrete is the material used. If we wish to construct a reservoir for irrigation, municipal water supply or flood control, a concrete dam solves the problem. If we wish to carry our railroads safely across streams, the concrete bridge at once comes to mind. If we wish to carry heavily loaded trucks at a rapid rate over our highways, the concrete pavement furnishes the means.

Concrete consists of an intimate mixture of Portland cement, water and aggregate which is permitted to set and harden under proper conditions. Cement is a most important constituent of concrete, but it should be understood that both the *quality* and quantity of the other constituents must be given consideration. So widely used is concrete that methods of improving its quality no longer appeal to engineers alone, but have become a matter of public policy, and hence of general interest.

As concrete is strong under compression and comparatively weak under tension, this led to the introduction of iron and (later) steel bars to take the tensile stresses. As a result of the general interest in the subject a great deal of experimental work was carried out in the United States and Europe during the decade beginning about 1903. Much valuable information was secured from the many studies of reinforced concrete, and engineers soon became able to design members and structures of reinforced concrete with the same degree of certainty that was recognized in steel, timber or stone masonry structures.

Up to about 10 years ago most attention was given to tests of *cement* and *reinforced concrete*, the underlying idea being that a good cement was the sole requirement of good concrete, and that the stress distribution was the most important factor in a reinforced concrete member. It gradually became apparent that the manufacture of cement was surrounded by such safeguards that rigid tests were no longer necessary, and that we knew a great deal more about *reinforced concrete* than we did about *concrete*. This last statement may seem somewhat anomalous, but it is literally true. If we make certain assumptions concerning the quality of the concrete, the strength and behaviour of a reinforced concrete member or structure can be

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calculated with considerable accuracy; however, no one could at that time estimate with any degree of certainty the quality of *concrete* which would result from mixing certain materials together and testing in a given manner.

It was the desire to learn more of the properties of concrete that led to the organisation of the Structural Materials Research Laboratory in 1914. Since 1916 the Laboratory has been conducted through the co-operation of Lewis Institute and the Portland Cement Association. Lewis Institute is an endowed educational institution located in Chicago; the Portland Cement Association is an organisation of the cement manufacturers in the United States, Canada, Mexico and Cuba, with the aim of extending and improving the uses of concrete. The Laboratory is now one of the best equipped in the United States. About forty engineers, chemists and assistants give their entire time to this experimental work, and the results are made available to those who may be interested through papers read before engineering societies, and by a series of bulletins and circulars published by the Laboratory.

This paper will deal principally with methods of proportioning concrete, with brief references to other phases of our experimental work which have been completed. It should be noted that our tests have thus far been confined almost entirely to *concrete;* in other words, little or no attention has been given to *reinforced concrete*.

Design of Concrete Mixtures

A number of important lines of investigation may be grouped under the general head of studies of design of concrete mixtures. These studies have to do with the effect of varying the relative quantities of the constituent materials, grading of aggregates, etc. Many different methods have been used and several theories have been advanced as a basis for proportioning concrete. We have the present custom (almost universal, I regret to say) of proportioning concrete by arbitrary quantities; that is, we use, say a 1-2-4 mix regardless of the characteristics of the aggregate materials, with no attention whatever to the quantity of mixing water used and take little account of the strength of the resulting concrete. Needless to say, this method is extremely crude, and does not recommend itself to thoughtful engineers.

The minimum-density-of-aggregate method has been advocated and used to some extent. Here the endeavour was to grade aggregates in such a way as to give an aggregate mixture of maximum density, and then to supply the quantity of cement that was considered necessary to produce concrete of the desired quality.

Another method is based on the voids in the aggregates. The voids in the coarse aggregates are determined, a sufficient quantity of sand is supplied to fill these voids, then a sufficient quantity of cement added to fill the voids in the combined aggregates. This is a little more rational than the purely arbitrary method. It, however, has no scientific basis. It will, in general, give fairly good concrete, but our investigations have shown that the voids in the aggregates do not constitute the determining factor in concrete mixtures.

Experimental Studies of Proportioning

A great deal of experimental work has been done in endeavouring to arrive at a proper basis for proportioning concrete. Much of the early work of R. Feret[1], a French engineer, was devoted to a study of this problem. Feret confined his studies almost entirely to sand mortars; consequently it is not easy to apply his methods directly to concrete mixtures. A. Hazen[2] did some interesting work in his studies of sands for water filtration. He made use of the "effective size" and "uniformity coefficient" of sands, factors which undoubtedly served a useful purpose, but many engineers have endeavoured to apply them to concrete aggregates without obvious reason for so doing. It is apparent that these functions cannot be usefully applied to concrete aggregate since they are based on separations made by one or two sieve sizes and consequently are inadequate to show the value for concrete of aggregate which covers a wide range in size. A good idea may be gained of the wide range in sizes in concrete aggregate when we consider that the diameter of a 3-in. pebble is over 500 times that of a particle of sand which passes the 100-mesh sieve.

The work of Fuller and Thompson[3] is a source of valuable information. However, our experiments have shown that the grading given by Fuller in his "maximum-density curve" is too coarse for the ordinary mixtures; in other words, for the usual quantities of cement, the grading he suggests gives a harsh-working concrete. Another corollary of Fuller's method indicates that the aggregates should be separated into a number of sizes and recombined in order to approximate the so-called maximum-density curve. Our investigations show that the separation of aggregates into a number of different sizes followed by recombination is seldom, if ever, necessary or desirable; in addition, for fine aggregates this method involves great expense and many difficulties.

It was apparent at the beginning of our experimental work that a proper basis for proportioning concrete was not available; consequently, among our first investigations was a number of studies of the general subject of proportioning. The studies carried out so far, which deal with the many phases of proportioning concrete reach a total of about 100,000 tests, and are being continued. Capt. L. N. Edwards[4], Mr. R. B. Young[5], Prof. A. N. Talbot[6], Mr. F. L. Reman[7], and Prof. R. W. Crum[8], have furnished valuable information, so that we are able to approach the subject from many different angles.

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[1] *Ann. Ponts et Chaussées;* also *Etude Experimentale du Ciment Armé*, 1906.

[2] *24th Annual Report Mass. State Board of Health;* reprinted in "State Sanitation," *Harvard Univ. Press*, 1917, **2**, 232.

[3] *Trans. Am. Soc. C.E.*, 1907, **59**,; also *Concrete Plain and Reinforced*, by Taylor and Thompson, 1916.

EFFECT OF WATER ON THE STRENGTH OF CONCRETE

During our experimental work it soon became apparent that the quantity of mixing water used and the consequent consistency of the concrete was an important element in its final strength. A more comprehensive study of this phase of the subject has shown that the quantity of mixing water is by far the most important feature of the mixture; assuming, of course, that the concrete materials used are of good quality. The new feature of this relation is that the strength and other properties of the concrete are determined (other factors being equal) by the ratio of the quantity of water to the quantity of cement used in the batch, regardless of the reason for the change in the quantity of mixing water; that is, whether the quantity is changed because of variations in grading of the aggregates, change in the quantity of cement, or change in the consistency of the concrete (or any combination of these) so long as the concrete is plastic. This has given rise to a factor which we call "water-ratio" in dealing with concrete mixtures. This fundamental relation has been brought out by a great many different series of tests carried out in this Laboratory, and has been verified by many tests made by other laboratories. Concrete of the usual type has a water-ratio of about 0·75 to 0·90, depending on mix, grading of aggregates, and relative consistency of the concrete. The practical application of these principles lies in the fact that concrete of a given water-ratio has a constant strength (other factors being equal), consequently anything which tends to raise the water-ratio, such as wetter consistency or a finer aggregate, will reduce the strength. If a wet consistency or a fine aggregate *must be used*, the only way to restore the water-ratio to its proper value is to use more cement. Conversely we see that no advantage is secured from using more cement *unless* the water-ratio is lowered. The value of a coarse and well-graded aggregate lies in the fact that it can be mixed into a plastic concrete with a lower water-ratio than can a finer or poorly graded aggregate.

The mixing water in concrete serves two distinct purposes: (1) to supply the water necessary for the hydration of cement; and (2) to produce a plastic mixture. The exact quantity required for hydration has not been determined, but such information as we have indicates that it is a relatively small percentage as compared with the quantity which must be used in the concrete. Probably not more than a quarter or a third of the water that is usually placed in concrete is necessary for hydration.

The water-ratio is the factor which governs the strength and wearing resistance of the concrete. If we use one cb. ft. of water (about 7½ galls.) to each sack of cement, we would have a water-ratio of 1; a smaller quantity of water per sack would give a water-ratio of less than 1, etc. The usual water-ratio for ordinary conditions is about 0·8 or 0·9, or about 6 to 6¾ galls. per sack of cement. In dealing with water-ratio we disregard water absorbed by the aggregates, although water mechanically held by the aggregate would be considered. The use of more cement, improving the grading of the aggregate, or the use of different methods of finishing or placing concrete, in order that it may be placed with a lower quantity of mixing water—all of these things are simply means to an end; namely, to produce a plastic concrete with a lower water-ratio.

This brings us to a point which is generally overlooked in building codes and specifications. It seems to be a general opinion that the cure for all the difficulties of weak or inferior concrete is to increase the quantity of cement. However, if the addition of cement is not at the same time accompanied by a reduction in the water-ratio, it does not accomplish any useful purpose. The water-ratio may be altered owing to changes in the relations of the quantity of cement, grading of aggregate, or changes in relative consistency of the concrete; however, we arrive at the same result, indicating that it is the water-ratio which actually controls the strength and other properties of concrete.

GRADING OF AGGREGATES

Another important feature brought out by our early investigations was the general law which seems to govern the relation between the grading of aggregates and the quantity of water required for a concrete mixture and, indirectly, the strength of the concrete. This relation has given rise to the factor which is known as the "fineness modulus" of the aggregate—a simple function of the sieve analysis using a series of wire cloth sieves in which the size of clear opening is varied by multiples of 2. The following sieves recently recommended by the American Society of Testing Materials in their "Tentative Method for Sieve Analysis of Aggregates for Concrete," conform to this arrangement: No. 100, 50, 30, 16, 8, 4, ⅜ in., ¾ in. and 1½ in. The sum of the sieve analysis expressed in percentages of the material by weight or by volume *coarser* than the given sieves is the fineness modulus of the aggregate. A low fineness modulus corresponds to a fine aggregate and a high fineness modulus to a coarse aggregate. A concrete sand well graded up to ¼ in. has a fineness modulus of about 3·00 and a well-graded gravel or crushed rock from ¼ to 1½ in. in size has a fineness modulus of about 7·00. This factor is useful in dealing with various combinations of aggregates of different gradings.

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[4] *Proc. A.S.T.M.*, 1917, **17**, Part II, 301; also *Proc.*, 1918, **18**, Part II, 303.

[5] *Proc. A.S.T.M.*, 1920, **20**, Part II, 137.

[6] *Proc. A.S.T.M.*, **21**, Part II, 940.

[7] *Eng. and Cont.*, May 5, 1915, 403; also *Bull.* 14, *Ill. State Highway Dept.*, 1917.

[8] *Proc. A.S.T.M.*, 1919, **19**, 458.

It is not necessary, or desirable, that the aggregate be proportioned according to any fixed grading; wide variations in gradings may occur without affecting the quantity of mixing water or the quality of the concrete.

Theory of Concrete Mixtures

The real problem in proportioning concrete mixtures is to take advantage of the characteristics of the materials available and to produce from them a satisfactory concrete at a minimum cost. At present aggregate materials cannot be transported long distances; we may know ever so much about the ideal characteristics of sand and coarse aggregates, but we may not be able to get aggregates of ideal quality. In other words, we must make the best we can of the materials at hand.

Our investigations have led us to the following fundamental principles:—

1. The strength of a concrete mixture depends on the quantity of mixing water in the batch, expressed as a ratio to the volume of cement, *so long as the concrete is workable*, and the *aggregates are clean and structurally sound*. The strength of the concrete decreases as the water-ratio increases.
2. The effect of differences in the quantity of cement is reflected by differences in the water-ratio.
3. The sieve analysis of the aggregate is the basis on which proportioning must be done. There is an intimate relation between the size and grading of the aggregate and the quantity of water required to produce concrete of a given workability.
4. It is not necessary, or desirable, that the aggregate be proportioned according to any fixed grading; wide variations in gradings of aggregate may occur without affecting the quantity of mixing water or the quality of the concrete. The sieve analysis expresses the life history of the material, so far as its concrete-making properties are concerned. It is only necessary for us to interpret this information in order to use the material to the best advantage.
5. Plasticity or workability is an essential requirement of concrete for structural purposes.

Plasticity of Concrete

The question of plasticity or workability of concrete is a very important one. We could not use concrete at all if it were not for the fact that it can be mixed and placed while in a plastic condition. We must put in enough water to make our concrete plastic so that it can be worked into place. The question of a satisfactory method for controlling and measuring the plasticity of concrete is giving concrete engineers more concern to-day than probably any other one thing. A number of methods have been suggested and a great deal of experimental work is now under way. The method which probably has met with most common use, because of its simplicity, is the "slump" test, using a truncated cone form 4 in. in diameter at the top, 8 in. at the bottom and 12 in. in height. The shortening of the fresh concrete upon removal of the form is taken as a measure of the plasticity of the concrete.

There is a great need for constructive research in developing a satisfactory and practical method of determining the plasticity of concrete. Any method which is used for this purpose in the field should not be interpreted too strictly. If the specification indicates that the concrete should be mixed to a slump of 6 in., we would not be justified in rejecting a batch of concrete simply because it gave a slump of 7 in. The purpose of the test is to ensure that the concrete does not habitually go beyond the quantity fixed by the specification. If a slump test were made on the concrete as placed in most building construction, we would get a slump of 10 to 11 in. That is the type of concrete to guard against. A few engineers are still sceptical as to the practicability of such control; some may doubt whether an excess of water *does* produce an inferior concrete. In many cases the concrete produced on the job has a strength of probably not more than 20 to 30 per cent. of the strength it should have, and probably not more than 60 or 70 per cent. of the strength upon which the design was based. Under these conditions we should not be surprised to find inferior concrete, and we do find it too often.

Application of Principles of Proportioning

The foregoing principles lead us to a number of practical features of concrete-making.

The quantity of mixing water used to produce concrete of the condition of workability necessary is of major importance. Every care should be taken to restrict the mixing water to a minimum. An excess of mixing water produces the same result as omitting a large portion of the cement from the batch.

Methods have been developed whereby aggregates may be scientifically proportioned on the basis of sieve analysis without separation into a large number of sizes. Aggregates may be used with good results regardless of the fact that their grading does not conform to our older ideas. For example, the Iowa State Highway Department has embodied in its specifications for concrete roads a method whereby pit run gravels can be used in almost any proportions in which they occur, so long as they are clean, regardless of the fact that there may be a great excess of sand. Their method requires an increase in the quantity of cement in proportion to the quantity of sand in excess of a certain minimum. The specifications would permit the use of a mixture of cement and sand only, providing the cement content were increased to such an extent as to produce concrete of the strength and wearing resistance aimed at by the specification. The Illinois Division of Highways permits the same thing. This procedure would have been frowned upon a short time ago, but it has proven its value and will, no doubt, become general practice in the near future. The problem is to put together the aggregates available in order to get the best concrete we can for a given or a minimum cost.

Quality of Concrete

We have come to accept the compressive strength of concrete as a measure of other desirable qualities. The strength of concrete is an important factor in building and other types of construction; however, the quality of concrete has a wider bearing than mere strength. A structure which is exposed to the weather, with wide ranges of temperature, wide variations in moisture content, and probably exposed to other destructive agencies, must have a very considerable degree of resistance if it is to give a good account of itself, entirely apart from any load-carrying requirements. It is true, however, that the strength of concrete reflects to a very large degree its ability to withstand other destructive agencies. Our experiments have shown that, in respect of wearing[9] resistance, it is true that the strength is the proper measure of the quality. The flexural strength[10] of concrete is also influenced in the same general way as the compressive strength; tests and observation show that the resistance of concrete to attack of alkali, sea water, etc., is dependent on the same factors as those which govern the strength. We may say then that the compressive strength of concrete is an entirely satisfactory measure of its quality.

Tables of Quantities of Materials Required for Concrete

Based on the information secured from several thousand tests we have recently compiled a series of tables (*Bulletin* 9. Structural Materials Research Lab.), giving the proportions and quantities of materials required for concrete of strengths varying from 1500 to 4000 lb. per sq. in. at 28 days when tested in compression in 6 by 12 in. cylinders. Separate values have been worked out for mixtures of fine and coarse aggregates of different sizes and a wide range of consistencies as measured by the slump test. These tables will be found useful in estimating quantities of materials required for concrete of given materials and mixtures and also in estimating the probable strength of concrete and the relative strength of concrete of different mixtures, aggregates and consistencies.

Standard Tests of Concrete and Concrete Materials

During the past year or two the American Society for Testing Materials has published in its "Standards" and Proceedings the following *new* standards or tentative standards which are of interest to all concrete engineers.

1. Standard Method of Making and Storing Specimens of Concrete in the Field.
2. Tentative Method of Making Compression Tests of Concrete.
3. Tentative Specifications for Workability of Concrete for Concrete Pavements.
4. Tentative Method of Test for Sieve Analysis of Aggregate for Concrete.
5. Tentative Method of Test for Organic Impurities in Sands for Concrete.
6. Tentative Method of Securing Specimens of Hardened Concrete from the Structure.
7. Standard Method of Test for Unit Weight of Aggregate for Concrete.
8. Tentative Specifications for Concrete Aggregate.
9. Tentative Method of Test for Voids in Fine Aggregate for Concrete.
10. Tentative Specifications for Workability of Concrete for Concrete Pavements.

Those who have not looked up these standards recently will be well repaid for doing so. Many of the concrete tests made in the past are of little or no value, because sound principles of testing were violated. It is frequently impossible to interpret indications of concrete tests properly, on account of the lack of proper standard methods of manipulation. The tentative standard method for making tests of concrete should be consulted and followed so far as possible by all who have occasion to make tests. In those standards the details are given whereby consistent results can be secured in different laboratories and in different sections of the country, something we have not been able to do heretofore.

We have been floundering around for forty years, and for the first time we now have some semblance of a standard method for making sieve analysis of aggregates. Heretofore practically every laboratory used a different set of sieves or used a different method of recording sieve analyses, and consequently the results have been so divergent that it has been almost impossible for one person to make anything out of the work done by others; standard sieves and methods are very important steps in advance. Considerable progress is being made in many directions in the improvement and standardisation of concrete tests, all of which will exert an important influence on the quality of work, and will in the near future result in a higher average of good concrete.

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[9] See "Effect of Curing Condition on the Wear and Strength of Concrete," *Bull.* 2, *Structural Materials Research Laboratory*; also "Wear Tests of Concrete," *Proc. Am. Soc. Testing Mat.*, 1921. See *Bull.* 11, *Structural Materials Research Laboratory.*

[10] "Flexural Strength of Plain Concrete," *Proc. Am. Concrete Inst.*, 1922; *Bull.* 11, *Structural Materials Research Laboratory.*

SOME RECENT WORK ON THE FATTY ACIDS

By T. W. JONES, B.Sc.

The higher fatty acids figure among the substances most recently investigated by means of the X-ray spectra. Since Laue's brilliantly successful experiments in 1912 the application of X-rays to the elucidation of the structure of solid bodies has resulted in a continuous increase and extension of our knowledge of the latter. As is well-known, Laue's work had for its object the measurement of the wave length of the X-rays. The interatomic spacing of the crystal being known to be of the order of 10^{-8} cm., he used the crystal as a diffraction grating and so obtained, on an ordinary photographic plate, a spectrum somewhat similar to that of optical light. From the spectra the wave length of the X-rays was calculated to vary between the orders 10^{-8} cm. and 10^{-9} cm.

Having unlocked the door to the elucidation of crystal structure he passed on, leaving to others the task of opening it. Foremost among those to take up this work and reveal to us that the external symmetry of the crystal is an outward and visible sign of an internal regularity of arrangement of its atoms were Sir W. Bragg and his son, Prof. Bragg. They showed us that the crystal may be regarded as a series of planes parallel to its face, each plane being packed with molecules the atoms of which are arranged in the form of a space lattice; and that each plane is equidistant from its neighbour, this distance being the "spacing" of the crystal. As might be expected, Laue's methods had to undergo many alterations and elaborations, from which was finally evolved the X-ray spectrometer. This instrument, now in almost general use, allows X-rays from the anticathode of an X-ray bulb, constricted by lead slits to a narrow pencil, to impinge on the crystal, or mass of powdered crystals, mounted at the axis of a rotating arm; the reflected rays, both incident and diffracted, are then photographed on an ordinary photographic plate or film. By rotating the arm a continuous band spectrum is obtained, in place of the discontinuous spectrum of concentric rings of dots obtained by Laue. A further elaboration of the method is to receive the rays from the crystal in an ionisation chamber, containing a heavy gas, such as sulphur dioxide, ionisation of which is recorded on a gold-leaf electroscope. From measurements obtained by these means the internal arrangement of the atoms and molecules of a large number of crystals has been calculated.

It would seem but a step from the application of X-rays to crystals, to their application to the discovery of the internal composition of other solids. This step, however, has been somewhat difficult to take until just recently, by reason of the paucity of our knowledge of the physical structure of these bodies. Particularly were we ignorant of those substances, which are neither crystal nor liquid, and called, for want of a better name, liquid crystals. Recent work by G. Friedel, however, has so far enlightened our knowledge of these substances as to enable us to utilise the X-rays to reveal their structure. In a paper published early this year he postulated that matter is capable of existing in two forms, distinguishable by their structure, and neither crystalline nor liquid, to which he applies the term "meso-morphic state." The first form he calls the smectic phase, so named after the soaps which are included in it, and the second the nematic phase on account of the linear discontinuities which constitute its chief feature. The smectic phase is optically positive, possesses high viscosity and is quite rigid, except in the direction of its optical axis, displacement being invariably accompanied by change of structure. Friedel is of the opinion that the smectic bodies consist of a regular formation of equidistant molecular layers, and hence they should be able to diffract the X-rays in a manner similar to that displayed by the reticular parallel planes of a crystal system.

Since this paper appeared the result of work on some of the smectic bodies, the alkali salts of oleic acid, has been published by De Broglie and Friedel in the *Comptes Rendus*. Taking into consideration the fact that the chemical formulæ of these substances always contain a long rectilinear CH_2-chain, and that these chains were probably arranged parallel to the optical axis, it seemed probable that the distance between two homologous points of two successive layers, *i.e.*, the spacing, would be at least equal to the length of these chains and large compared with the atomic distances. They therefore decided to employ X-rays of a longer wave length than would be used for work on crystal structure. The X-ray spectra so resulting were consistent with a spacing of about 40 Angstrom units, which would seem to confirm the correctness of Friedel's original opinions regarding the molecular construction of the bodies.

Experiments on a series of homologous fatty acids have also been carried out by Muller in a similar manner to that adopted by De Broglie and Friedel. The acids investigated were the more common ones, capric, lauric, myristic, palmitic, and stearic, a series showing increasing length of the CH_2-chain. It was found that the spacing increased with increase of the length of the CH_2-chain, thus providing still further confirmation of Friedel's theory.

The method adopted was to melt a little of the pure acid on a glass plate and spread it out in a thin film 2-3 mm. wide, 1 cm. long, and 0·1 to 0·2 mm. thick, the acid then crystallising in flakes which oriented themselves parallel to the surface of the glass. The plate was fixed in the crystal holder of an X-ray spectrometer, and oscillated, this giving a spectrum consisting of lines on each side of the reflection of the primary beam, so eliminating any errors which would result from using the latter as the zero line. The photographs show well-defined lines and the distances between corresponding lines vary for the different acids, decreasing as the length of the CH_2-chain increases. The photographs show, in addition to these characteristic lines, two other lines which appear constant for all the acids.

From these data it is assumed there is a possibility that the unit cell of the fatty acid may be in the shape of a long prism of the same cross-section for all the acids, the length of the prism increasing proportionately to the number of CH_2 groups in the molecule.

Only future events can demonstrate the truth of this hypothesis, but some proof is afforded of the increase of spacing corresponding with an increase in the length of the CH_2-chain in papers by N. K. Adams in the *Proceedings* of the Royal Society for last year, where it was deduced from measurements of thin films of these acids on the surface of liquids, in which they were insoluble, that the molecules arranged themselves in parallel cells and that the spacings increased with increase in length of the CH_2-chains.

THE PRINCIPLES OF BOILER FEED WATER TREATMENT

There is ample room for a short treatise giving in clear and concise language the essential scientific principles underlying the hardness of water and the methods to be adopted for the prevention of scale and corrosion in boilers. Such a publication (pp. 32), has just been issued by Messrs. Brunner Mond and Co., Ltd., having been written by their research staff, and may be obtained free of charge from the company at Northwich, Cheshire. The detailed explanation of the soda ash and lime method of treatment, together with the selection and method of working of the necessary plant, is particularly good. The great advantage of this method, the old Porter-Clark process with the addition of suitable mechanism to facilitate the quick separation of the precipitated calcium carbonate, is that not only does it separate practically all the objectionable scale formed and corrosive material outside the boiler, and deliver clear water only, but that no soluble salts are added to the water. Substances such as sodium sulphate and other neutral salts are in themselves harmless, but when they accumulate in the boiler they give rise in practice to all kinds of difficulties, tending to cause, for example, electrolytic action and heavy priming, besides impregnating the steam and affecting the jointing material.

The proper scientific method is to take everything out of the water before it goes into the boiler, and whilst one may, perhaps, not altogether agree with the statement (p. 25) that the soda ash and lime treatment will give a final water as low as 3° hardness, at any rate 5° can certainly be obtained without difficulty by anyone who has a reasonable knowledge of the process. The book should prove invaluable in showing how results of this kind may be obtained all the year round, and also in dealing with the more difficult aspects of the question, such as the removal of the last traces of magnesium, and the presence of oil, carbonic acid, carbonates, and acids, both mineral and organic.

LOW TEMPERATURE CARBONISATION

Coalite Developments at Barnsley

The well-known "Coalite" plant at Barugh, near Barnsley, which has been in practically continuous operation since the latter part of 1921, is now to be greatly extended so as to be capable of carbonising 500 tons of coal per 24 hours. It is claimed that the very difficult practical problems of the low temperature carbonisation of coal have now been finally solved with the present form of plant, but Messrs. Low Temperature Carbonisation, Ltd., have desired to give the matter a thorough large-scale practical test of long duration. Hence the two years' run, and it may be stated also that the plant in operation at Barnsley has been visited by a large number of chemists, fuel technologists, engineers, and other experts, not only from all over Great Britain, but also from foreign countries as well. The results are stated to have been so successful that the present great extensions are now to be proceeded with immediately, and it is also the intention to erect similar 500-ton plants in different industrial centres so as to supply the local demand for smokeless fuel, motor spirit, liquid fuel and sulphate of ammonia. As will be remembered, the "Coalite" process consists in the direct carbonisation of coal, without any preliminary treatment or subsequent briquetting, at 1000° F., and that the yield from one ton of ordinary average semi-bituminous coal, with 25—30 per cent. volatile matter, is 4500—6000 cb. ft. of very rich gas (700—825 B.Th.U.), 18–20 gallons of valuable paraffinoid low temperature oils, 15 lbs. of sulphate of ammonia, and 14 cwts. of residual smokeless "Coalite" containing 10 per cent. volatile matter, which is, of course, absolutely smokeless for this reason.

Of course the yield differs, depending on the coal, and some recent lengthy experiments, for example, carried out over many months showed that 8280 tons of coal gave a yield of 6210 tons of smokeless coalite, 172,565 gallons of tar oils, and over 38,000,000 cb. ft. of rich gas, over 800 B.Th.U. and there seems to be no question that the problems are now finally solved.

The work that has been involved in this achievement is almost incredible, dating back to Parker's first experiments at Wednesfield, near Wolverhampton, in 1901, and the total cost is stated to have been over £1,000,000, whilst the amount of coal carbonised is over 100,000 tons. The chief trouble, of course, is one of price, and especially the value to be placed on the "Coalite." It is agreed that a smokeless fuel of this nature burns in an open grate with a very high radiant efficiency, something like 30—35 per cent. as against 20 per cent. for coal, but it is obvious the householder will never pay anything like its true value. However, it is stated that "Coalite" can be put on the market at the same price as raw coal and still leave a reasonable margin, and if this is the case the success of low temperature carbonisation should be assured.

FORTHCOMING EVENTS.

Nov. 16. Chemical Engineering Group at the Chemical Industry Club, 2, Whitehall Court, London, S.W. 1, at 8 p.m. "A New Source of Potash and its Industrial Exploitation," by Prof. J. W. Hinchley.

Nov. 19. Society of Chemical Industry, *Yorkshire Section*, the Queen's Hotel, Leeds, at 7.15 p.m. "The Work of the Chemist in Connexion with the Textile Industries," by Dr. Lloyd.

Nov. 21. Society of Chemical Industry, *Nottingham Section*, the University College, Nottingham, at 7.30 p.m. "Observations on certain Micro-organisms growing in Glycerol," by H. S. Holden and J. E. I. Gilbert. "Organic Compounds of Tin," by H. Lambourne. "Demonstration of a Universal Regulator of Acidity, with some suggested Uses in Analysis," by Dr. E. B. R. Prideaux.

Nov. 19. The Institution of Rubber Industry, Midland Hotel, Manchester, at 7.30 p.m. "Costing in the Rubber Industry as an Essential Factor to Successful Production," by C. A. Fryer.

Nov. 21. Royal Microsopical Society, 20, Hanover Square, W. 1, at 7.30 p.m. "Exhibition of Bacteriomorphic Granules Resulting from Cell-lysis or Digestion," by Dr. H. M. Woodcock.

Nov. 21. Society of Glass Technology, Lecture Room of the Coal, Gas, and Fuel Industrial Department, The University, Leeds, in the afternoon.

Nov. 21. Institution of Electrical Engineers, *Wireless Section*, Savoy Street, Victoria Embankment, London, W.C. 2, at 6 p.m. "Periodic Trigger Reception," by E. V. Appleton and F. S. Thompson. "A Dynamic Model of a Valve and Oscillating Circuit," by R. C. Clinker.

Nov. 23. The Institution of Mechanical Engineers, Storey's Gate, London, S.W. 1, at 7 p.m. Informal Meeting.

Nov. 23. Society of Chemical Industry, *Manchester Section*. Annual Dinner at the Queen's Hotel, Manchester.

Nov. 23. West of Scotland Iron and Steel Institute, Royal Technical College, George Street, Glasgow, at 7 p.m. "Effects of Time and Temperature on High Speed and Similar Steels," by W. E. Woodward.

Nov. 23. The University of London, W.C. 1, at 8 p.m. "The Fundamental Concepts of Natural Science," by Prof. G. Dawes Hicks. (Lecture 4.)

Nov. 23. Society of Chemical Industry, *Glasgow Section*, The Engineers' and Shipbuilders' Institute, 39, Elmbank Crescent, at 7.15 p.m. "Artificial Resins—their Preparations and Uses," by H. Hepworth, D.Sc.

Nov. 26. The Faraday Society. General Discussion on "Electrode Reactions and Equilibria," at the Institution of Electrical Engineers, Victoria Embankment, from 3 to 7.30 p.m.

Nov. 26. Birmingham University Chemical Society, Chemical Lecture Theatre, Edgbaston, Birmingham, at 5.30 p.m. "Chemical Theories of Atomic Structure," by C. J. A. Taylor, B.Sc.

Nov. 26. Chemical Industry Club. Annual Dinner at the Connaught Rooms, Great Queen Street, W.C. 2, at 7 for 7.30 p.m.

Nov. 27. The University of London, W.C. 1, at 5.30 p.m. "The Pan-Pacific Congress," by W. J. Perry.

Nov. 28. Royal Institute of Public Health, 37, Russell Square, W.C. 1, at 4 p.m. "Problems in Relation to Health in the Tropics" (with lantern illustrations), by Miss K. Platt, M.D.

Nov. 28. Royal Microscopical Society, *The Industrial Applications Section*, 20, Hanover Square, W. 1, at 7.30 p.m. "The Characteristics of a Microscope for General and Special Purposes," by J. E. Barnard, F.Inst.P.; "The Application of the Microscope to Industrial Diseases," by Dr. S. H. Browning, L.R.C.P.

Nov. 28. Royal Society of Arts, John Street, Adelphi, W.C. 2. "The Effect of Sun, Sea, and Open-air in the Treatment of Disease," by Sir H. J. Gauvain, M.A., M.D., at 8 p.m.

Nov. 29. Institution of Mechanical Engineers, The Medical Theatre, University, Edmund Street, Birmingham. "Metal Rolling and the Influence of Cooling on Plastic Flow," by J. E. Fletcher.

Nov. 29. Institution of Mechanical Engineers, Engineers' Club, Albert Square, Manchester. Further discussion on "Clyde Marine Oil-Engines," by Prof. A. L. Mellanby.

SOCIETY OF CHEMICAL INDUSTRY

SOUTH WALES SECTION

A meeting was held in Cardiff on November 8. The formal meeting was preceded by a dinner, at which the chairman, Capt. Hugh Vivian, presided, the guests including Dr. E. F. Armstrong, F.R.S., the President, the Lord Mayor of Cardiff, Principal Trow of the University College, Mr. William Johnson, President, and Mr. Martin Price, Secretary of the South Wales Institute of Engineers, and Principal Coles of the Technical College.

The loyal toast having been honoured, the chairman proposed the health of the President, Dr. Armstrong, referring to his eminence in the realm of pure science as well as in industry, and expressing the thanks of the section to him for his visit to South Wales. Mr. W. R. Bird (vice-chairman) proposed a toast to the hon. secretary, Dr. H. E. Cox, expressing the regret of the committee and of the members that he had to resign this office on account of his removal to London. Mr. G. R. Thompson seconded. The members and guests then adjourned to the South Wales Institute of Engineers (whose theatre was kindly lent by the Council of that Institution), where, after a brief introduction by Capt. Vivian, Dr. E. F. Armstrong delivered an address on "The New Chemistry."

Dr. Armstrong said that it can be argued that we have just entered on a new stage in chemical investigation. Labours in the main of an analytical type have enabled the exact structure of all but a very few substances to be established; the results have been confirmed by synthetic operations, and most compounds have been built up step by step from their elements. Whilst the modern school of physicists by a series of most brilliant researches has learned much about the nature of the atom, the chemist is now concerned with the behaviour of the molecule. This has entailed the recognition that he has not only to deal with crystals and relatively simple molecules in solution, but also to consider actions taking place at the surface of colloid aggregates. As it is probable that the bulk of the reactions in the plant and animal cell are of this nature their importance will be at once conceded. Further, it must be realised that there is evidence that molecules in solution have a definite space orientation at such colloid surfaces and indeed, according to the work of Hardy, at surfaces in general.

According to the accepted space lattice theory of matter, there is a definite attraction causing adhesion between each layer of molecules and consequently at a surface, say, of a piece of glass there are unsatisfied forces of valencies. At first when a drop of a lubricant is placed on such a surface nothing happens, but when two surfaces of glass are moved over one another the molecules of the lubricant become arranged according to a definite pattern. The chemist to-day in seeking to explain chemical action has to realise that this takes place in many instances between aggregates of molecules and at the surface of such aggregates and not between single simple molecules in solution such as his equations postulate and the ionic theory in its original form demands.

The first fact which has emerged from the detailed study of chemical action at a surface is that the action is not one of the so-called first order in which the same fraction of the reacting substance undergoes changes in successive equal intervals of time—a change expressed graphically by a logarithmic curve. When proper and sufficient care is taken to keep the surface active the rate of change is uniform, provided that the changing substance is present at the surface in sufficient quantity. These facts are in accord with the hypothesis that action is preceded by the formation of an additive unstable complex which breaks down in all possible ways, that is, into a variety of components practically as fast as it is formed. The problem of the source of the energy necessary to effect this is not without interest, but it is common to all chemical reactions and its discussion may safely be left to the exponents of the quantum and other theories.

Such actions as we are considering are known as catalytic, the change being effected by virtue of the activity of the catalyst surface, the only other agent involved in practically all cases both in the living cell and the test tube being water. It is now recognised that the water molecule can undergo rupture in two ways, either being distributed upon a single molecule, which is thereby resolved into two others

$$A.O.B. + H.OH = A.OH + B.OH$$

or divided between two molecules in such manner that whilst the one is oxidised the other is reduced—

$$A + 2\,H{\cdot}OH + B = AO + H_2O + BH_2.$$

Entirely different classes of catalysts bring about the two actions, but all are classed as enzymes when concerned with changes which take place in the cell. Such enzymes as are well known are highly specific and selective, a different enzyme being required for each class of compound.

Armed with the knowledge of the fundamentals of chemical action in the cell, the time is ripe for the chemist to ascertain the inner meaning of phenomena which the biologist can only investigate by the recording of external visual characteristics. As a case in point, the coloration of flowers and its inheritance may be cited. There is much in favour of the view that flower colours, whether anthocyans or belonging to other groups, are the product of the interaction of two factors, an oxidase and a colourless precursor of the pigment. The absence of either factor means failure to develop colour by the plant, *i.e.*, white flowers, and there may also be a third factor present which prevents action taking place between oxidase and leucobase.

If proper combination of effort between the biologist and chemist can be ensured, very many baffling problems, many of which are of far-reaching economic importance, can be attacked.

A hearty vote of thanks was proposed by Mr. Bird and seconded by Professor C. M. Thompson.

LONDON SECTION

At the first meeting of the session on November 5, Dr. Monier-Williams, the hon. secretary, gave an account of experience gained during the past two years in the fumigation of ships for the purpose of destroying rats and vermin with hydrogen cyanide. He pointed out that poisoning and trapping can never account for the whole of the rats on a ship, whereas fumigating, if properly carried out, can do so. In the past, sulphur dioxide has largely been used, but as the United States quarantine regulations of 1920 require all vessels engaged in trade with foreign ports to be fumigated every six months, it became necessary to fumigate the passenger quarters of trans-Atlantic liners, for which purpose sulphur dioxide cannot be used owing to its corrosive action on furnishings and decorations.

Hydrogen cyanide was first used in 1890 in the orange orchards of California and Florida; in 1898 it was used by the Cape Government railways for bugs and lice in sleeping carriages; it was used in India by Col. Glen-Lister in 1899 and in quarantine work at Porto Rico in 1910. Since the war, the use of hydrogen cyanide has become general, especially in American, Australian and Italian ports. Until last year, however, it was used on a comparatively small scale and only recently, owing to the United States quarantine regulations, has the complete fumigation of large passenger vessels been attempted. As a consequence, the use of hydrogen cyanide was decided upon by the Cunard and White Star companies, and Dr. Stock and Dr. Monier-Williams were deputed to watch the experiments on behalf of the Ministry of Health.

The toxicity of hydrogen cyanide is not so great as was formerly imagined, and possibly 1 part in 10,000 of air, or even a higher concentration, can be breathed with impunity. At the same time, beyond 1 part in 2000 of air, its action is rapid, and 1 in 500 would probably kill a man instantly. It is not an irritant, however; it has not much smell; and the critical point is not easy to recognise. Thus the precautions necessary are more elaborate than with sulphur dioxide, and it is essential when fumigating by this method to organise the work most carefully.

The various methods of using hydrogen cyanide were then described, the simplest being to place tubs in various parts of the ship containing 1½ parts by weight of sulphuric acid to 1 part of water, and to hinge, on the sides of the tubs, boxes containing solid cyanide, these boxes being tipped up by means of a cord so that their contents fall into the tubs and so cause liberation of the gas. Accidents have occurred in foreign ports by the use of hydrogen cyanide, but Dr. Monier-Williams is of opinion that these have mostly occurred through negligence in adopting the most ordinary precautions.

Among the other methods mentioned was a solution method in which the cyanide was previously dissolved in water and the solution poured through funnels on deck through rubber hose pipes leading to the tubs below, and on the whole it was suggested that this was the most preferable. Many investigations are required, however, before the fullest information can be available with regard to the use of hydrogen cyanide for fumigation. We know practically nothing about the rate of mixing of gases in a ship, nor do we know at how many points should gas be liberated, whether artificial circulation of air should be effected, how far hydrogen cyanide is liable to form pockets and so be a danger afterwards, and how far it is absorbed by walls and different materials and given off subsequently. The only way to obtain reliable information is by thorough sampling of the gas and the vacuum bottle was suggested as the best method of doing this.

After stating that fumigation by hydrogen cyanide is cheaper than sulphur dioxide, Dr. Monier-Williams said that if the former was to be adopted generally, the problems which he had suggested must be tackled with the view of carrying out the operation in the most effective way at a minimum expense.

During the discussion various suggestions were made for the use of other substances such as chlorine and carbon monoxide. It was also mentioned that the greatest expense connected with the complete fumigation of ships was the enormous amount of labour involved on large vessels like the *Berengaria* or *Mauretania*.

MANCHESTER SECTION

In the announcement of the forthcoming papers to be read before the Manchester Section there is one by Knecht and Muller on "The dehydration of alcohol." In consequence of the appearance of two recent papers, the first by W. B. S. Bishop, on "Ethyl formiate from oxalic acid, glycerol and ethyl alcohol" (This *J.*, 1923, 401 T), and the second by R. Wright on

"Selective solvent action by the constituents of aqueous alcohol" (*J.C.S.*, 123 & 124, 2493), the authors have decided to communicate briefly the essential point in their forthcoming paper, which consists in the employment of anhydrous glycerin as a convenient means for the dehydration of alcohol. In its simplest form the process consists in adding to commercial alcohol (*e.g.*, P.B.S.) about a quarter of its weight of pure glycerin and distilling the mixture from a water bath, the distillate being collected up to 80° C. (bulb in vapour). Details and modifications of the process, as well as analytical data, are given in the paper.

NEWCASTLE SECTION

At the opening meeting of the Session, held on October 31 in Armstrong College, Mr. A. Trobridge presiding, Mr. H. R. Whitehead, M.Sc., read a paper on "Milk."

The opening part of the paper dealt with the necessity of a pure milk supply, and described the chemical constituents of milk in some detail, as well as the various methods adopted for the estimation of its constituents.

The question of bacteriological contamination was treated at length, and the fact that milk is almost an ideal medium for the growth of bacteria was utilised to show how necessary it is to keep the milk at a low temperature and to prevent contamination by bacteria. The fallacy of the so-called dirt test was emphasised, and it was pointed out that the amount of dirt found bore no relation to the number or kind of bacteria present and was no criterion of cleanliness. A description was given of the usual kinds of bacteria which were found in milk, and the regulations issued by the Government regarding graded milk and the methods of carrying out the tests specified were discussed.

BRISTOL SECTION

The second ordinary meeting of the Session was held in the Chemical Theatre of the University on November 1, when Mr. A. H. Bridges read a paper entitled, "Some aspects of the paint trade—fine colour and lake making." The audience numbered 78, and included members of the Bristol Printers' Managers' and Overseers' Association, who were present by invitation. Mr. M. W. Jones occupied the chair.

The author touched briefly upon the universal use of colour for personal and decorative ornament from the earliest times, pointing out how the development of the coal-tar dyestuff industry furnished the colour-maker with shades hitherto unattainable and gave rise to a large and interesting branch of chemical industry.

In discussing chromate of lead colours, the lecturer set forth how the various shades and qualities were produced, demonstrating by formulæ and experiments the differences between them. Passing on to Cyanogen Blues, an account was given of the manufacture of the various trade types—Prussian, Pure and Chinese, and the characteristics of each. Pure and Brunswick Greens, made by blending Chrome Yellow and Cyanogen Blue in various proportions were next touched upon, and it was shown how lakes and fine colours were prepared by precipitating one or more of the coal-tar dyestuffs upon a suitable base, the nature of which frequently affected the ultimate shade.

The plant and routine of a colour works was fully described, the uses to which the finished colours are put were elaborated, and it was shown how these products of the colour-maker are passed on to enrich paints and colour distempers, to print or stain wall-papers, floorcloth and linoleum, to produce printing inks either for paper or metallic surfaces, and for the decoration of motor-cars and carriages.

The paper was illustrated by numerous experiments, lantern slides and samples, and gave rise to an interesting discussion, after which the meeting terminated with a vote of thanks to the lecturer.

BIRMINGHAM AND MIDLAND SECTION

A meeting was held on November 6 in the University Buildings, under the scheme of co-operation with the Chemical Society. Summaries of the papers are appended.

The aminoacetophenones as colour intermediates, by Prof. G. T. Morgan, F.R.S., and J. E. Moss, M.Sc.

The nitration of acetophenone furnishes an interesting illustration of the Crum Brown rule of substitution among aromatic compounds, the main product being *m*-nitroacetophenone, accompanied by *o*-nitroacetophenone as by-product. Although the yield of the latter increases with rise of temperature, meta-substitution of the nitro-group remains a predominant factor, but owing to oxidation a considerable portion of the meta-derivative appears in the form of *m*-nitrobenzoic acid. The ortho,- meta- and para-aminoacetophenones, when diazotised and coupled with β-naphtholsulphonic acids, do not behave as mordant dyes, although this property is developed when *o*-aminoacetophenone is replaced by anthranilic acid.

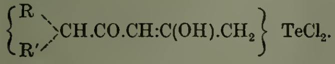
The bactericidal action of tellurium derivatives of aliphatic β-diketones, by Prof. G. T. Morgan, E. A. Cooper, and A. W. Burtt.

The action of the tellurium derivatives of aliphatic β-diketones of the general formula, $R.C_5H_6O_2{:}Te$ have been studied on *B.typhosus*, *Staphylococcus py.aureus* and other micro-organisms. The carbolic acid co-efficient is shown to vary considerably with alterations in the chemical structure of the β-diketonic group.

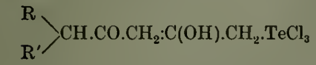
Interaction of tellurium tetrachloride and the higher β-diketones. Parts I., II. and III. Prof. G. T. Morgan, H. D. K. Drew, E. Holmes and R. W. Thomason.

The interaction of tellurium tetrachloride and the homologues of acetylacetone is influenced in a remarkable degree by the chemical structure of the β-diketones. When the carbon chain is unbranched two hydrogens are substituted in the diketone, giving rise to dichlorotellurium derivatives of the general formula $R{\cdot}C_5H_6O_2''TeCl_2$; these dichlorides on reduction give rise to well-defined tellurium derivatives $R.C_5H_6O_2Te$, appreciably soluble in water, which have a marked bactericidal action on various pathogenic organisms.

When the carbon chain is branched the condensation leads to tellurium derivatives of the type :—

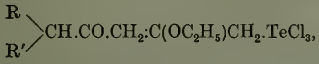


$$\left\{ \begin{matrix} R \\ R' \end{matrix} \!>\! CH.CO.CH{:}C(OH).CH_2 \right\} TeCl_2.$$



$$\begin{matrix} R \\ R' \end{matrix} \!>\! CH.CO.CH_2{:}C(OH).CH_2.TeCl_3$$

and



$$\begin{matrix} R \\ R' \end{matrix} \!>\! CH.CO.CH_2{:}C(OC_2H_5)CH_2.TeCl_3,$$

the last of these arising from the intervention of ethyl alcohol present in the chloroform employed as the organic solvent. β-Diketones of more complicated type, such as diacetylacetone and dimethylhydroresorcinol react quite differently, giving rise to oxonium tellurichlorides.

BIRMINGHAM UNIVERSITY CHEMICAL SOCIETY

At the meeting held on October 29, Mr. F. J. Corby, B.Sc., read a paper on " Perfumes." After a brief description of the natural perfumes, the general types of compounds used in the perfumery trade were described, and an account was given of the various processes employed in extracting plant perfumes, including those of distillation, expression, enfleurage, maceration and extraction with volatile solvents. The process of " fixation " was outlined, together with a short account of musk and ambergris and a more detailed account of such perfumes as jasmin, violet, rose and lily, illustrated the uses of various synthetics and natural products in the manufacture of scents. The latter part of the lecture was devoted to specific examples such as eau-de-cologne and lavender water, and a comparison of the old and modern recipes for various scents. The lecture was amply illustrated by slides showing the various cultivated areas mentioned, and a large number of samples of raw materials and finished products was exhibited.

CHEMICAL SOCIETY

MEMORIAL LECTURE, NOVEMBER 8th, 1923

Dr. J. H. Jeans, Secretary of the Royal Society, delivered the Van der Waals Memorial Lecture to a large company of Fellows and visitors in the lecture hall of the Institution of Mechanical Engineers, the President, Prof. W. P. Wynne, F.R.S., occupying the chair.

Referring briefly to the career of the distinguished Dutch physicist, a self-made man whose eminence was illustrated by the fact that even his doctorate thesis was a classic, the lecturer pointed out that he was the pioneer in that field of physics and chemistry which still characterised research in Holland.

Van der Waals' equation :—

$$\left(p+\frac{a}{v^2}\right)(v-b)=\alpha T$$

expresses the result of supposing a molecule to be endowed with two distinct physical properties—finite size, giving rise to the term b, and cohesive force, giving rise to the term a/v^2. The physical meaning of the equation is best exhibited by drawing diagrams of isothermals of the familiar type. Representing different gases there will be different diagrams corresponding to different values of a and b. It is, however, readily shown that one diagram of this type can be made to represent all values of a and b, and so the isothermals of all gases, by suitable expansions and contractions of its horizontal and vertical scales. On removing the scale from any single diagram we have a universal diagram which represents the p.v.T relation for all gases, but without specifying the scale. The circumstance that such a diagram is possible is equivalent to the so-called " Law of Corresponding States " : this is now seen to be a mathematical consequence of Van der Waals having confined himself to a two-constant specification of molecular structure.

Thus the accuracy, or the reverse, of the law of corresponding states provides a test of the sufficiency of Van der Waals' two-constant specification of a molecule. In actual fact the law is not very closely obeyed, and the deviations show distinct correlation with atomicity and so suggest that the two-constant specification is not altogether adequate—a full treatment must take account of differences of atomicity (or physical shape) as well as of differences of size and cohesive power.

Van der Waals explained his cohesive power by the supposition that all matter possesses inherent powers of attraction for all other matter. Gravitational attraction is numerically far too small to come into the question at all, so that it is to the electrical structure of matter that we must look for the origin of this supposed universal attraction.

If molecules were electrically charged structures, similar molecules would repel one another; as they are electrically neutral, they will repel in some orientations and attract in others, but two molecules meeting at random are as likely to repel as to attract. It is only when we study the *duration* of molecular encounters that we find an explanation of the preponderance of attraction over repulsion—attractive encounters draw the molecules further and further into each other's sphere of influence, and so last longer than repulsive encounters. Comparing the two types of encounters, the "birth rate" is the same for each, but the "expectation of life" is longer for attractive encounters, so that for the encounters in being at a specified instant, there is a preponderance of attractive encounters, and hence a resultant attractive force. This attractive force, however, originates far more in an abstruse theorem of statistical mechanics and far less in an inherent property of matter, than Van der Waals supposed.

If this interpretation is right the cohesive forces must disappear at very high temperatures and must steadily increase with decreasing temperatures, so that a must be a function of the temperature and not, as Van der Waals supposed, a constant. In point of fact, all attempts to bring Van der Waals' equation into closer agreement with observation begin by making a a function of the temperature. Moreover, a is found to vanish at infinite temperatures in conformity with the suggested explanation.

The second constant b was supposed by Van der Waals to have its origin in the finite sizes of the molecules. If, for instance, the hydrogen molecule is regarded as a sphere, its radius as calculated from the observed value of b is found to be $0{\cdot}64 \times 10^{-8}$ cm. The same radius can be calculated independently in other ways; the coefficients of viscosity, of conduction of heat and of self-diffusion all agree in yielding the value $0{\cdot}68 \times 10^{-8}$ cm. The average of these, $0{\cdot}66 \times 10^{-8}$ cm. would give for the hydrogen *atom* a volume equal to that of a sphere of radius $0{\cdot}53 \times 10^{-8}$ cm. But the normal hydrogen atom, as we now know from the researches of Bohr, consists of two electric charges, describing a circular orbit, one about the other, of radius precisely equal to $0{\cdot}53 \times 10^{-8}$ cm. As regards collisions with other molecules, this invertebrate structure consisting of two point-charges with no material connexion between them appears to reserve for itself a three-dimensional spherical volume with as much precision as though it were a sphere of infinite hardness.

The explanation of this infinite hardness is to be found in the intangible fetters of the quantum dynamics. The nature of these fetters we do not in the least understand, but we believe that they are such that no force in creation can cause the electron of the hydrogen atom to describe a smaller orbit than the normal orbit of radius $0{\cdot}53 \times 10^{-8}$ cm. If we further suppose that this orbit is free to assume all orientations in space we at once understand why it is legitimate, for kinetic theory purposes, to treat the hydrogen atom as an infinitely hard sphere of radius $0{\cdot}53 \times 10^{-8}$ cm. The quantum-theory brings us back, in a sense, to the infinitely hard spherical atoms of Lucretius, and the radius of these spherical atoms can now be calculated with precision from the quantum theory; their infinite hardness is beautifully exemplified in the experiments of Franck and Hertz.

We thus see that the a and b of Van der Waals admit of exact interpretation in terms of the physical conceptions of to-day. His b arises from what we may call the quantum forces—the perfectly unyielding restraints which bind the electrons of an atom down to definite orbits—while his a arises from the ordinary electric field of force. It is the b of Van der Waals which saves us from immediate annihilation, through positive and negative charges rushing together to their mutual destruction, just as it is his a which saves us from rapid disintegration.

Prof. F. G. Donnan, F.R.S., in proposing a vote of thanks to the distinguished mathematical physicist to whose brilliant exposition they had listened, remarked upon the continuance in Holland of the investigations into the states of matter which had begun with Van der Waals' work; and this in turn had been largely a mathematical interpretation of the experiments of Thomas Andrews.

Dr. N. V. Sidgwick, F.R.S., seconded, alluding to the exceptional lucidity of the treatment which they had had the privilege of hearing.

SOCIETY OF PUBLIC ANALYSTS

Mr. P. A. Richards presided over the meeting held in the Rooms of the Chemical Society on November 7, when three papers were presented:—

(1) "The Gold-Beaters' Skin Test for Tannins," by Phyllis H. Price, B.Sc. In tanning the tannins are fixed by animal fibre. A reliable tannin test must therefore demonstrate this specific property, and such a test has been described (*Biochem. Jour.*, 1922, 16, 516), the method consisting in fixing the tannin on gold-beater's skin and subsequently staining the skin with ferric chloride. Non-tannins are not fixed on the gold-beater's skin, which consequently, is not stained. The author has further developed the test and finds that it is possible to detect 0·00005 g. of gallotannin in 1 c.c. of solution with the use of either ferrous sulphate, ferrous chloride or amyl nitrite fumes in place of ferric chloride. It was also noticed that on decolorisation with dilute hydrochloric acid skins previously treated with pyrogallol tannins are completely decolorised, whereas

those treated with catechol tannins have a reddish stain left on them. This is suggested as a test for phlobaphenes.

(2) "Determination of Nitrogen in Coal," by W. Donovan, M.Sc. The author confirms the work of Fieldner and Taylor, Terres, Fleischer and others, who observed that the Dumas process as described in the report of Research Committee of the Institute of Gas Engineers, and the Kjeldahl method, both gave results below truth, the former owing to incomplete combustion, the latter by loss of gaseous nitrogen, but points out that the Dumas process makes no provision for the complete removal of hydrocarbons. Concordant results are, however, obtained with the Dumas process (hydrocarbons having been completely removed) by the addition of a constant 0·2 per cent. to the Kjeldahl figure, using mercury as a catalyst.

(3) "The Estimation of Lead in Potable Waters and in Urine," by J. C. Thresh, M.D., D.Sc. In estimating traces of lead in coloured moorland waters the influence of the colour is not always removed by making the standards with the same water diluted with distilled water. The presence of even one part of copper in 100 millions reduces the depth of the tint given by lead, and iron in solution also interferes with the colorimetric estimation of lead, and accounts for most of the discrepancies obtained with moorland waters. It is essential that the standard should have the same acidity and contain the same acid as the water or urine under examination. A sensitive method of testing for lead in urine is described, and it is shown that three kinds of filter paper contained sufficient lead to cause urine which was free from lead to give a positive result in the test.

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held at the offices of the Association on November 8, Sir William Pearce, in the absence of the Chairman, occupying the Chair.

In response to a letter which had been addressed to all members of the Association, it was stated that only two firms had reported actual difficulties with Local Authorities in connexion with terms of contract. The matter is being followed up with the view to securing a form of contract between buyer and seller that will bind both parties.

A letter from the Federation of British Industries, asking for co-operation of the Association in making a survey as to the present position of "costing" throughout the industry. The Council agreed to assist, but the General Manager was authorised to point out to the Federation that whilst costing is a recognised works function throughout the Industry, there is no standardised system adopted except in the Acid Section.

The Council decided to press the Government for further reductions in taxation, and in doing so, to point out that there is still room for economy to be practised by the Government.

The General Manager reported a visit he had received from the Secretary to the Bribery and Secretary Commissions League, and the Council authorised the sending of a letter expressing their sympathy with the objects of the League.

A report was presented by the General Manager on the arrangements in connexion with the Chemical Section of the British Empire Exhibition, from which it is interesting to learn that the Palace of Industry was handed over by the builders to the Exhibition authorities on Monday last. It is also gratifying to learn that £2750 has already been promised, or subscribed, towards the costs of the Scientific Exhibit.

The question of competitive awards was considered by the Council on a proposal made by the Fine Chemical Section of the Association, but, without expressing any opinion, it was referred to the Committee of Exhibitors to deal with.

A report from the Transport Manager indicated that the Traders' Co-ordinating Committee have met the Railway Companies on the question of the retention of Exceptional Rates, and it is hoped that a means will be devised whereby the Traders will be saved the necessity of scheduling the Exceptional Rates they wish to keep after the "Appointed Day."

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

In addition to the addresses delivered at the third congress, notes of which were given in our last issue, it is of interest to record some of the papers read before the various sections as these are of more than usual interest.

The question of fuel alcohol occupied most of the attention of the Fuels Group, before which Messrs. C. W. Watson and Dr. W. R. Ormandy read a paper on "Bench Tests of Mixtures of Alcohol and Heavy Petroleums." The tests were so satisfactory that the fuel has been tried on a large scale for uses with motor buses. Experiments with a mixture of 100 parts of a certain petroleum and 10 parts of alcohol showed that the addition of alcohol to petroleum of medium quality improved the yield, diminished the explosion, and allowed a fatter spark to be used, the exhaust gases being free from disagreeable odours. Monsieur Pétrick described the use of "Dynalcol" consisting of 421·3 parts of alcohol (96°), and 571·70 of benzine, which has been used on a large scale for motor lorries. Various speakers treated the question of national fuel in France, methods being suggested to ensure regular and intensive production of the alcohol required.

In the Heavy Chemicals Group, Professor C. Matignon discussed the stock of combined nitrogen produced in France by organic, vegetable and animal life, and Monsieur G. Claude followed with a paper on the reduction in price of fertilisers. As it appeared that the hyper-pressure system in France would shortly yield an annual production of 300,000 tons of ammoniacal nitrogen, it was evident that nitrogen produced cheaply could not be combined with expensive sulphuric acid of no fertilising value. This sulphuric acid could be advantageously replaced by the chlorine wasted in large quantities by the Solvay soda process. On treating a solution of sodium chloride in ammonia with carbonic acid, the sodium is precipitated as a bicarbonate, the ammonia being transformed into ammonium chloride which can be separated. According to recent tests ammonium chloride, weight for weight of nitrogen, is equal in fertilising value to the sulphate and, moreover, is much less expensive. Sylvinite ($KCl+NaCl$) could be used as a cheap source of salt, for if the salt used in the Solvay process is replaced by sylvinite the sodium of the sylvinite will be precipitated as bicarbonate, whereas the potassium chloride would remain with the chloride of ammonia, thus giving a combined nitrogenous and potassic fertiliser. In this way ammonia and carbonate of soda would be produced by the help of chlorine and sodium respectively, that cost nothing. Monsieur Claude also pointed out that the only reason for transforming natural phosphates into superphosphates was to enable them to be introduced into the soil in an extremely fine state of division. If the phosphate could be reduced mechanically to this fine state of division, a similar result should be obtained and at the same time a costly operation avoided. This, he suggested, could be done by grading the ground phosphate by means of a current of air along a long tunnel, the larger particles being deposited almost immediately, the finer particles being carried farther away, and precipitated by the Cottrell process. A plant working on these lines is already producing 3 m.t. per day in Morocco, and cultural tests of the product carried out by Monsieur Claude appear to have given good results.

Monsieur Briaux discussed the comparative assimilability of tricalcium phosphate and phosphates of aluminium and iron, showing that aluminium phosphate was slightly better than tri-calcium phosphate for the production of dry matter, and considerably better as regards the fixation of phosphoric acid by the plant, whereas ferric phosphate was decidedly less assimilable than the other two phosphates. Further work by the same author indicated that advantage should be taken of the acidity of certain soils to render soluble a large part of the phosphoric acid in natural phosphates, thus postponing the necessity for liming and marling. Monsieur Graftin, President of the Belgium Chemical Society, showed that, in Belgium, phosphates from the Mons basin, after fusion with fluxes such as phonolite, alkali carbonates, siliceous slag, felspar, etc., yielded highly assimilable phosphates, the process marking new progress in the utilisation of mineral phosphates.

The utilisation of peat as a fertiliser was treated by Prof. C. H. Berthelot, who stated that a mixture of ground peat superphosphate and potash gave good results on medium soils. Peat could also be mixed with natural lime, dried blood, and leather wastes and other organic matters, the nitrogen of which is absorbed and fixed by the turf.

Monsieur Ginselm discussed the rational utilisation of organic wastes in agriculture, and Dr. J. G. Lipmann (U.S.A.) spoke on sulphur as a fertiliser with special reference to the production of potatoes and the treatment of potato scab, flowers of sulphur being mixed with ground mineral phosphates.

Monsieur Rabati suggested the use of sulphuric acid solutions containing 4 to 12 per cent. by volume of 65° Bé acid, at the rate of 1000 litres per hectare as a spray to destroy weeds in cereal crops.

Sir John Russell next discussed micro-organisms of the soil and Monsieur E. Kayser spoke on the nitrogen fixing power of the azoto bacter, pointing out the variability of this power and its causes.

Agricultural bacteriology was the subject of a paper by Monsieur G. Truffaut who discussed nitrogen fixation from the point of view of partial sterilisation of the soil.

The Société de Chimie Industrielle is to be heartily congratulated on its recent meeting, which has proved so suggestive and interesting.

ANNUAL REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY

Vol. VIII is now in preparation and will be issued early in 1924. The price of the book is 7s. 6d. to members of the Society, and 12s. 6d. to non-members. Vol. I is out of print, but copies of Vols. II, III, IV, V, VI, and VII may be obtained by members at 4s. 6d., 5s. 6d., 5s. 6d., 8s. 3d., 7s. 6d., and 7s. 6d., and by non-members at 7s. 6d., 10s. 6d., 12s. 6d., 15s., 12s. 6d. and 12s. 6d. respectively. If Vols. II, III, IV, V, VI, and VII are ordered at the same time as Vol. VIII, the set may be obtained by members for £2 2s. 6d., and by non-members for £3 15s. The appropriate remittance must accompany every order. The books are sent to purchasers post free.

CORRESPONDENCE

A QUESTION OF STYLE

Sir,—We note with surprise your shyness in using the Latin adjectives "optimum" and "maximum" to agree with English nouns. We thought that their long residence in the English language had so completely naturalised them that their association with words of Anglo-Saxon lineage would not offend even the most scrupulous, and surely no renitency ought to be expressed to the union of "optimum" and "conditions." We believe they are both of pure Latin parentage.

Personally, we feel queasy about using a noun as a verb, though we will admit that present day usage and convenience of expression have legitimised this conversion of "motor." This use, however, jars our delicately adjusted poise, as we are enlivening the hours of our daily "chemistrying" by a little "literaturing."—I am, Sir, etc., C. Burrows Morey

Buffalo, New York
October 26, 1923

[We have no objection to the use of "maximum" as a noun; "optimum conditions" seem to be merely the best conditions expressed by means of a singular adjective agreeing with a plural noun; the phrase is discordant to us and for that reason we dislike it, but we are perhaps unduly sensitive. We are also rendered uneasy by the too frequent use of a noun as a verb, and our minds do not function, or condition, or action, in that manner without some sense of impropriety.—Editor.]

THE CHEMIST AND BUSINESS TRAINING

Sir,—A playful interpretation of a paragraph in my letter of October 17 is displayed in the somewhat grotesque criticism levelled at an expression which, in fact, was taken verbatim from your Editorial of October 12. It will be obvious to your readers, however, that our discussion really concerned young men in their "twenties" who had spent a reasonable time in laboratory and lecture-room in training for the profession of chemistry. Calculations on the prospects of "the man of thirty-eight" therefore do not apply.

May I be permitted to draw attention to the excellent article in a recent *Journal*, by Mr. J. H. West, A.M.Inst.C.E., on "The Chemist and Industry"? The cases quoted therein afford striking examples of what might be avoided if the problem of business training for chemists were seriously tackled and solved. Mr. West shows clearly that the capacity to "think industrially" is a desideratum the importance of which is not yet fully recognised either by raw University graduates or by manufacturers as a body. No one will deny that business instinct is a gift which is not possessed by every man, but at the same time I would suggest that much talent of this kind is doomed "to blush unseen" for want of the proper opportunity.

Without attempting to dogmatise in any way, we may still assert that there are many phases of industry, as yet untried, in which the young trained chemist might combine his scientific knowledge with a certain amount of common-sense applied to the control side of operations. Promise of special acumen in the desired direction should lead to increased responsibility and admission to the "inner councils" of which Mr. West speaks; the right man would justify his appointment in the long run.

It is not too much to hope that, in the near future, opportunities will be created in our industrial concerns whereby ability to "think industrially" will be recognised and fostered, with eventual benefit to employer and employee.—I am, Sir, etc., William Doran

Department of Organic Chemistry,
Liverpool University

BRITISH DYESTUFFS INDUSTRY

Sir,—The comment of the Clayton Aniline Company on my letter of the 21st ulto., would lead your readers to believe that I had given the price of 12s. 3d. for Direct Sky Blue FF, as the then current market quotation. My letter was a comment on Professor Morgan's article in which, in the course of developing an argument on what he considers to be unfair competition to which British dyestuff makers are subjected, he stated that the B.D.C. produced Sky Blue FF at 12s. 3d. per pound and for large quantities they were prepared to take the exceptionally low price of 4s. 3d.

My comment pointed out that the price of 12s. 3d. was twelve times pre-war price of Sky Blue FF, following on with this sentence:—

> "If prices on this basis are essential to maintain the Industry as a national necessity, the Colour Users' argument is, that the whole burden should not be borne by him."

It is only fair to point out that the corresponding product of Sky Blue FF, as marketed by the Clayton Aniline Company, is weaker than Chlorazol Sky Blue FF, and therefore its price must necessarily be a lower one.—I am, Sir, etc.,

C. M. Whittaker

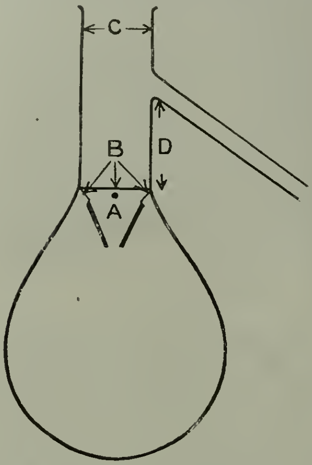
Cheadle Hulme, Cheshire
November 7, 1923

A MODIFIED CLASSEN FLASK

Sir,—I append sketch and particulars of a modified Classen flask which I have devised, and used with success, in the hope that it will be of interest to some of your readers.

Several distillations under reduced pressure (as low as $p=10$ mm.) were carried out, the distillate being very clear and pure.

For a 250 c.c. flask the following dimensions held: $C=2{\cdot}5$ cm. in diameter, $D=7$ cm. *B* are four small holes, about $\frac{1}{16}$ in. diameter, as near to the point of fusion of the cone and to the flask proper as is possible. *A*, the cone, has an orifice 0·7 to 0·8 cm. in. diameter. The bulb of the flask should be pear-shaped. The side-neck resembles that on an ordinary distilling flask.



The flask is used in conjunction with a capillary tube, which passes through the same stopper as the thermometer.

The chief drawback to this design is the trouble which would be experienced in extracting the pieces of capillary tube from the flask, should the capillary break, but a "thick-walled" capillary would minimise such a risk.—I am, Sir, etc., G. A. Collinson

The University, Leeds
Nov. 7, 1923

LEGISLATION AND THE CHEMICAL INDUSTRY

Sir,—It appears probable that legislation will shortly be proposed, having for its object the protection of British industries, and it is seasonable to inquire whether the chemical industry is now in a position to make its influence felt in the principles as well as the wording of any new statutes Parliament may pass.

The Safeguarding of Industries Act produced a crop of correspondence in your columns ranging from the pontifical to the merely querulous. Sir William Jackson Pope flogged a dead horse with amazing skill, and we still miss the weekly photographs of him visualising with papal infallibility the orgies of misrepresentation before the Board of Trade referee. Some sections of the society also held most useful debates on the meaning of the vague chemical terms vaguely punctuated which were allowed to pass into the schedules to the Act. It is safe to say that had these debates been held before the Act was passed instead of after, the Act might have been substantially improved and some injustices mitigated.

I write to suggest that the industry should keep a watchful eye on the legislature next Session. Perhaps this could best be done if each section were to appoint a small Parliamentary Committee who would study the list of Parliamentary and Stationery Office publications, published monthly by H.M. Stationery Office at a nominal cost, and also, if funds permit, the Parliamentary Debates in the House of Commons, which cost £2 10s. per Session, delivery extra. If such a committee were to bring to the immediate notice of the section any projected legislation which touched the interests of the members there would be a chance for chemists to debate at their meetings or discuss in these columns what the effect of the proposals would be and to put their views before their Members of Parliament.—I am, Sir, &c., Foster Sproxton

Manningtree,
November 2, 1923

A CORRECTION

Sir,—May I ask you to correct the statement in your report of the recent Congress of the French Society of Chemical Industry, that I was present as a representative of the Chemical Society. That august democratic body cast me out early this year, after fifty years' continuous wear, as useless. I received no mandate and went to Paris to represent myself alone, and, if possible, the courtesy of a past generation—as an act of politeness and policy, in response to the direct invitation of the French society, of which I am privileged to be an honorary member—a privilege I value the more as I am not even an ordinary member of our home society. Throughout my professional career as a technical chemist, this select body has always treated me as a pariah, in fact. In France I am not yet ruled out.

Henry E. Armstrong

PERSONALIA

The Nobel Prize for Chemistry for 1923 has been awarded to Prof. Fritz Pregl, of Graz, Austria. Amongst Prof. Pregl's chief work mention may be made of the isolation of acids in bile, of cleavage products of the egg case of the dogfish, and of the acids of egg albumin, the acetylation of soluble starch, and apparatus for drying under reduced pressure at high temperatures and for extracting aqueous liquids by chloroform. Prof. Pregl is also an exponent of micro-chemistry, a subject on which he has recently published a treatise.

The Nobel Prize for Physics has been awarded to Dr. Millikan, of Pasadena, California.

The following have been elected corporate members of the Institute of Physics: *Fellows*: G. R. Bolsover, J. A. Jones, C. H. Lander, T. Takamine, A. Warren. *Associates*: K. R. Brain, A. L. Gregson, J. S. Grew, J. A. Hughes, E. O. Hercus, T. J. Lonsdale, R. D. Thompson, J. F. Wood.

Mr. M. Dixon (Emmanuel) has been appointed Senior Demonstrator in Biochemistry in the University of Cambridge for five years.

R. Fisher, formerly of the Chemistry Department of the University of Illinois, V. F. Parry, late of the U.S. Bureau of Mines, and W. B. Plummer, formerly research chemist for the Grasselli Chemical Co., have been appointed research chemists in the laboratories of the Combustion Utilities Corporation, New York.

Mr. P. A. Ellis Richards, President of the Society of Public Analysts, has been appointed to the seat on the Departmental Committee on Preservatives and Colouring Matters in Food left vacant by the resignation of Mr. O. Hehner.

Dr. A. Balfour, C.M.G., M.D., B.Sc., director of the Wellcome Bureau of Scientific Research in London, has accepted the directorship of the Rockefeller School of Hygiene, London.

* * *

With regret we record the death of Lt.-Col. A. C. Bishop, chairman of Kemball, Bishop and Co., Ltd., manufacturers of cream of tartar and of tartaric and citric acids.

The death of Dr. Carl Harries, at the early age of 57, marks the loss of one of the pioneer workers in the field of rubber chemistry. Led from early work on the constitution and analysis of rubber to consider the possibilities of synthesising it, Harries discovered that isoprene could be made to polymerise by heating it in the presence of acetic acid for a lengthy period, a caoutchouc-like product being obtained. A further development of the process consisted in replacing the acetic acid by metallic sodium, a method which, however, was anticipated by Dr. Matthews. Perhaps the most important contribution to science due to Harries was his exhaustive work on the formation and properties of the ozonides, a term introduced by Schönbein to designate certain protoxides that give off ozone when decomposed, but now applied to compounds containing the radicle O_3. The formation of ozonides serves to determine the presence and, frequently, the position of a double bond in organic compounds, *e.g.*, as in oleic acid. Born in 1866, Harries was educated at Jena, Munich and Berlin, and became successively assistant to Hofmann and Emil Fisher. From 1904 to 1916 he held the professorship of chemistry in the University of Kiel and for a long time was scientific adviser to the firm of Siemens.

OBITUARY

Dr. J. E. STEAD, F.R.S.

Metallurgical science has suffered a severe loss in the death of Dr. J. E. Stead at the age of seventy-two. For more than fifty years he had been directly engaged in metallurgical work, and during that time he had been associated with some of the most important developments in the metal industries. Trained as an analytical chemist, he had held posts in both copper and iron works before becoming in 1876 a partner with the late Mr. John Pattinson, whose pupil he had been. He gained a great reputation as an analytical authority, and in the course of his consulting practice he came into contact with a great variety of industrial processes, on which his opinion was sought. He was closely connected with the early stages of the basic Bessemer process, and it was he who specially directed attention to the necessity of the after-blow for the removal of phosphorus. The relations between phosphorus and iron were a favourite subject, to which he returned on several occasions, his work being the foundation of our present-day knowledge.

The attention of Dr. Stead was directed to microscopical metallography at the International Engineering Congress held at Chicago in 1893, and from that time onwards he was one of the most active workers in that field. He developed new experimental methods, and made most skilful use of the method of heat-tinting first employed by Martens. A little book on metallography, based on two papers by Osmond, long served as a text-book. Dr. Stead's skill in the preparation and etching of specimens was great, and he had the faculty of recognising and explaining interesting structures in alloys of the most varied kind. In other fields of experimental investigation he frequently obtained important results from small crucible meltings, and he thus contributed largely to our knowledge of slag reactions.

Kind and warm-hearted to an exceptional degree, the personal character of Dr. Stead endeared him to all who knew him. His vast stores of metallurgical knowledge were at the service of all, and a letter from a young metallographer, propounding some difficulty, would promptly bring a long reply, often accompanied by specimens or photo-micrographs. He was an unfailing source of help, to experts and students alike, in scientific perplexities. His intervention in discussions before technical societies was always welcome, and he preserved his genial good humour in controversies, often acting as peacemaker between rival schools. He received several honorary degrees, and was elected a Fellow of the Royal Society in 1903. In 1920 he was chosen as President of the Iron and Steel Institute, and fulfilled the duties admirably for a time, but his health was already failing, and on some occasions he had to delegate his functions to others. He will be greatly missed, but he has left a permanent mark on metallurgical science, and personally influenced two generations of metallurgists. C. H. Desch

NEWS AND NOTES

UNITED STATES

The American Chemical Prize

It is announced (*Ind. and Engineering Chemistry*) that a gift for the promotion of chemistry in America has been received by the American Chemical Society, in the form of an annual prize of $25,000 founded by the Allied Chemical and Dye Corporation. This prize will be awarded annually to that chemist (man or woman, a citizen or resident of the United States of America at the time), who, in a certain year, or through a period of years, has made a contribution of high merit or in some marked way has promoted the betterment of society through the science of chemistry. The award will be made at a meeting of the American Chemical Society, when the recipient will be expected to receive the prize in person, and will be invited to deliver an address before the Society. The name of the prize will be "The American Chemical Prize" (founded by the Allied Chemical and Dye Corporation).

Coke and By-Products in 1921

The coke industry was severely depressed in 1921. The output of by-product coke was only 25,287,622 tons (31,000,000 t. in 1920), and that of beehive coke was less than in any year since 1885, the output being 5,538,042 t. (20,500,000 t. in 1920). The depression in the beehive-coke industry represents one of the most remarkable slumps in the history of any industry, the most slack period being in July, when only 7000 t. of coke were produced daily, being only 7 per cent. of the average daily rate of production during the years 1915-1918. But the outlook improved by December, when the average daily rate of production was 19,000 t. The average price per ton for both beehive and by-product coke was about $3 less than in 1920, which was a year of abnormally great activity. By-products sold in 1921 produced only $60,000,000 gross (about $94,000,000 in 1920), and included 310,188,713 m. cb. ft. of gas, 253,051,649 galls. of tar, 657,001,003 lb. of ammonium sulphate or its equivalent, and 76,917,269 galls. of light oil. At the end of 1921 there were 11,141 by-product coke ovens in existence and 85 under construction, but the number of beehive ovens remaining at the end of the year was the smallest since 1901, many having been abandoned during the year. The total export of coke in 1921 was 306,755 t., valued at £2,760,939 (919,802 t. valued at £9,993,665 in 1920), and imports amounted to 30,990 t. at £336,394 (41,143 at £403,175 in 1920).

Building Materials in 1921

The following are the figures of the outputs of various building materials in the United States in 1921 :—Cement, 96,046,549 barrels (valued at $181,675,440); clay, 1,716,746 short tons ($6,025,300); gypsum, 3,050,984 t. ($23,700,290); lime, 2,532,153 t. ($24,895,370); silica, 184,613 t. ($1,783,036); stone, 63,538,740 t. (valued at $106,962,266). All show a decrease in comparison with the output of the previous year.

Cement.—Both the total output and the total shipments of Portland cement in the United States in 1921 decreased by 1 per cent., and the gross value of the shipments decreased by 7 per cent. The average selling price at mills decreased 13 cents a barrel, or about 6 per cent. The stock reported on hand at the close of 1921 amounted to 12,187,364 barrels. Domestic consumption was estimated at 94,448,455 barrels, and the average factory price per barrel in bulk of Portland cement in 1921 was $1·89. The number of plants manufacturing cement was 115 compared with 117 in 1920, and the total number of rotary kilns reported in plants that operated in 1921 was 740, as against 753 in 1920.

Clay.—The general depression in business had a marked effect on the clay-mining industry in 1921, the output decreasing 45 per cent. and the value 48 per cent., as compared with 1920. Fire clay, which showed the largest output in both quantity and value, decreased 49 per cent. in quantity and 52 per cent. in value as compared with 1920.

Gypsum.—The quantity of gypsum produced in the United States in 1921 exceeded 3,000,000 tons, but was 2 per cent. less than in 1920. The amount of gypsum sold crude to Portland cement factories decreased from 541,901 t. in 1920 to 526,042 t. in 1921. Keenes cement decreased 12 per cent. in quantity and 6 per cent. in value; the average price per ton rising from $14·90 to $16·11. Wall board decreased 52 per cent. in quantity and 24 per cent. in value from 1920, the average price per ton rising from $26·28 to $41·75; blocks and tile decreased 44 per cent. in quantity and 29 per cent. in value from 1920, and the average price increased from $13·12 to $16·65.

Lime.—Total sales of lime in 1921 decreased owing to trade depression, to less than those of any other year since 1904, the output falling in 34 out of the 42 producing States and Territories. The cost of production was generally reported to have been less than in 1920. High freight rates were, perhaps, the greatest obstacle and it was suggested that new plants should be built to supply local trade.

Silica.—The sales of quartz from pegmatite dikes, veins and quartzite in 1921 fell by 83 per cent. in quantity in comparison with 1920. Prices of crude and ground quartz in 1921 averaged $4·63, and $16·89, respectively.

Stone.—The quantity of stone sold in the United States in 1921 was the smallest in six years, showing a decrease of 19 per cent. in quantity and of 20 per cent. in value. The decrease in output was largely due to the depression in the metal industries. Granite produced in 1921 amounted to 4,752,180 t. ($20,592,217); basalt and related rocks (trap rock), 8,524,480 t. ($11,450,899); marble, 315,400 t. ($8,580,416); serpentine, $290,968; limestone, 75,171,000 t.; sandstone, 2,640,460 t. ($6,425,339); bluestone, 53,510 t. ($659,796); miscellaneous stone, 1,685,220 t. ($2,163,801); and crushed stone 43,202,840 t. ($51,717,478).

GENERAL

World Prices of Coal and Iron, 1923

The following statistics compare the prices of coal, coke and iron in the chief consuming countries in June, July and August, 1923, with those ruling in 1913-14. To enable comparison the prices in the various currencies are converted into paper and gold marks.

New Laboratory at the Birmingham Technical School

On October 31 Sir Robert Hadfield formally opened the new laboratory and lecture room in the chemistry department of the Birmingham Technical School.

The need for extension of the chemical department, of which Dr. J. Newton Friend is the head, has long been realised, and even now, though fairly well provided for, more space is required. The recognition of the usefulness of the work of the chemical department is shown in the fact that a number of industrial firms of Birmingham and the district have made contributions towards equipping two rooms, formerly used as store rooms. One is principally equipped for research on corrosion, and the other is a lecture room with a library and museum. In addition, the pharmaceutical laboratory has been completely refitted. The funds have come in donations ranging from a few pounds to a generous contribution of £150 in three yearly instalments of £50 each year by Messrs. Phillip Harris and

	Germany	England	France	Belgium	United States
Actual Prices					
	Mk. per metric ton	per long ton	per m. t. Fr.	per m. t. Fr.	per short ton $
Pit coal :—					
1913/14	12,00	10/11	20,50	—	1,18
1923, June	320,893	22/6 1/2	82	105	1,64
July	1,126,742	22/–	82	110	1,68
End August	70,707,000	19/–	82	112,50	1,63
Prices in 1000 paper marks per metric ton					
1913/14	12,00	10,97	16,61	—	6,46
1923, June	320,9	660,9	667,6	622,0	199,1
July	1,126,7	1,750,7	1,703,6	1,898,2	614,9
End August	70,707,0	34,681,1	38,113,6	43,020,0	14,668,0
Prices in gold marks per metric ton					
1923, June	12,25	21,42	21,71	23,81	7,60
July	13,38	20,83	20,29	22,60	7,31
End August	36,38	17,85	19,49	22,01	7,66
Actual Prices					
	Mk. per metric ton	per long ton	per m. t. Fr.	per m. t. Fr.	per short ton $
Metallurgical coke :—					
1913/14	18,50	—	—	—	2,44
1923, June	470,693	37/6	216	190	4,93
July	1,647,213	35/–	212	190	4,78
End August	103,284,000	32/6	212	190	4,88
Prices in 1000 paper marks per metric ton					
1913/14	18,50	—	—	—	11,30
1923. June	470,6	936,5	1,488,2	1,126,7	697,3
July	1,647,2	2,785,0	4,404,4	3, 278,7	1,862,6
End August	103,284,0	69,322,9	98,637,6	72,656,0	43,900,8
Prices in gold marks per metric ton.					
1923, June	17,96	35,74	56,91	43,09	22,81
July	19,57	33,14	62,46	38,98	22,13
End August	63,14	30,63	60,40	37,21	22,60
Actual Prices					
	per metric ton	long ton	per m. t. Fr.	per m. t. Fr.	per short ton $
Pig iron :—					
1914. July	69.50	61/3	82	65,50	14,76
1923, June	2,634,700	116/8 2/5	401	452	31,16
July	8,924,806	107/3	383	460	28,04
End August	227,998,398	100/–	415	465	25,76
Prices in 1000 paper marks per metric ton					
1914, July	69,50	61,44	66,42	53,06	60,94
1923, June	2,634,7	2,914,2	2,775,6	2,680,3	3,372,6
July	8,924,8	8,534,0	8,060,9	7,937,8	9,760,6
End August	227,998,4	182,532,0	192,892,0	177,816,0	210,201,6
Prices in gold marks per metric ton					
1923, June	100,55	111,26	106,13	102,56	128,77
July	106,01	101,56	96,05	94,42	116,88
End August	117,30	93,95	98,66	91,06	106,47

On August 31, 1923, the pound sterling was worth 35 million paper marks.

Co. Another important donation of £142 16s. was given by the Midland Varnish, Paint and Colour Manufacturers' Association. Other donations included £50 from Messrs. Dunlop, £50 from Messrs. Mitchell and Butler, and £25 from Messrs. Chance and Hunt. The total of these contributions exceeds £425. The chemical department has received additional help in the form of research prizes offered by Sir R. Hadfield, F.R.S., the Dunlop Rubber Co., the Mond Nickel Co., and the Pharmaceutical Associations of Birmingham and Staffordshire. The school also benefits by two grants made personally to the head of the department, Dr. Friend, who receives a grant of £150 from the Royal Society and one of £100 from the Carnegie Research Fund for work on corrosion. These grants take the form of a micrographic apparatus loaned or given to Dr. Friend, and housed in a special dark room

Gypsum, 1913-1919

The Imperial Mineral Resources Bureau has now published the section of "The Mineral Industry of the British Empire and Foreign Countries" devoted to gypsum (pp. iv+31, price 9d.), and giving a digest of relevant statistical and technical information relating to the war period. Below are given the figures showing the world's production of gypsum in 1913 and 1921 in long tons:—

	1913	1921
United Kingdom ..	285,338 ..	264,840
Union of South Africa	108 ..	(a)
Canada	611,362 ..	387,987
Cyprus	3,714 ..	8,881
India	24,961 ..	33,801
Australia	8,826 ..	45,822
France	2,000,000 (c) ..	(e)
Germany (Bavaria) ..	50,000 (c) ..	(e)
Greece	2,194 ..	1,243
Italy	(e) ..	448,071
Spain	6,938 ..	4,601
United States ..	2,320,989 ..	2,724,093
Argentina	171 ..	(e)
Chile	6,000 ..	11,616
China	4,970 ..	6,059
New Caledonia ..	— ..	(e)

(a) Value only stated; (c) Estimated; (e) Information not available.

Manganese deposit in Java

Indications of manganese ore have been discovered in the Residency, Djokjakarta (Java) over an area of nearly two miles. It is undoubtedly a sedimentary deposit, and the layer has an average thickness of from 3-4½ ft., increasing in places to 5½ ft. In the lower bed of the seam pyrolusite has been found which contains 50 per cent. of manganese, but the upper bed is not so pure. By calcining, an export product can be made with 63 per cent. of manganese. Manganese ores also occur in the lake districts of Celebes. These are highly ferruginous, and on analysis show 19·3 per cent. loss by burning, 3·46 per cent. SiO_2, 47·60 per cent. Fe_2O_3, 24·09 per cent. Mn_3O_4, 1·18 per cent. NiO, and 0·46 per cent. Cr_2O_3.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Nov. 8*)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Hardware	412/7/1/1/173*
British India	Copper wire woven sheets, steel (tender)	**
Canada ..	Paper	12236/E.D./M.C./2
China ..	Dental, photographic and rubber goods, perfumery	521
Far East ..	Paint, varnish, soap ..	522
Finland ..	Tinned steel wire (tender)	8276/F.R./E.C.
France ..	Petroleum products, rubber chemicals ..	510
Greece ..	Tar	11729/F.E./M.C./2
Netherlands	Tinplate	511
New Zealand	Steel pipes (tender) ..	12474/E.D./E.C./2
Portugal ..	Lubricating oil ..	516
Siam ..	Brass wire gauze, paint, varnish, paper, soap (tender) ..	11568/F.E./G.P.
South Africa	Glassware	505
,, ,,	Cast Iron (tender) ..	11162 and 12491/E.D./E.C.
Spain ..	Leather	518
United States	Iron, brass, copper and pewter goods ..	20878/F.W./M.C./2

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* The Official Secretary, Commercial Bureau, Australia House, Strand, London, W.C. 2.

** The Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E. 1.

TARIFF CUSTOMS EXCISE

Australia.—A dumping duty has been applied to caustic soda.

Bulgaria.—Increased import duties are applied to articles of wax, ceresine, paraffin, stearine or soap; perfumery, skins, silk, brass, bronze, nickel, and aluminium.

Germany.—The internal tax has been increased on sugar.

Guatemala.—Modifications have been made in the duties on silk, rubber goods, celluloid, soap, perfumery.

Poland.—The duties on acetic acid, sugar, oil, asphalt and tar have been increased.

Portugal.—Export surtaxes are now levied on fertilisers, oils, hides, and resin.

REVIEWS

ALCOHOLIC FERMENTATION. *By* PROF. A. HARDEN, Ph.D., D.Sc., F.R.S. *Third edition. Pp.* 194. *London: Longmans, Green and Co.*, 1923. *Price 6s. 6d.*

This is one of the well-known series of monographs on biochemistry and the fact that it is the third edition is sufficient evidence of its appreciation. The rapid progress of the subject has necessitated the extension of the work by 38 pages. Soon after the discovery of zymase by E. Buchner in 1897, investigations were commenced at the Lister Institute on a-cellular fermentation, but it was not until six years later that Prof. Harden took up the subject on which he has extended our knowledge so considerably that he has become the leading authority in this country.

As might be expected the monograph deals principally with the chemical side of the subject, that is to say with a-cellular fermentation, but in the historical summary forming the introduction the evolution of our knowledge of fermentation is lucidly described from the days of Stahl, Lavoisier, Liebig, Pasteur, Buchner, etc., to the present day. "The subject still remains," says the author, "one of the most interesting in the whole field of biological chemistry."

Availing himself of the fact that the literature of alcoholic fermentation is less extensive than that of some other branches of biochemistry, Prof. Harden has produced a work which really constitutes a treatise on the subject as well as a complete bibliography. The text is divided into ten chapters and the various views on the chemistry of fermentation are clearly and impartially described. The monograph is remarkably free from typographical errors, the only slip noticed being on page 101, where it is stated that "methylene blue is added with the object of deviating the hydrogen supposed normally to be used in reducing the *alcohol* to *aldehyde*."

Prof. Harden may be congratulated in having brought up to date a monograph on one of the most important and suggestive branches of biochemistry. ARTHUR R. LING

JOURNAL OF SCIENTIFIC INSTRUMENTS. *Produced by the Institute of Physics with the Co-operation of the National Physical Laboratory. Vol. I, No.* 1, *October*, 1923. *Pp.* 32. *London: The Institute of Physics,* 10, *Essex Street, Strand, W.C. Price* 2*s.* 6*d.*

In the first number of the Journal of Scientific Instruments a standard is set which augurs well for the future of this new publication. The following list of contents will serve to indicate its scope:—(1) The Measurement of True Height by Aneroid, by L. N. G. Filon, M.A., D.Sc., F.R.S.; (2) Two New Methods of Measuring the Internal Diameters of Transparent Tubes, by J. S. Anderson, M.A., D.Sc., Ph.D., and Guy Barr, B.A., D.Sc.; (3) On an Improved Temperature Control for the Pulfrich Refractometer, by Prof. T. M. Lowry, D.Sc., F.R.S., and R. G. Parker, B.Sc.; (4) A New Relay and its Application to Sustaining Pendulum Vibrations, by H. A. Thomas, M.Sc.; (5) A General-Purpose Recording Drum, by Prof. C. V. Boys, F.R.S.; (6) The Chain Balance, by Prof. Sir Flinders Petrie, D.C.L., LL.D., F.R.S.; (7) A New Recording Kata-Thermometer, by E. H. J. Schuster, D.Sc.; (8) Miscellanea; (9) Reviews.

There must be but few scientific workers who can escape the necessity of employing physical methods at some phase of their investigations, and to them the new journal will prove invaluable. Well printed on good paper, the journal appeals to both eye and mind, and one cannot but offer it a hearty welcome and prophesy its success.

HANDBUCH DER LACK- UND FIRNISINDUSTRIE. *By* DR. F. SEELIGMANN *and* EMIL ZIEKE. *With the collaboration of* W. SCHLICK *und* DR. F. ZIMMER. *Third edition. Pp.* 827. *Edited by* E. ZIEKE *und* DR. HANS WOLFF. *Berlin*, 1923.

The second edition of the "Handbuch der Lack- und Firnisindustrie" appeared in 1914, and was at the time the best book on the subject in any language. It was a mine of information and rich in references to the world's literature of the varnish industry. The editors of the new edition have been unable to obtain the co-operation of Dr. Seeligmann, who is resident in America. The book has been reduced from 1074 to 827 pages by re-arrangement of the material and deletion of much out-of-date information. The editors are to be congratulated on having produced a valuable treatise on the subject, but the new material is too limited, and it is evident that a comprehensive treatment of the subject in one volume is impossible. Division into several small monographs by different authors would give to readers the detailed information required, unless copious references were inserted in the one volume. The new edition lacks the broad and well-informed character of the earlier editions. There is no review of literature, and the recent work quoted is almost entirely from German sources. In view of the researches in other countries, especially in America, the result tends to show that German progress since 1914 has been slow, which detracts largely from the value of the book. Very many instances could be given and a few may be quoted:—

The account of recent work on abietic acid, Japan lacquer, fish and "stand" oils, and the viscosities of oils and varnishes is too short, and recent statistics on raw materials are not given. The section on insulating varnishes is a reprint of the account given in the second edition. The lack of adequate reference to recent investigations in other countries is difficult to understand, since one of the editors is a recognised authority on paint and varnish problems. A most interesting chapter on the defects of varnishes has been deleted in the new edition, which is much to be regretted. In spite of these criticisms there are chapters of great value. The treatment of China wood oil is full and fairly up-to-date. A useful summary of the properties of rosin esters, driers and enamels is given, and the old classification of varnishes has been properly modified. An excellent chapter on German methods of varnish analysis is communicated by Dr. Wolff, full of information, but suffering from the general defect of the whole work. The old formulæ and recipes are retained and no new ones inserted, but rather general principles, which will disappoint works-manager readers. In the chapter on the manufacture of varnishes many new figures of plant appear, which are not really up-to-date. The old foreign friends of Seeligmann and Zieke's *Handbuch* will be disappointed and will feel that an excellent opportunity has been lost of enhancing the reputation of the former editions.

RHUS DERMATITIS FROM RHUS TOXICODENDRON, RADICANS AND DIVERSILOBA (POISON IVY): ITS PATHOLOGY AND CHEMOTHERAPY. *By* JAMES B. MCNAIR. *Pp. xi*+298. *Chicago*: *The University of Chicago Press*, 1923. *Price* $4.00.

The genus *Rhus* furnishes a considerable number of useful products, including the tanning materials sumach and Chinese galls, the yellow dyestuff "young fustic" and the natural varnish, which forms the raw material of the lacquer-ware industry of China and Japan. The three species of *Rhus* with which Mr. McNair deals are, however, most undesirable members of the flora of North America since they secrete an intensely irritant substance, which produces dermatitis in those who come into contact with the plants. Mr. McNair has been at work on these noxious species since 1917, and this book consists largely of papers contributed by him to botanical, chemical and medical journals in the United States. It gives a very complete account of the whole subject from the botany of the three plants to the character of the dermatitis produced by their secretions. Some suggestions for remedial treatment are made in a chapter rather grandiloquently entitled "A Contribution to the Chemotherapy of Rhus Dermatitis and Tentative Method for Treatment."

Chapter X deals with the Chemistry of the Poisonous Principle about which next to nothing is known, though it has been given several names of which the author contributes "lobinol." He appears to have disposed of several unwarranted speculations about its nature which is all to the good. The method he used for the preparation of "lobinol" is hardly likely to have yielded a pure product, and in view of the interest which the frequent cases of *Rhus* poisoning evokes in the United States, it is to be hoped that, as the author himself suggests, someone will continue this work and isolate and determine the nature of the toxic substance.

It is curious that irritant substances of this kind have not attracted more attention from chemists. Some progress has been made in determining the components of Japanese lacquer, which also contains a toxic substance probably similar in nature to that of the poison ivy, and the dermatitis caused by East Indian satinwood has been shown to be due to an alkaloid, chloroxylonine, but the irritant constituents known to occur in other timbers of industrial importance such as West Indian satinwood, and certain of the boxwoods have not yet been characterised, though they give rise to cases of dermatitis in workmen from time to time. Mr. McNair's book should serve to direct attention to this field of work.

T. A. HENRY

PRINCIPLES OF CHEMICAL ENGINEERING. *By* W. H. WALKER, W. K. LEWIS and W. H. MCADAMS. *First edition. Pp. ix*+637. *London : McGraw-Hill Publishing Co., Ltd*, 1923. *Price* 25*s*.

The authors claim that this book is the "outgrowth of extensive engineering practice" in which they have profited by many ideas offered in the way of suggestions, criticisms or advice. The greater part of the text is said to have been in use for some time as students' notes at the Massachusetts Institute of Technology, where the authors are professors of chemical engineering.

It would appear that the United States are far ahead of this country in the study of chemical engineering. The book under review is in itself evidence of this fact.

The subject matter is treated in a thoroughly scientific manner, which will no doubt prove very pleasing to the student of physical chemistry or to the chemist possessed of a mathematical bent. The practical man or works manager, on the other hand, will probably not be so well satisfied because of the lack of description of works processes and the paucity of useful information regarding methods of working. In other words, the writers confine themselves strictly to their title—principles of chemical engineering, and in this way keep the size of the treatise within reasonable limits for a single volume. This kind of book has been very much wanted of recent years and will repay close study, close study being necessary fully to understand the text, which is by no means diffuse.

The book may be divided roughly into five parts :—

1. The principles of industrial stoichiometry are reviewed. The pound mol. is strongly recommended as a basis of calculation; this and the pound atom are used throughout the text. A number of pages are devoted to the working out of typical examples of problems occurring in chemical works' practice. These problems have to do chiefly with the measurement of gases. One is inclined to think that too much space is taken up with these calculations, which to a well-trained chemist seem rather elementary. More space, on the other hand, might have been given to a study of the principles of practical measurement and testing.

2. The phenomena accompanying the flow of fluids and the flow of heat are treated in an able way mathematically. The problems that are here stated and solved ought to prove of great service to the student of this rather perplexing branch of the subject.

3. Fuels and combustion are discussed very lucidly and effectively, if rather briefly, in Chapter VI. The following chapter is devoted to furnaces and kilns, Chapter VIII to gas producers. The Morgan and the Chapman gas producers are the only ones illustrated.

4. The principles of crushing and grinding, and mechanical methods of separating materials are dealt with in a well thought out, systematic and scientific way, the treatment of the subject being mathematical wherever advantageous. The important subject of filtration is briefly but clearly expounded in Chapter XI. A longer reference to the Cottrell method of electrostatic precipitation (only a dozen lines are given) would have been welcome. Centrifuges, too, are left almost entirely in the cold.

5. Processes relating to vaporisation are discussed at considerable length and are usefully treated from the standpoint of vapour-pressure equilibria. Evaporation, humidifying, dehumidifying, condensing, drying and, finally, distillation come under this heading. These subjects occupy 235 pages of the text.

As one might expect, the examples of plant chosen for illustration are nearly all American. But, none the less, chemical engineers in this country will be amply repaid by a careful perusal of the treatise.

The whole style of the book (binding, paper, printing and illustrations) is excellent.

W. B. Davidson

LEGAL INTELLIGENCE

Contracts for the Supply of Soda Ash
Scrimaglio v. Thornett and Fehr

On October 24, Mr. Justice Greer heard the action of Signor Scrimaglio, of Genoa, against Messrs. Thornett and Fehr, London, in respect of contracts for tallow and soda ash.

The defence admitted the plaintiff's claim for £392, an over-payment in respect of certain packages of vegetable tallow, subject to a counterclaim which arose out of two contracts by which the plaintiff agreed to purchase from defendants 200 tons of soda ash. For the defence it was alleged that the plaintiff had committed a breach by refusing to take up the shipping documents tendered. In accordance with the contract the plaintiff's liability in respect of his repudiation of the contract was referred to arbitration. The defendant company appointed Mr. C. Mangold as arbitrator, and as no arbitrator had been appointed by the plaintiff, Mr. Mangold held the arbitration and awarded the defendants £4800 damages, which the defendant company now claimed. For the plaintiff liability for alleged repudiation of the contracts was denied, and it was claimed that the only arbitration contemplated was arbitration in London in the usual way and under the Arbitration Act, *i.e.*, arbitration by a single arbitrator appointed by the Court. The plaintiff did not concur in the appointment of Mr. Mangold, and said that arbitration in the usual way in London meant arbitration according to the rules of the British Chemical Trade Association, which meant that the arbitrator was appointed by the Association, which was not the case. For the defence it was claimed that the habitual method of arbitration in the chemical trade was by two arbitrators and an umpire.

Mr. E. Fehr gave evidence that the rules of the British Chemical Trade Association did not apply to this contract, and Mr. Pitman contended that arbitration in the usual way meant according to the ordinary law of the land unless there was any stipulation to the contrary. Mr. Justice Greer thought that the usual way of conducting commercial arbitrations was with two arbitrators and an umpire, but Mr. Pitman said it was always subject to the rules and conditions of various trade associations. Mr. E. J. Parry, B.Sc., said that arbitration in London in the usual way meant arbitration under the Arbitration Act by one arbitrator. Probably the majority of people who employed these words anticipated the employment of two arbitrators and an umpire.

His Lordship, in giving judgment, said that the evidence showed that most forms of contract stipulated for two arbitrators and an umpire, and it was the rarest possible thing in the chemical market to find a contract which provided for a single arbitrator. The words meant arbitration in the usual manner in the chemical trade in London, and on the evidence that meant arbitration before two arbitrators and an umpire. It was remarkable that, although the British Chemical Trade Association had adopted a definite form of contract with a number of conditions, the chemical trade, with some small exceptions, preferred their own forms with the words "arbitration in the usual way." Therefore he decided in favour of the defendants that the award was valid and binding so long as it was not set aside and he was told it was too late to apply to set it aside. He therefore entered judgment for the defendants for the amount of the counterclaim, £4800 less £392 due to the plaintiff, with costs. A stay of execution was granted on terms.

REPORTS

Report on the Industrial and Economic Situation in Czechoslovakia, dated March, 1923. *By* S. P. Elliott, *Acting Commercial Secretary, Prague. Department of Overseas Trade. Pp.* 48. *H.M. Stationery Office*, 1923. *Price* 1*s*. 6*d*.

The chief difficulties with which Czechoslovakia has had to contend in the past year were due to the country's comparatively strong financial condition. The crown has appreciated in value till now it is fairly steady at about 160 to the £, but prices in general have not fallen proportionately. As the country can meet home demands by 30 to 35 per cent. of its industrial production its existence depends on its ability to export, but the rise in value of the crown and the weakening of the currencies of neighbouring countries made export difficult. Exports in 1922 were only about 3 per cent. less than in 1921, whereas imports fell by about 25 per cent., but the figures do not show the critical state of the country, as many of the exports were finished articles sold from stock at a loss, and owing to decreased production, imports of raw materials were smaller.

The glass industry, one of the most important in the country, did very well during the first half of the year, but the rapid rise in value of the Czech crown in August was catastrophic. Nevertheless in some lines the exports of glass reached and even surpassed the level of those of the old Austro-Hungarian Empire. Prices at present, however, are high owing to the cost of raw materials and transport. The coal industry was depressed: home consumption dropped to about one half of the pre-war figure, and exports dwindled steadily during the year. The two factors which kept the industry going were the prohibition of imports, and the necessity of Germany to import coal. The total production amounted in 1922 to 9,906,261 t. of hard coal and 18,942,020 t. of lignite, each about 15 per cent. less than in 1921. The metal industry is in a bad way; prices have fallen considerably.

Since the abolition of State control in October last, a syndicate has been in operation to eliminate competition between sugar producers. The total production of raw sugar was 720,969 metric tons and 318,179 t. was exported.

Since the formation of the republic there has been a falling off in trade with Austria and adjacent countries, whilst that with more Western European countries has increased, though this must be regarded as due principally to the low purchasing power of local currencies. Imports in 1921 were valued at 22,433 million Kc. and exports at 27,312 mill. Kc. Though in 1922 the weight of exports exceeded considerably that of imports, the actual values may show much less difference. The fact that many goods which could be supplied by British producers are already made in Czechoslovakia itself under a system of protection, hinders the British merchant from developing trade, but it is hoped that a commercial treaty into which Great Britain and Czechoslovakia are entering will remove many of the difficulties.

Report on the Economic and Financial Situation of Egypt, dated April, 1923. *By* E. H. Umlock, *British Commercial Agent, Cairo. Department of Overseas Trade. Pp.* 56. *H.M. Stationery Office*, 1923. *Price* 1*s*. 6*d*.

The year 1922, in spite of indications to the contrary, such as the favourable trade balance, large exports of cotton and a good budget surplus, was unsatisfactory economically. Although in 1922 the total quantity of cotton exported, 6,479,372 t., was above the average for recent years, its value was considerably less owing to the marked falls in cotton prices.

Industries in Egypt are divisible into three categories, mining, general and native. Among the former may be mentioned petroleum, obtained from the Suez area and refined, as is also some imported oil, at Suez. Anglo-Egyptian Oilfields, Ltd., produced 171,923 t. of crude oil in 1922. Phosphates from the Red Sea coast and Upper Egypt are sent to Europe and Japan, as the high cost of sulphuric acid prohibits the local production of superphosphate. Production of phosphates in 1922 amounted to 60,220 t. against 122,024 t. in 1921. Manganiferous iron ore is mined in Sinai and sent chiefly to Belgium, Holland, and the United Kingdom; the output in 1922 was 104,143 t. and 111,523 t. were exported. Crude sodium carbonate and sulphate are recovered from salt lakes in the Delta and the soda lakes at Wadi Natroon. Limestone and clay are quarried for cement production. There are several industries of a general nature connected with cotton, such as cotton-seed crushing and soap making. Sugar refining is important, and the country is capable of producing 11,000 t. of alcohol annually. The native industries are principally domestic, dyeing of fabrics being an important branch.

Imports in 1922, £E43,333,938, were about 22 per cent. less than in 1921 (*cf. J.*, 1922, 486 R), principally owing to the decrease in imports of coal and cereals. The principal imports included hides, skins, and leather, £E2,829,157; wood and coal, £E3,842,267; stone, earthenware and glassware £E1,265,934; dyestuffs, tanstuffs and colours, £E441,423; chemical and medicinal products, and perfumery, £E2,964,733; metals and metalware £E5,357,161. Exports amounted toi £E48,716,418, about 25 per cent. more than in 1921, consisting mainly of raw cotton and cereals.

Imports from the British Empire fell in 1922 by £E5 millions, and those from the United States by £E6½ mill., thus accounting for most of the fall in imports. Although part of the reduction of the British imports is due to trade depression, and to competition from countries with low currency values, it is not entirely due to these factors, and instances are given to emphasise the view that British manufacturers should do more to foster the demand for the goods they produce rather than leave this to their agents.

REPORT ON THE ECONOMIC AND FINANCIAL CONDITIONS IN URUGUAY, JANUARY, 1923. *By* E. A. CLEUGH. *H.M. Vice-Consul, Montevideo. Pp.* 30. *Department of Overseas Trade. H.M. Stationery Office*, 1923. *Price* 1*s*.

The two problems facing Uruguay at present are the state of the national finance and the universal industrial depression. Uruguay is eminently pastoral and depends on European markets to dispose of her meat supplies—a difficult matter under present conditions. Nevertheless, the country is economically sound and undoubtedly will react favourably when European conditions improve. The live stock industry has been in a bad state for some time, and State assistance has had to be given to many farmers. Sealing and whaling are important industries. The excellent results obtained recently in the sealing industry have led to a State inquiry into the present methods of working with the view to eventual nationalisation. The proposal referred to in the last report (*cf. J.*, 1922, 182 R) to nationalise the manufacture and sale of alcohol has not yet materialised, nor has a more recent similar proposal in connection with drugs.

The year showed a slight tendency towards improvement in trade compared with 1921, mainly in the later half, but the balance of trade is against Uruguay. The value of imports in 1922 is given as $81,778,640, and of exports at $77,458,046 (the value of the Uruguyan dollar varied between 40d. and 45d. during the year). Uruguayan importers have always shown themselves anxious to trade with the United Kingdom, though they became discouraged by the fall in the value of the dollar, and some difficulty in getting their requirements met. Their interest has, however, increased recently, but strong competition has to be met from Germany, the United States, France and Belgium.

REPORT ON THE ECONOMIC AND INDUSTRIAL CONDITIONS IN THE SERB-CROAT-SLOVENE KINGDOM (JUGOSLAVIA), DATED APRIL, 1923. *By* CAPT. E. M. HARVEY, *H.M. Commercial Secretary, Belgrade. Department of Overseas Trade. Pp.* 40. *H.M. Stationery Office.* 1923. *Price* 1*s*. 6*d*.

The year 1922 proved unsatisfactory to the trader and bright prospects in view at the beginning of the period (*cf. J.*, 1922, 513 R) were not fulfilled. This was largely due to the restrictions placed on exchange transactions in order to maintain the value of the dinar, but which also hindered genuine trade. Since the control was removed trading conditions have improved, though the dinar has decreased in value.

In spite of earlier reports to the contrary the grain harvest in 1922 proved average, and the grape crop was abundant, though the wine will be of inferior quality. Much propaganda work is being done to induce farmers to grow sugar beet. In 1922 30,000 to 35,000 tons of sugar were produced in the country, representing about one half of the home consumption.

Little has been done to develop the mineral resources of Jugoslavia, largely owing to lack of capital and of transport facilities. Boring for oil continues in the Save-Drave district, but apparently no definite results have yet been obtained.

Industry is still in its infancy. Lack of capital is a great difficulty, and the shortage of skilled labour and inadequate railway communications also prevent development. Various measures taken in 1922 to reduce prices proved disastrous to industry.

Exports in 1922 amounted to about 3,000,000,000 dinars. Prunes took first place among the exports, timber coming next. Italy and Austria were the chief buyers in Jugoslav markets, the former taking 29 per cent. and the latter 25 per cent. of the total exports. The United Kingdom took 2·4 per cent. Since the war Switzerland has taken a bigger share than previously.

Many restrictions were placed on importation in 1922 in order to assist the restoration of a favourable balance of trade and the value of national currency, among them being one prohibiting the importation of luxury articles. In December, however, these restrictions were removed.

Trade with Great Britain was not so great as anticipated. In one or two commodities, such as copper and tin, a fair amount of business has been done. It is pointed out that the best method of introducing new goods with any success is to provide a local agent with adequate stocks, rather than insist on payment through London credit accounts.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

No material changes have taken place in the heavy chemical market, but a more hopeful tone has developed, with an improved demand from the textile trade.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 9d.—4s. 3d. per carboy d/d.
Acid Nitric 80° Tw.	£21 10s. per ton makers' works.
Ammonia Alkali	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	5¾d.—6d. per lb.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Prices in this section are unchanged.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

With the exception of acetates of lime and lead the demand for wood distillation products keeps below normal.

Acetate of Lime—	
Brown	£12—£13 per ton d/d. Demand steady.
Grey	£22 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 5s.—£9 10s. per ton, according to grade and locality. Market quiet.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. per gall. 60% O.P.
Solvent	6s.—6s. 3d. per gall. 40% O.P.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead	£42—£43 per ton. Demand more active.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. 1d.—1s. 2d. per lb. Fair inquiry.
Crude 60's	3s. 4d. per gall. Market quieter.
Acid Cresylic—97/99	2s.—2s. 5d. per gall. Firm, with good demand.
Pale 95%	1s. 11d.—2s. 4d. per gall.
Dark	1s. 6d.—2s. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.
Anthracene Oil—	
Strained	8½d.—10d. per gall. Plenty of enquiries.
Unstrained	8½d. per gall.
Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.

Benzale, Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 5½d. per gall. d/d. buyer's works.
Pure	1s. 9d—1s. 11d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8½d.—9½d. per gall. according to grade and district. Good business being done.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 2d. per gall. Market sluggish.
Solvent 90/190	1s. 2d.—1s. 3d. per gall. Very little business.
Naphthalene Crude—	
Drained Creosote Salts	£7—£8 per ton. Demand increasing. Market scarce.
Whizzed or hot pressed	£9 10s.—£11 per ton.
Naphthalene—	
Crystals	£19 10s. per ton.
Flaked	£19 10s. per ton.
Pitch, medium soft	130s.—140s. per ton, according to district and time of delivery. Several inquiries. Market firm.
Pyridine—90/140	22s.—22s. 6d. per gall. Demand good. Supplies short.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

The slight improvement in dyestuffs business has been maintained.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 9d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Quieter.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 9d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Better demand.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	9d. per lb. naked at works.
Dinitrochlorbenzol	£83 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	5¾d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	2s. 7½d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
o-Toluidine	7d.—8d. per lb.
p-Toluidine	4s. per lb. d/d.
m-Toluylene Diamine	5s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The shortage of spot supplies of a number of products continues and prices are in consequence considerably higher for a few of the pharmaceutical chemicals which are in regular demand.

Acid, Acetic 80% B.P.	£47 10s. per ton.
Acid, Acetyl Salicylic	3s. 6d.—3s. 7d. per lb. In strong demand. Most makers fully sold ahead.
Acid, Benzoic	2s. 9d. per lb. for ordinary quality. B.P. quality worth 4s. 6d. lb. Stocks negligible.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Camphoric	17s.—19s. per lb.
Acid, Citric	1s. 4½d. per lb., less 5%, for ton lots. Firmer.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic. Cryst	6s. per lb. for 28 lb. lots.
Acid, Salicylic	2s. 6d.—2s. 7d. per lb. Firm market.
Acid, Tannic	3s. 3d. per lb. for B.P. quality. Very firm.
Acid, Tartaric	1s. 1½d. per lb. less 5%. Home trade poor. Raw material slightly easier.
Amidol	9s. per lb. d/d.
Acetanilide	Advanced to 2s. 9d. per lb. Small stocks.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	4s. per lb. for English make.
Ammon. Carbonate B.P.	£32 15s per ton.
Atropine Sulphate	12s. 6d. per oz. for English make. Demand very poor
Barbitone	17s. per lb. Neglected.
Benzonaphthol	5s. per lb. Quiet.
Bismuth Salts	A steady market. Prices according to quantity :
Carbonate	12s. 9d.—14s. 9d. per lb.
Citrate	11s. 4d.—13s. 4d. ,,
Salicylate	10s. 2d.—12s. 2d. ,,
Subnitrate	10s. 9d.—12s. 9d. ,,
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	
Potassium	7½d. per lb. Remain very firm.
Ammonium	8½d. ,, ,,
Sodium	8d. ,, ,,

Calcium Lactate	2s. 9d. per lb. for best English make.
Chloral Hydrate	4s. 3d. per lb. Position very firm.
Chloroform	2s. per lb. for cwt. lots. Very steady.
Creosote Carbonate	7s. 6d. per lb. Little demand.
Guaiacol Carbonate	Spot supplies very scarce. Present value 13s. 6d. per lb. Still advancing.
Hexamine	4s. 6d. per lb. Very firm market.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate	1s. 11d.—2s. 3d. per lb., according to quality.
Magnesium Carbonate—	
Light Commercial	£36 per ton net.
Magnesium Oxide—	
Light Commercial	£77 10s. per ton, less 2½%.
Heavy Commercial	£27 per ton, less 2½%.
Heavy Pure	2s.—2s. 3d. per lb., according to quality and quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 72s. 6d. per lb.
Mercurials	Firm and likely to advance.
Red oxide	4s. 11d.—5s. 1d. per lb.
Corrosive sublimate	3s. 8d.—3s. 10d. ,,
White precip.	4s. 6d.—4s. 8d. ,,
Calomel	4s. 1d.—4s. 3d. ,,
Methyl Salicylate	2s. 10d. per lb. for carboys. Very scarce. Higher values expected.
Methyl Sulphonal	Has rapidly advanced to 21s. per lb.
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 5d. per lb.
Phenacetin	7s. 6d. per lb. In better supply.
Phenazone	8s. 3d. per lb. Remains very firm.
Phenolphthalein	7s. 9d. per lb. Very firm. Shortage imminent.
Potass. Bitartrate—99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Market firmer.
Potass. Citrate	1s. 8d.—2s. per lb.
Potass. Ferricyanide	3s. per lb.
Potass. Iodide	15s. 8d.—15s. 11d. per lb. Good steady market.
Potass. Permanganate	10d. per lb. for B.P. crystal.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	6s. per lb.
Salol	4s. per lb.
Sod. Benzoate	3s. per lb. Scarce.
Sod. Citrate, B.P.C., 1923	1s. 9d. per lb. for cwt. lots.
Sod. Hyposulphite—	
Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Nitroprusside	16s. per lb. Less for quantity
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 10d. per lb., and Crystal at 2s. 11d. per lb. Firm and very active.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	Very much higher at 25s. per lb.
Thymol	13s. 6d. per lb. quoted for synthetic and 14s. 6d. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 9d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine	3s. 3d. ,, ,,
Benzaldehyde free from Chlorine	3s. 3d. ,, ,,
Benzyl Benzoate	3s. 6d. ,, ,,
Cinnamic Aldehyde Natural	22s. 6d. ,, ,,
Coumarin	20s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	37s. 6d. ,, ,,
Geraniol	6s. 9d. to 13s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. 9d. per lb.
Linalol ex Bois de Rose	18s. 6d. ,, ,,
Linalyl Acetate	18s. 6d. ,, ,,
Methyl Anthranilate	8s. 6d. ,, ,,
Methyl Benzoate	6s. ,, ,,
Musk Ketone	47s. 6d. ,, ,,
Musk Xylol	13s. 6d ,, ,,
Nerolin	4s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	16s. ,, ,,
Rhodinol	60s. ,, ,,
Safrol	2s. ,, ,,
Terpineol	3s. ,, ,,
Vanillin	25s. per lb.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 11d. ,, ,,
Bergamot Oil	13s. 3d. ,, ,, spot.
Bourbon Geranium Oil	37s. ,, ,,
Camphor Oil	80s. ,, ,,
Cananga Oil, Java	9s. 6d ,, ,,
Cinnamon Oil, Leaf	5d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 9d. ,, ,,
Ceylon	Very little on offer, too many parcels arriving containing spirit. These have been seized by the Customs.
Clove Oil	10s. per lb.
Eucalyptus Oil 70/75%	2s. 9d. per lb.

Lavender Oil—		
French 38/40% Esters	26s. per lb.	
Lemon Oil	2s. 10d. per lb.	
Lemongrass Oil	2¾d. per oz.	
Orange Oil, Sweet	11s. 9d. per lb.	
Otto of Rose Oil—		
Bulgarian	34s. per oz.	
Anatolian	26s. per oz.	
Palma Rosa Oil	24s. 6d. per lb.	
Peppermint Oil—		
English	70s. per lb.	Market very unsteady.
Wayne County	15s. 6d. per lb.	Market very unsteady.
Japanese	12s. 6d. per lb.	Market very unsteady.
Petitgrain Oil	8s. 9d. per lb.	Dearer.

TRADE NOTES

London Joint City and Midland Bank, Limited

At an extraordinary General Meeting of the shareholders of the London Joint City and Midland Bank Limited, held at the Cannon Street Hotel, London. E.C. 4, on Friday. November 9, 1923, a resolution was passed changing the name of the Company to Midland Bank Limited. A confirmatory meeting will be held on November 26 next.

Dyestuffs (Import Regulation) Act, 1920

The following statement relating to applications made in October for licenses under the Dyestuffs (Import Regulation) Act, 1920, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee :—

The total number of applications received during the month was 520, of which 428 were from merchants and dealers. To these should be added the 40 cases outstanding on October 1, making a total for the month of 560. These were dealt with as follows :—

Granted, 423 (of which 381 were dealt with within 7 days of receipt).

Referred to British makers of similar products, 75 (of which 63 were dealt with within 7 days of receipt).

Referred to Reparation supplies available, 53 (all dealt with within 2 days of receipt).

Cancelled, 1.

Outstanding on October 31, 1923, 8.

Of the total of 560 applications received, 498, or 89 per cent., were dealt with within 7 days of receipt.

Complaints under the Safeguarding of Industries Act

The Board of Trade has received formal notices of complaint that Rongalite, Sodium Formaldehyde Sulphoxylate and Zinc Formaldehyde Sulphoxylate have been improperly included in the lists of articles chargeable with duty under Part 1 of the Act. These complaints will be submitted in due course to the Referee appointed for the purposes of the Act and any person interested should communicate immediately with the Assistant Secretary, Board of Trade, (Industries and Manufactures Department), Great George Street, S.W. 1.

Trade Information

A New Photomicrographic Camera.—Although photomicrographic methods are in common use in technical laboratories, the apparatus used is not always of the most convenient kind. It is of interest therefore to direct attention to the handy Lucas photomicrographic camera, made by Euner and Amend, Third Ave., 18th to 19th Street, New York. This instrument has the great advantage that either plates or films can be used with it ; further, it is compact, easily operated, little affected by vibration, and capable of exact longitudinal adjustment. The price of the complete camera in a wooden case, together with two films, but without a microscope, is $60.

"Sira" Abrasive.—Messrs. R. & J. Beck, Ltd., of 68, Cornhill, London, send us particulars of the new "Sira" abrasive prepared according to the formula of the British Scientific Instrument Research Association. This abrasive can, it is claimed, advantageously replace emery, being more rapid and economical in use. "Sira" abrasive is tough and does not break down during use, and has the further advantage that it does not cease to act until much debris has accumulated.

An Improved Method of Sawing Metals.—We have received a pamphlet describing an improved method of sawing metals, which is said to halve the time and cost of sawing. The improvement consists in the use of a saw blade of high-speed tungsten steel, having a patent set which enables it to be sharpened many times, a novel saw-grinding machine being provided to form the correct shape of teeth. To enable full benefit to be obtained from the high-speed steel saw, the sawing machine has been designed to run at a high speed. Full particulars can be obtained from Messrs. E. G. Herbert, Ltd., of Atlas Works, Chapel Street, Levenshulme, Manchester.

Bleaching is an old industry, but there is still room for improvements in technique, and attention may be directed to pamphlets issued by the Castner-Kellner Alkali Co., Ltd., 257, Royal Liver Building, Liverpool, dealing respectively with bleaching by means of liquid chlorine in conjunction with bleaching powder, and bleaching by means of hydrogen peroxide. It is advocated that chlorine, supplied as liquid in cylinders, should be bubbled through the tank in which bleaching powder is being mixed, the free lime being converted into calcium hypochlorite, thereby raising the strength of the bleach liquor by 35 to 40 per cent., and reducing the quantity of waste sludge by three-quarters. Stronger liquors can thus be made up and fewer mixings are required, so that not only is less labour required, but the availability of the bleaching powder is improved, time lost in washing sludge to conserve bleach solution is reduced and the maximum output of the mixing plant can easily be doubled.

In the pamphlet on sodium peroxide, the uses, advantages, and properties of this universal bleaching agent are described and precautions are set out that should be observed in storing and using it. Useful practical hints are given to aid the user in preparing goods for bleaching—an essential point—in preparing the bleach liquor and in the after-treatment required. The pamphlet terminates with tables of equivalents, including the common hydrometer and thermometer scales, and it is stated that the Castner-Kellner Co. will consider any problem connected with sodium peroxide in which laboratory experience or small-scale laboratory trials can be of service.

Scouring is a process which, in domestic experience at any rate, is not unknown to end disastrously, so that any method based on accurate knowledge will be sure of a welcome. The Weston Chemical Co., Ltd., Royal Liver Buildings, Liverpool, have sent us a booklet which describes the uses of " Westropol " solvent scourers, non-inflammable fat-solvents incorporated in soaps in such a way as to become either soluble in or emulsifiable with water. These scourers are stated to have no action on metals and to contain no injurious or objectionable ingredients. Special products such as Westropol, Westrol and Westoran are available for particular materials, and it is claimed that much more effective results can be obtained with the use of these special products than with ordinary means, as not only are very obstinate mineral oil or fatty stains removed, but there is no felting, even the most delicate material is uninjured, work is accelerated and infected materials are sterilised.

Oil-extraction and degreasing.—In a further pamphlet sent by the Weston Chemical Co. an account is given of the varied uses of the chlorine derivatives of ethane and ethylene as non-inflammable, non-combustible, and non-inflammable solvents. These solvents include tetrachlorethane (Westron, a solvent for fats, oils, resin and sulphur), and trichlorethylene (Westrosol, for oils, fats, resins and rubber). Both these solvents can be used in most ordinary types of extractors, and are recovered with facility by steam distillation. Westrosol has practically no action on iron, but when Westron is used, iron parts should be protected with a coat of lead. Further information on the many uses of these interesting solvents can be obtained from the makers at the address given above.

New Water-resisting Glue

The new highly water-resistant blood albumin glue (c.*f. Chem. and Ind.*, 1923, p. 840), which is made by the addition of paraformaldehyde and ammonia to blood albumin, can be used with presses of the same sort used in gluing with animal, vegetable or casein glues, and can be applied without the use of a hot press. It has sufficient strength for use in plywood, as may be seen in the fact that plywood test specimens which were placed in the fungus pit of the Forest Products Laboratory under conditions of excessive humidity during one year, required a shearing force of 300 lb. to break them apart. Specimens placed in water for one month proved equally strong. The new glue formula is dedicated to the free use of the public.

PUBLICATIONS RECEIVED

MODERN ELECTRO-PLATING, A GUIDE BOOK FOR PLATERS, WORKS CHEMISTS AND ENGINEERS. *By* W. E. HUGHES, M.A. *Pp. vii+160. London: H. Frowde and Hodder & Stoughton,* 1923. *Price* 16*s.*

THE CHEMISTRY OF PAINTS, PIGMENTS, AND VARNISHES. *By* J. G. BEARN, D.Sc. *Pp. x+277. London: E. Benn, Ltd.*, 1923. *Price* 30*s.*

PUBLICATION OF THE DOMINION BUREAU OF STATISTICS, CANADA. *Mining, Metallurgical and Chemical Branch.* SPECIAL REPORT ON THE CONSUMPTION OF PREPARED NON-METALLIC MINERALS IN CANADA, *Pp.* 30. *Ottawa: F & A. Acland*, 1923.

PUBLICATIONS OF THE IMPERIAL MINERAL RESOURCES BUREAU, THE MINERAL INDUSTRY OF THE BRITISH EMPIRE AND FOREIGN COUNTRIES. *H.M. Stationery Office*, 1923:—
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EDITORIAL

WE may be pardoned if we say that the story of Agib, Prince of Tartary, has haunted us since the recent meeting of the Chemical Engineering Group. He would be bold indeed who dared to question the ability of any chemical engineer to strum a march upon the loud theodolite or blow the gay pantechnicon all night—suitable refractories would be recommended at least—but on this occasion we did not even need the piano's martial blast to wake the echoes of the past, for Prof. Hinchley was discoursing on potash. Not the potash of juvenile experiments with match-boxes or the remedy for incipient colds, but the material of prime importance to agriculture which has hitherto been supplied almost solely from the Stassfurt deposits. It was a fascinating story that Prof. Hinchley had to tell, and seldom can a long and difficult piece of investigation have been summarised so beautifully by a few equations. The importance of the new source of potash described can be realised when it is stated that the volcanic region in Central Italy contains sufficient leucite to supply the world's requirements in potash for several hundred years. Commercial extraction has been found not only possible but is being accomplished, and the raw material has many unique properties. In general the iron content of minerals is often so combined that electro-magnetic separation is impossible, but by good fortune—which was resented jocularly by one speaker—the iron in leucite can be separated quite readily by electromagnetic treatment. In powder form the mineral is practically equivalent in fertilising value to potassium sulphate of the same potash content, and the silica it contains can apparently be made use of by the plant. Leucite, being zeolitic in character, is of use in softening water, and it can be employed in many ways for the production of chemicals. Potash alum of high purity can be obtained by dissolving granular leucite in sulphuric acid, no objectionable gelatinous silica being formed, and iron can be removed by passing the solution over fresh mineral. The silica that remains dissolves at once in caustic soda and yields a very pure sodium silicate. Practically pure potassium chloride and pure hydrated aluminium chloride, or, alternatively, hydrated aluminium oxide and silica, are produced by treatment with hydrochloric acid, and caustic soda can be made by treating powdered leucite in an autoclave with caustic lime. Many possible applications, such as in the ammonia process for making alkali, at once suggest themselves for such a protean material, and it seems obvious, as Prof. Hinchley pointed out, that our chemical industry cannot afford to ignore the potentialities of leucite.

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It is interesting and even pleasant to watch from a serene spot, and at a safe distance, storms and other troubles, but it is even more exciting to see a break in the clouds and a glimpse of sun and hope. The devastated and impoverished condition of Europe provides but few of such encouraging signs and it is the more necessary to call attention to them. A year ago Austria's financial state was parlous, her currency was depreciating rapidly towards the infinitesimal, starvation and bankruptcy stared her in the face. To-day, thanks to the League of Nations and the capable experts who were appointed to improve matters, conditions are much better. Private deposits in the banks have increased from two million gold crowns a year ago to thirty-two millions, the monthly deficit in the national finances is a third of what it was; during the last six months the number of the unemployed has become half; the currency is now stable. Our great chemical industry will revive and with it the demand for trained chemists when our other industries are again more prosperous, and these doubtless depend to some extent on the prosperity of the world. Chemists must surely welcome the development we have mentioned and will hope to see this remedy applied elsewhere. Those who advocate duties, capital or other levies, free trade or other debatable topics, cannot fail to be impressed by this solid and recent achievement.

Mr. Rex Furness' article in this number on colour in nature opens up a whole vista of idle visions. Though science ever takes us back step by step from the obvious to the unknown, and though we are getting gradually to the stage when we can identify many of the natural colouring matters, describe their constitution, and explain the chemical processes by which they are built up, nevertheless the main fact that the red poppy propagates red poppies and the yellow ones produce yellow offspring is as mysterious and incredible as ever. What an astonishing complexity must exist in the tiny seed, able to arrange that in the grown-up plant there shall be a stalk and flower of definite size, shape and colour, that the leaves shall have specified areas, divisions and markings, that these shall have hairs of a particular length, breadth and thickness, and so on! Does the seed consist entirely of chemical molecules arranged in some special way or does inheritance involve something in addition? Can there be some tendency, some tradition or some influence, independent of atoms or molecules? This will be very surprising, but any other explanation seems equally difficult.

* * *

We are indebted to our contemporary, *The Chemist and Druggist*, for a most curious instance of bureaucratic interference with the private rights of the populace. One has almost become accustomed to legislative control of the use of alcohol, whether industrial or potable, passports and registration forms are necessities of life in some countries (though in this country too many forms have to be filled in annually for the comfort of most of us), and "grandmotherly legislation" has become a stock phrase of political argument. But we have never before heard of a whole nation being medicated forcibly. It is well known that potassium iodide is an excellent remedy for the disease, goitre, so common in many of the mountainous districts of Europe. Some kindly bureaucrat, having heard of this, concluded that the metabolism of the inhabitants of Austria was in decided need of improvement. The means were at hand, the decree went forth. Salt production in Austria is a Government monopoly, so, in future, culinary salt in that country will contain 0·005 grams of potassium iodide to each 1000 grams of sodium chloride. On inquiring further into this Attic *trouvaille*, it will be found, however, that, as each Austrian citizen consumes approximately 7 or 8 kilograms of salt each year, his or her metabolism will be stimulated by the ingestion of no less than 0·04 grams of potassium iodide annually, supplied without extra charge. One trembles to think of the consequences were our own bureaucrats to realise the possibilities of this ingenious method of safeguarding the nation's health, though a united effort of the chemical industry could produce results surpassing the powers of imagination.

COLOUR IN NATURE

By REX FURNESS

Introduction

During his recent visit to this country, Prof. Bancroft delivered a number of lectures on the subject of the colour of birds' feathers. As no full report of these lectures has appeared in the technical press, it was suggested that a general review, embodying Bancroft's work, would prove of interest. In the following article, Bancroft's papers in the American journals have been largely drawn upon, whilst in addition, Willstätter's classic work on the anthocyans, the colouring matters of many of our most beautiful flowers, has been reviewed. The colour of flowers is directly due to the presence of pigments, capable of isolation, whilst the colour of many feathers is produced in the entire absence of pigments, by the scattering of light or interference phenomena. Some attention is given to the question of the part played by oxydases and peroxydases in the formation of pigments in plants.

Colour in Nature

Colour is a characteristic of all forms of nature, wherein it has both utilitarian and decorative functions. Thus, the green colouring matter of plants, chlorophyll, acts as a photo-catalyst in the reaction between carbon dioxide and water, and is essential in this primary reaction of the complex process of plant growth. The charming hues of many flowers attract certain pollen-bearing insects, and colour therefore plays its part in the propagation of the species.

In the animal kingdom, colour is made use of in ensuring self-protection. The art of camouflage had been developed to a high degree amongst animals thousands of years before man demonstrated his superiority by employing it to assist him in the wholesale destruction of his kind. Protective colouring amongst animals is recognised by zoologists, and is displayed on almost every hand. The stripes and general colour effect of the tiger's skin protect him in the jungle by limiting colour contrasts and rendering him less visible in his natural surroundings. The sandy skin of the lion, the spots of the leopard and the stripes of the zebra serve similar purposes in particular localities. The animals of the polar regions are white, some, for instance the northern hare, assuming their white coats only in winter. Similarly, mottled and spotted fish are almost invisible in the sand. The colour and general physical form of many insects render them almost indistinguishable from the bark or leaves of trees, or from some other feature of their surroundings. The looper caterpillar can scarcely be distinguished from a dead twig, and many butterflies and moths simulate dead leaves. The same principle applies in imitative colouring, as when an animal with no powerful means of defence resembles one which is known to be dangerous.

Of quite a different order is the part which colour plays in sexual attraction amongst the humming birds and other birds possessing gay and decorative plumage.

The appreciation of the beauty of colour by mankind was probably prehistoric in origin, for there are many references to it in the earliest historical writings. The artistic sense evident in the selection and application of pigments and naturally coloured objects increased as civilisation advanced. In illustration there may be noted the contrast between the application of a crude woad extract to the body by the ancient Briton and the employment of the beautiful Tyrian purple for the dyeing of fine textiles by the peoples of the Roman and earlier civilisations.

The love of colour to-day is universal. Although nature's colourings cannot be surpassed, man finds a great pleasure in the beauty of many of his own productions—stained glass windows, afire in the rays of the sun, delicately coloured ceramic wares, cunningly worked, artificial silks, dyed in soft hues with the aid of the ever-increasing range of coal-tar dyestuffs. He has discovered how to colour all kinds of textiles, furs and leathers, and to beautify his dwellings by means of decorative papers, paints, lacquers and the like.

The love of colour is so deeply ingrained in human nature that a blinded man, once having seen and appreciated artistic colour arrangements, continues to enjoy them in retrospect, and to create in imagination new and wonderful effects. The dull bronze depths into which his sightless eyes seem ever to be gazing represent his only approach to actual colour vision—if the train of dazzling incandescent sparks which occasionally crosses the bronze void be excepted —but his imaginative faculties give him all the delights of colour sensation. His philosophy tells him to refrain from mourning a loss which cannot be repaired, and persuades him to believe, perhaps foolishly, that he is the gainer, when, as the warm beams of the westering sun fall upon his face, he transforms even the most watery of sunsets into a kaleidoscope of blended colours such as is seen in actuality only by a Turner.

Origin of Colour Effects in Nature

The ultimate reason why any object appears coloured to the eye is bound up, of course, with the phenomena of light absorption, reflection and refraction, but we are accustomed to regard colour as a result of the presence of a pigment. Thus, it is quite true that the colours of many of our most beautiful flowers are directly occasioned by the presence of the anthocyan pigments, which can be extracted and identified as definite chemical entities. The colouring of many birds' feathers, the blue colour of the sky, the sunrise and sunset tints and the colour of blue eyes are all directly the result of light phenomena. The actual final effects may be modified by the presence of a dark pigment, which often serves as background, or by the presence of a yellow pigment which, superimposed over a structural blue, results in a structural green colour. For the purposes of broad contrast, however, we may regard the colour of flowers as due to the presence of pigments, and that of blue feathers as due entirely to light effects, produced in the absence of pigments. The latter, the so-called structural colours, are divided into objective structural colours and subjective structural colours, the former being caused by the scattering of blue light by a turbid medium and being independent of the angle of incidence of the light. Subjective structural colours, on the other hand, are due to light interference phenomena, as in the case of the coloured "Newton's rings," and are responsible for the brilliant flashing colours showing a metallic lustre and seen, for instance, in the tail feathers of the peacock.*

Blue, Green, Non-Iridescent Colours of Feathers

The blue and green colours of birds' feathers are due entirely to the scattering of blue light by the disperse system constituting the feathers, with the aid of a yellow pigment superimposed upon the feather structure, in the case of green colour effects. Thus, no blue pigment can be extracted from the feathers of the blue bird, the blue jay, the kingfisher or the indigo bunting. The blue light, incident upon the feathers, is scattered by the disperse system, consisting of minute air cells in the horny structure of the feathers, the former representing, of course, the dispersed substance and the latter the disperse medium. The air cells or pores exist in the outer layers of the barbs of the feathers. The blue colour observed is the ordinary "Tyndall blue," and is common in turbid media, such as the sky and the human eye. The blue of the sky is, according to Bancroft, due to light scattering in the disperse system, which, contrary to that of feathers, consists of a gaseous dispersion *medium* and a solid disperse *phase*.

It is not suggested that every blue colour found in the feathers of birds is produced in the absence of blue pigments, and it is admitted that a "synthetic" structural blue feather has not yet been produced. Contrast, for instance, the imitation of a blue sky effect in an artificial atmosphere containing fine particles (*V-infra*). The theory of the cause of the blue colour of the feathers of the birds noted above fits into Bancroft's general conception of the scattering of blue light by disperse systems. These systems are of three classes, namely, a solid in a gas (as in the case of the sky), a gas in a solid (as in the case of blue feathers), and a liquid or solid in a liquid (as in the case of blue eyes).

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* It is impracticable to enter into a discussion of the various causes of colour in any detail in this article. A standard textbook of physics should be consulted, or the concise explanations of interference colours, Newton's rings and light scattering, which are available in the standard works of reference may be found to probe deeply enough into the question, so far as it concerns the chemist. Bancroft's four papers, Parts 1 to 4 of "The Colour of Colloids" (*J. Phys. Chem.*, 1918, p. 601, 1919, pp. 1, 154, and 253) discuss the questions of light absorption, reflection and refraction, with special reference to the colour of colloids—and therefore apply to the disperse systems constituting birds' feathers, blue skies and blue eyes—and form a masterly review of our knowledge of colour phenomena.

▲

Before passing to a consideration of the iridescent colours of birds' feathers, a short account of the scattering of light by the first and third noted disperse systems may be given.

THE BLUE OF THE SKY

The blue colour of the sky has been attributed to the phenomenon of light scattering from the time of Leonardo da Vinci, but even to-day the *exact* mechanism is under discussion. It has been suggested (*cf.* Bancroft) that the scattering is effected by finely-divided solid particles or dust, suspended in the air, whilst finely-divided water particles may provide an alternative explanation. Artificial blue "skies" have been created in disperse systems of solids in gases. Nichols states, however, that whilst there are reasons for regarding the sky as a turbid medium—a disperse system—experimental observations on the spectrum of sunlight cannot be entirely explained by the assumption of relatively coarse particles in the atmosphere. Rayleigh has shown that dust free air and other gases can scatter light, and in every case the scattered light is blue.

It thus appears that it is unnecessary to postulate an atmosphere containing dust, in order to account for the blue of the sky.

The sunrise and sunset colours are due to selective absorption of light. On account of the deeper layers of air through which the sun's rays have to pass (slantwise) at sunrise and sunset, the extent to which the blue light is scattered reaches a maximum. The residual red and orange light illuminating atmospheric haze and clouds provide the basis for the glorious tints so commonly observed (*cf.* Gibbs, "Disperse Systems in Gases," 4th Report on Colloid Chemistry, 1922, p. 179).

BLUE EYES

The structural blue colour of the eye is again due to light scattering by means of finely-divided particles suspended in the liquid medium of the iris. The structural blue is modified, in the cases of green, brown and black eyes, by the coloured layer before the iris, namely, the uvea, which also acts in preventing the red blood from showing and cutting down reflection from the back of the eye (*cf.* Bancroft, "Colour of Colloids," *J. Phys. Chem.*, 1919, p. 154).

IRIDESCENT COLOURS OF BIRDS' FEATHERS

The brilliant flashing metallic iridescent colours of the tail feathers of a peacock or the throat feathers of a humming bird, are subjective structural colours, and are caused by the thin laminæ in the barbules of the feathers. No bright pigment can be extracted from these feathers, nor is the colour effect destroyed by bleaching materials. The effects vary with the angle of incidence of the light to a greater extent than can be accounted for on the theory of selective reflection. The iridescent colours are true interference colours, akin to the coloured "Newton rings," as they are visible by reflected light and not by transmitted light. Indeed, as Bancroft says, the beautiful tail feathers of the peacock, viewed by transmitted light, show no more signs of colour than do the feathers of a crow.

An examination of the structure of iridescent feathers of many birds shows that the barbules—wherein the colours originate—consist of a core of fibrous or granular matter, two microns in thickness, covered with three thin laminæ, apparently in contact, each 0·4 microns thick. A final thin plate or laminated structure completes the barbule, which acts as a multiple thin film. A dark brown pigment provides a background for the interference colours, and aids the production of the flashing metallic lustre, but the colour effects remain until almost the whole of this pigment has been removed, and can then be observed under the microscope.

The curvature of the barbules is the factor determining the final beauty and delicate blending of hues in the iridescent feather. This is due to the different angles at which different parts of the barbule are viewed and, as noted above, the interference colours change with the changing angle of incidence of the light. Plain thin films cannot create the soft blended hues obtaining in the feathers and built up in the curved laminated structure.

The differences of colour and gradations of effect upon a single feather are due, in addition, to slight variations in the thickness of the colour-producing laminæ. A surprisingly small difference in thickness will cause a marked alteration in the interference colours, and it is marvellous, as Bancroft says, that the same general types of coloured feathers are produced generation after generation with such exactitude, when a relatively minute change in the thickness of the microscopic films would entirely alter the general appearance.

The iridescent metallic colours of many birds' feathers are thus structural in origin, being caused by the play of light interference phenomena upon a dark background, and softened and blended by reason of the curvature of the barbule surface, the curved laminæ of which do not give the garish colours of plain thin films.

The Colour of Flowers and Fruits

The colour of flowers and fruits is, in general, due directly to the presence of one or more pigments in the structure, and is not purely structural. The white of the lily is, however, a structural colour, resulting from the disperse system of minute air pores in the petal. The number of colouring matters in nature is enormous, and it is impossible to consider more than one special class. The anthocyan pigments have been selected for review, because they create some of the most beautiful colour effects in flowers, and in addition have been the subject of a profound, painstaking and brilliantly successful series of researches by Willstätter and his associates.

The anthocyans have attracted the attention and curiosity of chemists since the days of Berzelius, and although much interesting work has been reported, the greatest step forward was the isolation of numerous crystalline individuals by the improved methods of Willstätter and the characterisation of the class of anthocyanin pigments.

The anthocyanins are all related to three substances, namely cyanidin, pelargonidin and delphinidin. The red, blue and violet colours of flowers are due to the presence of these substances, their methyl derivatives or their glucosides. The latter are known as the cyanins, pelargonins and delphinins respectively, and are by far the most common form of the anthocyan pigments, it being comparatively rare that the free anthocyanidins occur in flowers. Even in these instances, the amounts are relatively small as compared with the amounts of the glucosides.

The glucosides are formed from the anthocyanidins and either dextrose, rhamnose or galactose. Dextrose is the principal sugar found, whilst galactose only occurs in a single instance. The wide variety of the anthocyanins is dependent upon variations in the nature and number of the sugar residues, and to differences in the position in the complex molecule—in their points of attachment to the anthocyanidin nuclei.

The colour of a particular flower depends not only upon the particular anthocyanin or anthocyanins present, but also upon the concentration, the nature of the cell sap, the presence of other bodies such as tannin or iron salts. In addition, the anthocyans may exist in the plant in the free state, as salts or as oxonium compounds with mineral or organic acids. In the respective conditions, the anthocyans form the basis for violet, blue and red shades.

As an instance of the variation in the amounts of pigment present in flowers, the following figures are of interest. Cyanin, the colouring-matter of the blue cornflower exists in the dried petals to the extent of 0·7 per cent. The same pigment occurs in the dark red garden variety to the extent of 14 per cent. Again, violanin, the glucoside of delphinidin with rhamnose and dextrose, forms the colouring matter of the violet pansy, the dried petals of which contain 33 per cent. of the weight of the anthocyanin.

A list of some anthocyanins is given here, and the extent of their occurrence in nature will become apparent if it be remembered that scores of other glucosides have been prepared in a pure state, following extraction by water or dilute alcohol, fractional precipitation, crystallisation, and so forth. It will also be apparent that the same anthocyanin may occur in flowers and fruits of widely differing colour. As noted above, all the anthocyanins are glucosides of three parent anthocyanidins (or their methyl ethers), namely, pelargonidin, cyanidin and delphinidin—the hydrochlorides of which have, respectively, the formulæ $C_{15}H_{11}O_5Cl$, $C_{15}H_{11}O_6Cl$ and $C_{15}H_{11}O_7Cl$.

Cyanin occurs in the blue and dark red cornflower, the rose, dahlia, and in some pelargonia. It is found in the bilberry and black and wild plum, and an isomer, mecocyanin, is largely responsible for the colour of the scarlet poppy. Both cyanin and mecocyanin are derived from cyanidin, dextrose being the sugar constituent of the natural glucoside.

Asterin and chrysanthemin, found in the aster and chrysanthemum respectively, are isomeric glucosides from cyanidin also, but contain only one dextrose residue in the molecule of the pigment, whereas cyanin contains two.

Keracyanin and prunicyanin again are isomeric with the cyanin of the cornflower and the mecocyanin of the scarlet poppy, respectively, but differ in that they contain two rhamnose residues. These glucosides are present in the cherry and sloe respectively.

Delphinidin glucosides occur in the larkspur, wild mallow and pansy, whilst the corresponding glucoside of delphinidin dimethyl ether, namely, oenin, is found in wine. The glucoside is present in the skin of the grape in conjunction with the free delphinidin, namely, *oenidin*—a circumstance which is by no means common.

Violanin presents us with an instance of two different sugar residues in the molecule, dextrose and rhamnose. The parent anthocyanidin is delphinidin.

The anthocyan pigments have been employed in the past for dyeing purposes, but the colours obtained upon textiles were mostly fugitive. To-day, for reasons which are obvious, they have no commercial significance.

It is impracticable to enter here into a discussion of the constitution of the anthocyanins and their parent anthocyanidins, but it may briefly be stated that they resemble the important flavones, the yellow colouring matters of many plants. They may be regarded as reduction products of the corresponding members of the flavone series. From the present point of view, colour, it is of interest that the anthocyans become darker as the hydroxyl content of the molecule increases, from polargonin through cyanin to delphinin.

Many other types of coloured substances are to be found in our flowers, fruits and plants generally, but to give a list in the absence of some slight discussion would be an intrusion upon valuable space. The anthocyans are a representative class, however, and particularly noteworthy as they are the immediate cause of some of the most beautiful exhibitions of colour in nature.

The Formation of Pigments in Flowers

The apparent simplicity with which plants synthesise the pigments responsible for the infinite variety and gradations of colour effects stands in strong contrast to the laboured efforts of the chemist to manufacture artificial colouring matters. The processes by which pigments are produced, in common with the general life processes of plants, are, however, complex and do not always receive from chemists the attention and study they merit. It is fitting, therefore, to indicate briefly the function which enzymes perform in the formation of flower pigments, since, although there are other important questions pertaining to this study, the rôle of oxidases has been determined with care and precision.

Pick, in 1883, first suggested the hypothesis that oxidases are concerned in the formation of pigments in plants, and several observers have supported this theory. In 1910 Miss Wheldale suggested that the colourless chromogen by the oxidation of which a pigment is produced, occurs in the plant in the form of a glucoside. Enzymes of the emulsin type hydrolyse the glucoside, itself resistant to oxidation, and the free chromogen is then oxidised by atmospheric oxygen, activated by an oxydase.

The definite proof of the intimate connexion between the presence of oxydases and the formation of pigments in the various parts of the plant has been afforded by the work of F. Keeble and E. F. Armstrong (*Journal of Genetics*, 1912, II., 277). The isolation of *glucosides* as the principal constituents of the anthocyan pigments may demand a modification of the hypothesis of Miss Wheldale (or, alternatively, it is conceivable that the pigment produced according to this view of the process, may subsequently combine with a sugar through the synthetic influences of enzymes), but in any case, the explanation of the function of oxydases is secure upon the basis of the work of Keeble and Armstrong.

These investigators first established a reliable test for the presence of oxydases (and peroxydases). Alcoholic solutions of benzidine and α-naphthol were found to give specific colour reactions with oxydases, the petal or other part of the plant being first decolourised by the reagent and then stained a rich dark brown when benzidine was used, α-naphthol producing a lilac blue or lavender. The addition of hydrogen peroxide may be required, and in some instances with benzidine, a temporary blue or blue-green colour may form prior to the development of the characteristic brown formed in the cell structure. Benzidine, moreover, registers the presence of oxydases in the epidermis of the petal, whilst both benzidine and α-naphthol react with oxydases present in the cells constituting the bundle sheaths. It is emphasised, too, that negative results must be accepted with caution, for, as will appear later, certain flowers contain inhibiting substances, which prevent the formation of the characteristic test colours.

With the aid of this valuable test, it has been clearly demonstrated that, in general, the distribution of pigments in flowers coincides exactly with that of oxydases. The oxydases, it is true, are more widely distributed than are the chromogens, but the distribution is in conformity with the oxydase-chromogen hypothesis, as will be illustrated by several typical examples, culled from the many available in the paper noted.

The flowers of *Primula sinensis* and of *Dianthus barbatus* (Sweet William) show most epidermal oxydase in the most deeply coloured varieties, less in the less deeply coloured, and none at all in the white varieties. The white flowers of certain *Primula sinensis*, *Pisum sativum* and *Lathyrus odoratus* have all been shown to contain oxydases, and the white colour is attributed to the absence of chromogen. In the Mont Blanc Star, the distribution of oxydase again parallels that of pigment. One flower had irregular magenta flaked petals with one exception, this particular petal being of a uniform magenta colour. The latter petal gave a well marked oxydase reaction, the magenta patches on the others demonstrated a fair reaction, whilst the white portions did not respond to the test.

Similarly Sweet Williams were grown in full coloured, white and almost white varieties, the latter showing rosy dots or lines. The fully-coloured flowers responded definitely to the tests for the presence of oxydases, whilst the white flowers also gave a definite, but limited reaction—the white colour being probably due, as explained above, to the absence of chromogen. The white flowers with rosy dots showed oxydases only in the parts of the petals corresponding to the pigmented dots.

Space forbids a full discussion of the interesting subject of inhibitors, and it must suffice to say that reagents were discovered, such as hydrocyanic acid solution, and carbon dioxide solution, which destroyed the influence of these substances, and allowed the oxydases present to respond to the specific tests noted. The investigations upon white primulas, and specially cultivated varieties possessing white zones upon a blue ground, and on other white flowers, which are also known by breeding records to be in the class of dominant whites conclusively support the Mendelian hypothesis that the dominant white flowers contain no pigment, by reason of the presence of inhibitors of pigment formation. Inhibition is exercised upon the oxydases and not upon the processes which result in chromogen formation. Again, the inhibitors, as the name implies, do not destroy the oxydases, but merely interfere with their otherwise normal activity.

The recessive white varieties are those, noted above, which owe their lack of pigment to the absence of chromogen and not of oxydase.

Although the questions of localisation of oxydases, effects of light and darkness upon the development of oxydases and other vitally important matters cannot be discussed here, enough has been written to indicate the accuracy of the views of Armstrong and Keeble on the important *rôle* of oxydases (and peroxydases) in the formation of flower pigments. Much remains to be done before the full mechanism of the life processes of the plant responsible for colour development is revealed, but an important step forward has been made.

It only remains to be added that substantial confirmation of the views of Armstrong and Keeble has been forthcoming in the work of Atkins, as reported in the *Scientific Proceedings* of the Royal Dublin Society. This investigator has shown the presence of oxydases and inhibitors in the petals of the iris, the colours of which are due to the presence of a yellow plastic pigment and an anthocyan or anthocyans. The general distribution of enzyme and pigment in the iris resembles that in *Primula sinensis*.

THE ESTIMATION OF HYDROSULPHITE

Messrs. Brotherton and Co., Ltd., the makers of "Hydros" (sodium hydrosulphite), have sent us the following method of quantitative estimation which will be of interest to our readers.

The great advantage of the method described below is that the results are not affected by oxygen in the water used in the analysis. It must not be used for analysing Hydros containing decomposition products or soda ash.

Theory of the Process

A mixture of hydrogen iodide and hydrogen iodate in solution decomposes at once, giving free iodine :—

$$HIO_3+5HI=3I_2+3H_2O.$$

A mixture of potassium iodide and iodate can, therefore, be used to measure the hydrion of the bisulphite formed when "Hydros" oxidises potassium iodate :—

$$3Na_2S_2O_4+KIO_3+3H_2O=KI+6NaHSO_3.$$

$$6NaHSO_3+KIO_3+5KI=3I_2+3H_2O+3Na_2SO_3+3K_2SO_3.$$

The sulphite formed in the reactions above is oxidised by the free iodine :—

$$3Na_2SO_3+3K_2SO_3+6H_2O+6I_2=3Na_2SO_4+3K_2SO_4+12HI.$$

The hydrogen iodide, however, reacts with more of the iodide-iodate mixture and liberates a further six molecules of free iodine, so that the oxidation of the sulphites may be ignored :—

$$12HI+2KIO_3=2KI+6I_2+6H_2O.$$

The effect of "Hydros" on a mixture of potassium iodate and iodide is, therefore :—

$$3Na_2S_2O_4+4KIO_3+2KI=3I_2+3Na_2SO_4+3K_2SO_4.$$

The "Hydros" liberates its equivalent of iodine, and this iodine is measured by titration with standard thiosulphate.

Analytical Details

A litre flask is about half filled with water, and 6 gms. of potassium iodate, together with 10 gms. of potassium iodide, are added and dissolved. These quantities are approximate, but more rather than less should be used. 300 c.c. of *N*/10 thiosulphate is added from a pipette, and the flask filled to within about 50 c.c. of the mark. About 2 gms. of Hydros are accurately weighed in a weighing bottle, and poured into the flask through a perfectly dry funnel with a short wide neck. The flask is first shaken so as to impart a whirling motion to the liquid, then the flask and funnel are inclined to meet the weighing bottle, so that when the latter is completely inverted the funnel seals its mouth. This prevents the loss of any fine particles of Hydros in the form of a cloud. The flask is then filled up to the mark, stoppered and shaken till the Hydros is dissolved. The empty weighing bottle is reweighed, and the weight of the Hydros is determined by difference.

The excess of thiosulphate is measured by titration (100 c.c. at a time), with standard *N*/10 iodine.

Caution.—It is essential that in the weighing the Hydros be transferred from the sample bottle to the weighing bottle with a spatula, and not poured from one to the other. In the latter case a partial separation of the salt, generally used as a diluent, occurs, and the results are always too low, often by several units per cent.

Calculation

Weight of Hydros taken = 2·0136 gms.

Mean titration = 7·24 c.c.

N/10 iodine used to titrate complete litre = 10 × 7·24 = 72·4 c.c.

∴ *N*/10 thiosulphate left after dissolving Hydros = 72·4 c.c.

∴ *N*/10 thiosulphate absorbed in Hydros reaction = (300—72·4) = 227·6 c.c.

Molecular weight of Hydros = 174.

∴ Percentage of Hydros =

$$\frac{174}{2} \times \frac{227{\cdot}6 \times 100}{10{,}000 \times 2{\cdot}0136} = 98{\cdot}34\%$$

SOCIETY OF CHEMICAL INDUSTRY

MEETING OF COUNCIL

The monthly meeting of Council was held on November 9, 1923, the President, Dr. E. F. Armstrong, F.R.S., in the Chair.

It was reported that the Council of the Chemical Society had approved the formation of the proposed Bureau of Chemical Abstracts and had nominated as its representatives on the Joint Committee Dr. Irvine Masson, Prof. G. T. Morgan, Prof. J. F. Thorpe, and Prof. W. P. Wynne. It had also approved the principles involved in the proposals for giving facilities to the members of each Society to acquire the publications of the other Society and for offering further inducements to chemists to join both Societies, and had remitted the discussion of details to a Committee of the Council.

It was decided to supply members of the Institution of Chemical Engineers who are not members of the Society of Chemical Industry with copies of *Chemistry and Industry* on certain terms, it being agreed that the Journal of the Society should become the official organ of the Institution.

It was decided to join in a scheme promoted by the Institute of Journalists for a Trade and Technical Journals Section at the British Empire Exhibition, 1924.

In furtherance of a scheme of co-operation between the Society of Chemical Industry and the Chemical Society, it was decided to supply Fellows of the latter Society with the Abstracts of the Society of Chemical Industry at the price of £1 10s. per annum, provided that a reciprocal arrangement be agreed to by the Chemical Society. It was further decided to supply Fellows of the Chemical Society with *Chemistry and Industry* at £1 per annum, with the additional provision that Fellows taking both the Abstracts and *Chemistry and Industry* shall pay the reduced annual sum of £2.

The Council agreed to the principle of the proposal that a reduction in the entrance fees should be made to anyone who shall join the two Societies.

Reports of various Committees of the Council were submitted and 15 new members (Home 12, Overseas 3) were elected.

It was intimated that at next meeting nominations would be received for the appointment of the Messel lecturer for 1924.

Prof. J. W. Hinchley was appointed one of the Society's representatives on the General Board of the National Physical Laboratory in room of Prof. F. G. Donnan who retires by seniority.

The date of the next Council meeting was fixed for Friday, December 14, 1923.

LIST OF MEMBERS ELECTED

November 9, 1923

Arkley, James, c/o Ritchie, 47, Polwarth Gardens, Edinburgh. Works Chemist.

Cory, Harold E. J., Kenwood, 10, Longlands Park Road, Sidcup, Kent. Technical Chemist.

Defries, Ralph, Sorbo Works, Woking. Technical Chemist.

Dewhurst, Milton, c/o White, Tomkins and Courage, Ltd., North Albert Works, Reigate, Surrey. Works Chemist.

Ferguson, Prof. John B., Chemical Building, University of Toronto, Toronto, Ont., Canada. Research Chemist.

Miller, Edgar C. L., The Library, Medical College of Virginia, Richmond, Virginia, U.S.A. Professor of Biochemistry.

Monsaroff, Boris, c/o Edwads and Edwards, Ltd., Leather Manufacturers, Woodbridge, Ont., Canada. Chemist.

Preston, James, 6, Dedridge Cottages, Mid-Calder, Scotland. Chemist.

Rowlands, John R., 25, Loughborough Road, West Bridgford, Nottingham. Chemist.

Silberrad, Charles A., Park House, Combe Martin, N. Devon. Indian Civil Service (retired).

Sparks, James, 6, Park Row, Greenwich, London, S.E. 10. Works Chemist.

Stevenson, Michael, c/o G. F. Merson, Ltd., St. John's Hill Works, Edinburgh. Technical Chemist.

Taylor, Colin K., 21, Cromwell Road, South Kensington, London, S.W. 7. Student.

Warner, Bertrand T., c/o Borax Consolidated, Ltd., 16, Eastcheap, London, E.C. 3. Pharmaceutical Chemist.

Woolcott, Herbert, Messrs. H. and G. Simonds, Ltd., The Brewery, Reading. Chemist.

ANNUAL REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY

Vol. VIII is now in preparation and will be issued early in 1924. The price of the book is 7s. 6d. to members of the Society, and 12s. 6d. to non-members. Vol. I is out of print, but copies of Vols. II, III, IV, V, VI, and VII may be obtained by members at 4s. 6d., 5s. 6d., 5s. 6d., 8s. 3d., 7s. 6d., and 7s. 6d., and by non-members at 7s. 6d., 10s. 6d., 12s. 6d., 15s., 12s. 6d. and 12s. 6d. respectively. If Vols. II, III, IV, V, VI, and VII are ordered at the same time as Vol. VIII, the set may be obtained by members for £2 2s. 6d., and by non-members for £3 15s. The appropriate remittance must accompany every order. The books are sent to purchasers post free.

CHEMICAL ENGINEERING GROUP

The first meeting for the session was held at the Chemical Industry Club, on November 16. Mr. J. Arthur Reavell occupied the chair, and Professor J. W. Hinchley gave a very interesting paper entitled "A New Source of Potash and its Industrial Exploitation."

Professor Hinchley pointed out that hitherto Germany had been the main source of potash supply, but since the war methods had been developed for obtaining potash from the mineral leucite, a rare mineral except along the line of Italian volcanoes, where it is characteristic of the lavas. The pure mineral contains 21·5 per cent. potash, 23·5 per cent. alumina and 55 per cent. of silica. Very large quantities of this mineral are found near the craters of extinct volcanoes which lie on a line extending from Orvieto to Naples, a distance of 186 miles. At present this mineral is being worked at the edge of the crater of the extinct Rocca Monfina volcano, where it is found in a very pure form. This deposit lies about 30 miles north of Naples, and about 12 miles from the seaport of Scauri. The land gradually declines from the edge of the crater to the coast and would therefore permit of easy transport of the material from the workings to the ship by a telpherage system.

It is estimated that the igneous rocks of this particular volcano, which cover an area of 80 square miles, contain 1,008,000,000 metric tons of potash and that in this deposit alone there is sufficient material to give at the present rate of consumption at least 500 years' world supply of potash, and that this could be obtained at no greater cost than that required for the working of the Stassfurt deposits. Over the whole range of these Italian volcanoes it is calculated that the leucitic lavas contain at least 8,786,000,000 metric tons of potash, making them the greatest accumulation of rich potash silica rocks known. Professor Hinchley visited these workings and found that the mineral occurs very near the earth's surface, and an examination of samples which he took at distances of half a mile apart reveals practically no difference in chemical content.

The development of this industry in Italy has been due to Baron Blanc, who, in spite of considerable opposition and difficulties, has been able to bring the processes to a state of commercial utility.

After mining the mineral is crushed into particles having an average size of one-sixteenth of an inch. During this stage a considerable amount of fine dust is produced, and this has been found useful as a fertiliser. The gangue contains a small amount of iron whose presence permits of its separation electromagnetically.

The separated mineral may be treated by many processes. In one process sulphuric acid is made to flow through a bed of leucite, the strength of the acid being gradually increased until the whole of the potash and alumina have been taken up. This treatment takes from two to three hours and is accompanied by a considerable rise in temperature. The saturated solution thus obtained is then allowed to cool from 75° C. and the potash alum crystallises out. If before crystallisation the saturated solution is passed through a fresh bed of leucite, any traces of iron present will be removed. The silica which is left in the treatment chamber is removed by an ejector and can be converted into sodium or potassium silicate by the simple treatment with caustic soda or caustic potash solution of suitable strength.

Another process consists in treating the bed of leucite with mother liquor and hydrochloric acid gas, when a solution of potassium and aluminium chloride is produced, which on cooling from 90° C., the temperature produced by the reaction, throws down the potash in the form of potassium chloride. The liquor is next treated with hydrochloric acid gas in the cold, when hydrated aluminium chloride is precipitated. The mother liquor after this precipitation is again used in the treatment of fresh leucite. The hydrated aluminium chloride passes into an inclined rotary kiln made of aluminium, where it is heated to 300° C. At this temperature hydrochloric acid gas is evolved, and this is carried back for further use on the fresh leucite in the extraction plant. Hydrated aluminium oxide is the solid product obtained from the kiln.

A third method, devised by Baron Blanc, assisted by M. Felix Jourdan, consists in treating the leucite with slaked lime in an autoclave for three hours at a pressure of about 200 lb. per square inch. The liquid produced is used in the similar treatment of a second batch of leucite and ultimately a 12 per cent. solution of caustic potash is obtained. The residue from the autoclaves has been found to make an excellent cement.

In conclusion, Professor Hinchley said he had introduced to the notice of the group a material which the chemical industry of this country cannot afford to neglect, and he hoped that before long he would be able to give the second part of the paper.

During the discussion, in which Messrs. Ormandy, Voelcker, Scholtz, Macnab, and Tripp took part, various aspects of the uses of the mineral and the products derived therefrom were discussed. Professor Hinchley replied to various points raised by the speakers and expressed his regret that time did not permit him to give a thorough description of the plants used, together with the balance sheets relating to their working. Mr. Reavell, in proposing a vote of thanks to Prof. Hinchley, suggested that such a paper should be given at a subsequent meeting of the group to be held at an early date.

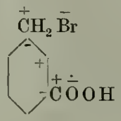
EDINBURGH AND EAST OF SCOTLAND SECTION

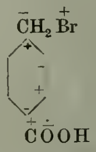
The second ordinary meeting took place on November 14 in the Hall of the Pharmaceutical Society, Edinburgh, Dr. H. E. Watt in the chair. This meeting was held under the scheme for co-operation with the Chemical Society. There was a good attendance of members and fellows of both societies.

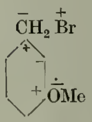
Mr. Teijiro Yabuta contributed a paper on "The Constitution of Kojic Acid, a pyrone derivative formed by *Asperigillus Oryzae* from carbohydrates." By the action of thionyl chloride on kojic acid, and subsequent reduction, the alcoholic hydroxyl is replaced by hydrogen, and a hydroxymethylpyrone results, *allo*maltol, isomeric both with maltol (Brand, *Ber.*, 1894, **27**, 806; Kiliani and Bazlen, *ibid.* p. 3115; Feuerstein *ibid.* 1901, **34**, 1804) and with *iso*-maltol (Backe, *Compt. Rend.*, 1910, **150**, 540, **151**, 78). *Allo*maltol can be transformed to 3 : 4 dihydroxy-6-picoline, which is a reduction product of comenamic acid (Bellmann, *J. prakt. Chem.*, 1884, **29**, 14). This shows that kojic acid is the alcohol corresponding to comenic acid, and is therefore 3-hydroxy-6-hydroxymethylpyrone, in accordance with the view previously expressed by the author on other grounds (*J. Chem. Soc. Tokyo*, 1916, **37**, 1185; A., 1922, i, 939). The relationship between kojic and comenic acids thus indirectly established, could not be demonstrated by direct interconversion in spite of numerous oxidation and reduction experiments. The instability of the pyrone nucleus, for instance, prevented the successful application of Rosenmund's method to the acid chloride of comenic acid.

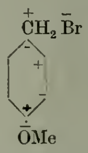
"The Reduction of the Mono-halogenated Phenols" was described in a paper by J. B. Shoesmith, M.Sc., and R. H. Slater, B.Sc., who applied the method employed to show that the halogen in *m*-methoxybenzyl bromide has acquired an induced positive polarity to the systematic investigation of the halogenated phenols. It was found, as was expected, that the order of reducibility would be *p*-Hal and *o*-Hal > *m*-Hal. The iodo compounds were reduced at 25° C. in glacial acetic acid solution by hydriodic acid; the bromo compounds were reduced at a higher temperature—namely, 78° C. The order in which the compounds reduce was $p\,\mathrm{I} > o\mathrm{I} > p\,\mathrm{Br} > o\mathrm{Br} > p\,\mathrm{Cl}$. The chloro compounds did not show much tendency to reduce. 4-Iodoresorcinol reduced rapidly under all conditions studied. Modified methods for preparing *m*-halogenated anilines were given.

In a paper on "Polarity Effects in the Isomeric ω-Bromo Toluic Acids," J. B. Shoesmith, M.Sc., and A. C. Hetherington, B.Sc., showed that reactivity in a molecule is mainly the result of (*a*) general polar influences, (*b*) spatial and steric influences, and (*c*) induced polar influences. In order to compare induced polarity effects in the aromatic series, effects due to (*a*) and (*b*) were minimised by the investigation of *m*- and *p*-isomerides. As a result of an application of the principle of induced alternate polarities to the case of the isomeric ω-bromo toluic acids it was anticipated that the ease of hydrolysis would be in the order $m > p$ and of reduction $p > m$, the reverse of such effects in the methoxybenzyl bromides.









The anticipated order was that discovered by experiment. The abnormal behaviour of the ortho isomeride is due to effects which were to be grouped under (*b*). The hydrolyses were carried out in aqueous alcoholic solution at 76° and the reduction in aqueous hydriodic acid—acetic acid solution at 110°.

SHAWINIGAN FALLS SECTION

A meeting was held at the Cascade Inn on October 15. Dr. F. W. Skirrow presided in the absence of Mr. R. A. Witherspoon, the chairman. A motion was passed continuing the officers elected in 1922-23 for another year.

The Shawinigan Section intends to hold monthly meetings during the winter, which will be of an informal nature and consist for the most part of the reading of papers by local men.

A very interesting paper by Mr. S. A. Wisdom was read, entitled "Carbon Black." Mr. Wisdom has been employed for some time by the Canada Carbide Company on research work in connexion with the manufacture of carbon black from acetylene, and is now operating a fair sized plant for its production in commercial quantity. On account of the patent situation, it was impossible to give much information on carbon black from acetylene, but the writer described in an interesting manner its manufacture in the ordinary way by incomplete combustion of natural gas. The manufacture of this valuable product permits the utilisation of natural-gas deposits in remote places which would be otherwise useless on account of the prohibitive cost of piping to industrial centres. The low cost of the plant allows it to be dismantled in case the well runs out, and moved to a new locality.

Carbon black has the property of extreme fineness, and possibly shows the greatest state of subdivision of any known solid. Its principal use is as a filler for rubber in automobile tyres, and to some extent in other kinds of rubber goods. It differs from other fillers in that it not only acts as a diluent but also imparts valuable properties to the rubber, making it wear longer, preventing hardening and cracking, and reducing its tendency to slip on a wet surface. On this account its use in pneumatic tyres had become almost universal.

TORONTO SECTION

The first meeting of the session was held on October 23, the attendance at the dinner being thirty-nine, and at the business meeting and address over a hundred. The local paint and varnish industry was well represented.

Mr. H. Green, of the New Jersey Zinc Co., spoke on " The Structure of Paint," illustrating his address by photomicrographs showing the nature of the particles and the manner in which they are suspended in paint. The many fine photomicrographs, which were taken with the aid of ultra-violet light, were much admired.

LIVERPOOL SECTION

The inaugural meeting of the session was held in the rooms of the Overseas League on November 16. The President of the Society, Dr. E. F. Armstrong, F.R.S., occupied the chair at the commencement of the proceedings, and referred to the deaths of Dr. E. K. Muspratt and Mr. H. S. Barker, votes of sympathy being passed in each case. Dr. J. T. Conroy was elected a trustee of the Hurter Memorial Fund in place of the late Mr. A. Carey. The chairman, Mr. Edwin Thompson, then delivered his address on " Our Water Supplies," which will appear in the forthcoming issue of *Chemistry and Industry*.

OTTAWA SECTION

There was an attendance of forty-two at the meeting held in the University Club on November 3, Dr. A. E. Macintyre in the chair. After the programme for the session had been outlined, Colonel Janson and Mr. R. T. Elworthy were appointed auditors, and the chairman then gave his address on " Education in Relation to Science."

There are two classes of learned men, he said : those who gather knowledge and seclude it, and those who disseminate it for the benefit of their fellows. The scientist belonged to the latter class. He did not appeal to the ordinary writer as a rule and his contributions were not literary art, but scientific prose containing accurate statements. Many scientists had been very able writers, and the inability of many persons to understand scientific authors was due to faulty education. Science demanded truth of its followers, and " about " or " near " did not satisfy the scientist. Reference was made to the statement of Premier Ferguson that our schools taught the youngsters to remember rather than think. Such a system would never develop a body of scientists with original and progressive ideas, and research of a high order could not be expected. In referring to recent criticism of American Universities, which appeared to be justified, it was pointed out that, although America produced over 85 per cent. of the world's output of non-benzenoid hydrocarbons, practically all the chemical research on these compounds had been performed by European chemists. The speaker emphatically stated that the text-books were playing too great a part in the education of the scientist to-day, and advised students to consult the original contributions. The value of reading was emphasized, but it was pointed out that literacy was not education, but merely an instrument by which it could be obtained. The mechanical and logical phases of memory were explained and the great value of imagination, one of the chief assets of the scientist, was pointed out. Whereas Capital and Labour generally considered that they alone created wealth, it was stated that their role was much inferior in its creation to that of mind. In closing his address, Dr. Macintyre urged chemists to apply to the study of science the injunction, " Read, mark, learn and inwardly digest."

Dr. Shutt thought that we were perhaps too ready to blame our educational system for the failure to develop more outstanding chemists, whereas the fundamental underlying real success was love and enthusiasm for the science of chemistry. Mr. Connor thought our educational system tended to develop too many men whom he referred to as " rough lumber." Mr. Peak suggested that a man might know so much as to be of no value to a firm. Any process of education, he thought, must develop reason which would give the individual pleasure in its use. Many people were not qualified by nature to acquire a scientific education. Mr. Hambly said that learning to digest our reading was most important, and that men of pre-eminence in science did not confine their reading to their particular subject. Dr. Atack referred to the attachment of some men to recipes and found that such men frequently were given appointments on the basis of this qualification. Journal reading, he thought, should be followed with caution in order not to clog the brain, but leave it free to think. He suggested " read as much as possible, forget most of it, but remember where to get it." He stressed the value of imagination, and thought that probably the accumulation of so much scientific knowledge in Britain was due to the fact that many chemists may exist in colleges there at research work on a mere pittance. Dr. Macintyre replied briefly to the points raised in discussion.

FORTHCOMING EVENTS

Nov. 26. The Royal Scottish Society of Arts, 117, George Street, Edinburgh, at 8 p.m. "The Development of the Supply of Electricity in Edinburgh and a Description of the New Generating Station," by F. A. Newington, M.Inst.C.E.

Nov. 27. Royal College of Science Chemical Society. Joint Meeting with the Royal School of Mines Metallurgical Society, The Royal College of Science, South Kensington, S.W. 7, at 5 p.m. "Metallurgical Processes in use at the Mint," by Sir T. Kirke Rose, D.Sc., A.R.S.M.

Nov. 27. The Optical Society, Imperial College of Science and Technology, South Kensington, S.W. 7, at 8 p.m. The 1923 Thomas Young Oration, by Dr. M. von Rohr (Jena).

Nov. 27. Society of Chemical Industry, *Birmingham and Midland Section.* Dinner to be held at The White Horse Hotel, Congreve Street, Birmingham, at 6 p.m., followed by Meeting in the University Buildings, Edmund Street, at 7.15 p.m. (1) "Acceleration of Vulcanisation by Xanthates, and the Influence of Metallic Oxides as Activators," by D. F. Twiss and F. Thomas. (2) "An Important Variable in Raw Rubber," by D. F. Twiss and F. B. Jones.

Nov. 28. Royal Microscopical Society, *The Industrial Applications Section*, 20, Hanover Square, W. 1, at 7.30 p.m. "The Characteristics of a Microscope for General and Special Purposes," by J. E. Barnard, F.Inst.P.; "The Application of the Microscope to Industrial Diseases," by Dr. S. H. Browning, L.R.C.P. "The Microscope in the Examination of Condensed Milk," by C. A. Newton.

Nov. 29. Institution of Mechanical Engineers, the Medical Theatre, Birmingham University. "Metal Rolling and the Influence of Cooling on Plastic Flow," by J. E. Fletcher.

Nov. 29. Institution of Mechanical Engineers, Engineers' Club, Albert Square, Manchester. Further Discussion on "Clyde Marine Oil-Engines," by Prof. A. L. Mellanby.

Nov. 30. Institution of Mechanical Engineers, Storey's Gate, London, S.W. 1, at 6 p.m. "Clyde Marine Oil-Engines," by A. L. Mellanby, D.Sc.

Nov. 30. The Manchester Literary and Philosophical Society, *Chemical Section*, at 7 p.m.

Nov. 30. The University of London, W.C. 1, at 8 p.m. "The Fundamental Concepts of Natural Science," by Prof. G. Dawes Hicks. (Lecture 5.)

Dec. 3. Birmingham University Chemical Society. Chemical Lecture Theatre, Edgbaston, Birmingham, at 5.30 p.m. Lecture by A. Appleyard, M.Sc.

CHEMICAL SOCIETY

An ordinary meeting was held on Thursday, November 15, 1923, at 8 p.m., the President, Professor W. P. Wynne, F.R.S., being in the chair.

The President announced the complete constitution of the new Bureau of Chemical Abstracts to be as follows: Chairman, Professor J. C. Philip, F.R.S.; representatives of the Chemical Society, Dr. I. Masson, Professor G. T. Morgan, F.R.S., Professor J. F. Thorpe, F.R.S., and Professor W. P. Wynne, F.R.S.; representatives of the Society of Chemical Industry, Dr. E. F. Armstrong, F.R.S., Mr. Julian L. Baker, Mr. E. V. Evans, and Sir William J. Pope, F.R.S. The Bureau had already met, and was making arrangements for the issue of Abstracts for 1924 in two sections, (*a*) Pure Chemistry, and (*b*) Applied Chemistry, although for that year these sections would be practically of the same forms as those at present issued by the two societies. An agreement had also been reached whereby Members of the Society of Chemical Industry may procure the former section for 1924 for the sum of £1 10s., and Fellows of the Chemical Society (on application to the Society of Chemical Industry) can obtain *Chemistry and Industry* for 1924 for the sum of £1 and the latter section of Abstracts for £1 10s., or, alternatively, both these publications for 1924 for £2.

Fellows were also informed of a resolution of the Council to the effect that no publications for 1924 other than the *Journal* (containing thenceforth only the original papers communicated to the Society) would be sent to those Fellows who had not made application to the contrary by December 31, 1923. It was urged that replies to the circulars on this subject should be forwarded immediately, for only in the case of Fellows resident abroad could any extension of this period be considered.

In a further announcement, concerning the Harrison Memorial Prize, the President said that in accordance with the trust deed governing the Harrison Memorial Fund, a selection committee, consisting of the presidents of the Chemical Society, the Society of Chemical Industry, the Institute of Chemistry, and the Pharmaceutical Society, would shortly meet to consider the first award. The prize, which is of the value of about £150, is to be awarded to the chemist who, being of either sex, a natural-born British subject, and not at the time over thirty years of age, should be judged by the Selection Committee to have conducted during the previous five years the most meritorious and promising original investigations in any branch of pure or applied chemistry; the results of those investigations to have been published in a scientific periodical or periodicals. Provided that there is a candidate of sufficient distinction, an award would be made for the first time in December, 1923, and the President of the Chemical Society, on behalf of the Selection Committee, was prepared to receive applications, nominations, or information in connection therewith not later than Monday, December 10, 1923.

In the first paper, Dr. C. K. Ingold entered into the mathematical basis of the authors' views on the mutarotation of sugars, the position being summarised by the authors as follows :—

Ring-chain tautomerism. Dynamical evidence relating to the mutarotation of the sugars.
J. W. Baker, C. K. Ingold, and J. F. Thorpe.

FINAL proof of the incorrectness of the theory that water intervenes in the mutarotation of sugars—a theory suggested, for example, by Lowry, and accepted by most sugar chemists at the present time—can be obtained by studying the dynamics of the process. A paper on the mechanism of mutarotation, dealing not only with dynamical, but also with structural and other aspects of the problem, was read to the Society earlier in the year, and it was shown that the mutarotation-time curves have (*a*) a form ; (*b*) a spacing, on the mutarotation-time-concentration diagram, which are entirely at variance with the dynamical consequences of the intermediate-hydrate theory, but are in complete agreement with the hypothesis of ring-chain tautomerism, to which structural evidence also points. When this paper was read the criticism was raised that the derivation of the dynamical consequences of the hydrate theory was based on a fallacy. The authors do not accept this finding. The derivation given was admittedly an approximate one and was incorporated in the paper on account of its simplicity. However, private correspondence having failed to produce agreement on this point, they have now decided to present to the Society the complete mathematical analysis on which their conclusions were based.

Professor T. M. Lowry, F.R.S., said that he had not the slightest difficulty in accepting the suggestion that mutarotation in the sugar series might be due to a reversible acetal condensation. He had himself in 1899 (*T.*, 75, 213) been the first to suggest that this mutarotation might be due to isomeric change, instead of to hydration (Emil Fischer's theory) or to the breaking up of a complex " crystal molecule " as suggested by still earlier workers. Further, he had in 1903 (*T.*, 83, 1316) and, again, in 1904 (*T.*, **85**, 1569) made the concrete suggestion that the intermediate form in the interconversion of the stereoisomeric glucosidic forms of the sugars was probably " the aldehydic form of the sugar or its hydrate." The former of these two suggestions had been adopted by the authors, and to this the speaker raised no objection whatever.

He was, however, completely at variance with them in their assertion that water does not intervene in the mutarotation of the sugars, since mutarotation in aqueous solutions is approximately 200 times more rapid than in the cases studied by them. The authors' calculations had, on the contrary, led them to conclude that the velocity change should be independent of the concentration of water in the solvent, not only when the water was present in mere traces, but also over a wider range. This result was obviously incorrect for solutions containing much water ; and, at the other extreme, if Bakerian dryness could be obtained in a solution it would probably likewise be incorrect, since facile isomeric changes, such as those of nitrocamphor and ethyl acetoacetate, had been arrested by careful purification, and there was no reason to suppose that the sugars would behave differently. There was also evidence from measurements of solubility (*T.*, **85**, 1581) which suggested very strongly that the intermediate compound was increased in quantity by the addition of water, and was therefore probably hydrated. Whilst, therefore, the reversible acetal condensation provided a possible mechanism for isomeric change in the sugar series, there was no experimental basis whatever for the assertion that it was the only mechanism that was possible even when large quantities of water were present

Dr. T. Slater Price confessed that he had been the innocent cause of the " heavy gunfire " of mathematics to which they had been subjected; despite correspondence with Dr. Ingold he had been unable to agree that the conclusions which had been originally drawn rested on an unassailable mathematical foundation. It was, however, manifestly impossible to criticise " on sight " an analysis (although this led to the same conclusions) which had taken some weeks to evolve, and in regard to it he had an open mind.

Dr. H. Weiss, Professors W. N. Haworth, H. E. Armstrong, F.R.S., and J. F. Thorpe, F.R.S., contributed to the discussion.

Dr. Ingold, in reply, said that nothing in the experiments affected the practical certainty, that no reaction would take place in complete absence of water. All that had been shown was that if water plays a part, it does not act *by adding on and splitting off again.* The mode of action of catalysis by water was unknown, but he considered that no special catalysis of this kind superimposed on the dynamical consequences of the hydrate theory could reinstate the latter, because this would here involve the incorrect assumption of negative catalytic influence. Professor Lowry had suggested possible complications arising from a competition between the carbonyl group of the second solvent (ethyl acetate in one set of experiments) and that of the sugar, for the added water. Apart from the fact that the same effects were observed in solvents which do not possess a carbonyl group, such a condition would cause the velocity constant to decrease with decreasing water content more rapidly than would correspond with direct proportionality, instead of less rapidly as suggested by Professor Lowry.

The evidence from solubility measurements that there is an intermediate substance between α- and β-sugar was of interest, but such measurements did not distinguish between a hydrate and an isomeric aldo-form.

The speaker disclaimed any suggestion that the authors had originated a theory of mutarotation, the credit for the ring chain tautomerism theory being ascribed entirely to Jacobsen and Stelzner; and he gathered, from what had been said, that Professor Lowry still adheres to his 1903 paper, despite his 1899 paper.

The following are abstracts of investigations which were described by Dr. G. Shearer:—

An X-ray investigation of certain organic esters, and other long chain compounds. G. Shearer.

This work extends that of Müller on the normal fatty acids (*T.*, 1923, **123**, 2043). By means of an accurate X-ray reflexion method, measurements have been made upon solid crystalline films of methyl, ethyl, octyl, and cetyl palmitates, of methyl and ethyl stearates, of *p*-hexadecylphenol, *p*-octadecylphenol, and of octadecylbenzene. As in Müller's experiments, very good reflexions are obtained from what are probably the crystal cleavage-planes, the distances or "spacings" between which can thus be determined. These are given in the paper. The cleavage spacings of the palmitic esters increase regularly with the number of carbon atoms in the alkyl group; and the increment per carbon atom of the chemical formula is the same for these esters as for the two stearates studied, namely, 1·22 Å.U. for each CH_2 of the *alkyl* radicle. When the palmitic and stearic esters of a given alkyl radicle are compared, the increment in spacing per CH_2 of the *acid* radicle is found to be 1·0. This figure agrees with Müller's value of 2·0 in the case of the free fatty acids, if his assumption is adopted that there are two molecules end-to-end between the cleavage planes of the free acids, and if only one be allowed in the cell of the esters. The accepted and independently measured "diameter" of the carbon atom is 1·5 Å.U. In order that chains, built of atoms of this diameter, shall have the perpendicular distance of 1·22 Å.U. between contiguous carbon atoms, which is shown to prevail in the alkyl chains, it is necessary, either that the chains shall be tilted at an angle to the cleavage planes, or else, if their lengths are perpendicular to the planes, that the carbon atoms should be linked spirally or zig-zag. On the latter idea, the angle between neighbouring carbon atoms would be given by $\sin \theta/2 = 1{\cdot}22/1{\cdot}50$, or $\theta = 109{\cdot}3^\circ$; which agrees with the tetrahedral angle. In the alkyl phenols and alkyl benzene, it seems that there is a pair of molecules, end-on, in the cell; in this case the increment due to ·O· is of the expected order, as is that due to $\cdot CH_2\cdot$; but the exact value of the latter is not yet decided upon. It is possible to calculate with fair accuracy the observed cleavage spacings from the molecular formulæ, placing one or else two molecules between successive cleavage planes as already indicated, by using the independently-known "atomic radii," and by allowing that an acid radicle increases by 1·0 Å.U., an alkyl radicle by 1·22 Å.U., per CH_2 group; where necessary, W. H. Bragg's value for the dimensions of the benzene ring is also used.

Further X-ray measurements of long chain compounds, and a note on their interpretation. Alex. Müller and G. Shearer.

Data are first given for the cleavage spacings of undecylic, pentadecylic, and margaric acids; for oleic, elaidic, and *iso*-oleic acids; and for erucic and brassidic acids. As in the foregoing paper and in that of Müller (*loc. cit.*), two other observed sets of spacings are also recorded, which apparently correspond with the cross-sections of the molecules, since they are practically constant for all the substances concerned. The cleavage spacings of the "odd" fatty acids are nearly equal to those which would be interpolated from the spacings of the "even" members, but slightly exceed them.

A systematic exposition is given of the conclusions which can legitimately be drawn from these experiments. On the assumption that the tetrahedral angle is conserved, it is shown that, theoretically, only a very limited number of different types of periodic chain can be constructed. Two of these chains show average increases per CH_2 group, which agree excellently with the observed increases in the alkyl and acid radicles respectively, when the "diameter" of the carbon atom is given its generally accepted value. Other explanations are considered but are not found satisfactory. The interpretation is shown to be in agreement with the slightly anomalous lengths of the "odd" free acid molecules. In the case of stereoisomers of a given unsaturated acid, the observed differences, when expressed in terms of the two types of chain, lead to the inference of cis-trans isomerism, and point to a definite attribution of structure as between the two isomers. The differences between corresponding saturated and unsaturated "straight-chain" acids are discussed.

Sir W. H. Bragg, F.R.S., offered his congratulations to the authors, and called attention to the parallel results which were being obtained relative to the length of the molecule and the structure of the chain by investigations of films of various organic compounds on water. The assumption that the general line of the molecule is perpendicular to the surface was justified by the results. If the carbon tetrahedral angle was real, the number of types of chain admissible was limited to three, one of which would lead to optical activity; the others were those which now received experimental justification.

Professor Armstrong's question whether any considerable interval was observed before the stable condition was reached was answered in the negative.

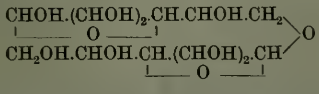
Mr. N. K. Adam observed that Dr. Shearer's results showed the existence of two packings of different densities, and consequently no safe deductions as to the length of a molecule, involving an assumption that the film-density equals the liquid density, could be made from measurements of cross-section alone. In some recent experiments no substantial difference could be detected between the cross-sectional areas of alcoholic and acidic chains in surface films; lengthening the chains by one or more CH_2 groups increased the lateral attraction between the chains by the same amount in each type of chain. There seemed to be no reason, however, why the two types of chain suggested should not have nearly identical properties in these two respects. From a consideration of regularities in the melting points, the speaker had already predicted, for the crystals of fatty acids and their esters, a structure which was practically the same as that evolved from X-ray measurements.

Dr. A. Müller said that much further work was requisite in order to study the effect of various groups. The consideration of compounds of the simpler types was meanwhile being undertaken.

Professor W. N. Haworth then gave an account of some further investigations in the domain of sugar-chemistry :—

The constitution of the disaccharides. Part IX. Gentiobiose. Its identity with amygdalin biose. W. N. Haworth and B. Wylam.

On hydrolysis of completely methylated gentiobiose, two partly methylated glucoses were isolated, which were identified as 2.3.5.6-tetramethylglucose and 2.3.5 trimethylglucose of the normal type. It follows, therefore, that gentiobiose possesses the same constitution as both maltose and amygdalin biose. Moreover, since the latter sugar contains a β-linking uniting the two glucose residues exactly as does gentiobiose it is now demonstrated that gentiobiose is the disaccharide which occurs in amygdalin, and is to be represented by the following structure :—

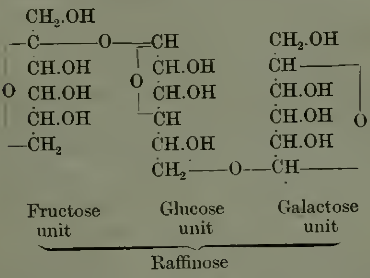


$$\begin{array}{l} \underbrace{\text{CHOH.(CHOH)}_2\text{.CH}}_{\text{O}}\text{.CHOH.CH}_2 \\ \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad > \text{O} \\ \text{CH}_2\text{OH.CHOH.}\underbrace{\text{CH.(CHOH)}_2\text{.CH}}_{\text{O}} \end{array}$$

Synthetic work which is in progress, directed to the synthesis of amygdalin, has also confirmed this result. The constitutional formula for the trisaccharide gentianose follows from this investigation.

The constitution of raffinose. W. N. Haworth, E. L. Hirst, and D. A. Ruell.

Raffinose, prepared from cotton seed meal, gave rise on methylation to hendecamethyl raffinose distilling at 238° C. /0·02 mm., and showing $[\alpha]_D = +128°$. Hydrolysis of this product with one per cent. hydrochloric acid at 90° C., led to the isolation of three partly methylated hexoses, which were recognised respectively as tetramethyl γ-fructose identical with that isolated from methylated sucrose, as 2.3.5-trimethyl glucose (butylene oxidic), which gave a crystalline methylglucoside melting at 94° C., and as a tetramethyl galactose, which gave a crystalline anilide identical with that prepared from methylated lactose. From a constitutional study of these cleavage products the following structural formula for raffinose is deduced :—



It would therefore appear that the constitution of melibiose is to be represented by a formula in which the glucose unit, through the hydroxyl group attached to its terminal carbon atom 6, is linked with the reducing group of galactose.

INSTITUTION OF CHEMICAL ENGINEERS

A meeting was held at the Engineers' Club, Piccadilly, W. 1, on November 14, Sir Arthur Duckham, K.B.E., the President, in the Chair. The President, in commenting on the value of formal meetings, said that the Council had not yet been able to complete arrangements for future meetings, whether formal or informal; there would, of course, be a formal annual meeting next year.

Mr. M. B. Donald then gave a short account of the paper by himself and Mr. C. W. Tyson, entitled "A Study of the Absorption Tower." In the preparation of sulphite liquor for use in the pulp industry, milk of lime is converted into bisulphites in a plate absorption tower, the additional sulphur dioxide being added in a tile tower. The object of the research was to ascertain the factors of the design of these towers and to determine the factors underlying the absorption of gases by liquids on a plant scale. The results of the investigation have already been published in the *Transactions* of the Institution of Chemical Engineers. An interesting discussion followed, the speakers including Prof. J. W. Hinchley, Sir A. Duckham, Prof. Williams and Messrs. T. C. Broomfield, Finlayson, Swinden and West.

The second paper, "A Study of the Conditions of Constant Rate of Flow in Filter Presses," by M. B. Donald and R. D. Hunneman, which was read in abstract by Mr. Donald, has also been published in the *Transactions* of the Institution. Mr. A. E. Alliott then raised a number of questions to which Mr. Donald replied.

THE CHEMICAL INDUSTRY CLUB

The Fifth Annual Meeting of the Chemical Industry Club was held in the Club Rooms, at 2, Whitehall Court, on Monday, November 12, Mr. A. Gordon Craig presiding. After the Report of the Executive Committee and the Accounts had been passed, Dr. W. R. Ormandy moved the election of Mr. J. Miller Jones and Dr. E. H. Tripp to the posts of honorary treasurer and honorary secretary, respectively. These appointments were approved unanimously, and hearty votes of thanks were accorded to the retiring officers, Mr. C. J. Goodwin and Mr. H. E. Coley. The Rules, as revised during the past year, mainly through the labours of Mr. W. Cullen and Dr. A. Rule, were approved. Under the new regulations the Club is empowered to elect a President and a Vice-president, to hold office for a period not exceeding two years, and Sir William Pope and Prof. W. R. E. Hodgkinson were elected to fill these positions. A vote of thanks to Mr. Craig for his services as Chairman of the Executive Committee during the past two years was passed with acclamation. Subsequently to the meeting the Executive Committee appointed Mr. H. E. Coley to be its chairman for the ensuing year.

The speakers at the Annual Dinner of the Club, to be held in the Connaught Rooms, W.C., on Monday, November 26, will include Sir Lionel Phillips, Sir Arthur Duckham, Mr. F. W. Harbord, and probably Sir John Cadman. A large gathering is already assured, and those who still require tickets (15s. each, inclusive of cocktails and tips) should apply without delay to the Secretary at 2, Whitehall Court.

At a recent meeting the Société Pathé Cinema announced that its factory for the manufacture of cinematograph films was now in working order in England.

ROYAL MICROSCOPICAL SOCIETY.

A meeting of the Industrial Applications Section was held on October 24, the president, Prof. F. J. Cheshire, in the chair.

Dr. Marie Stopes read a paper on "The Microscope as applied to Recent Coal Research," in which she gave a brief historical review of the application of the microscope to research on the intimate structure of coal, pointing out that the early workers like Dawson and Huxley tended to treat "coal" as if it were a uniform substance. But recent work had shown the importance of the physical, chemical and microscopic differences between the finer bands, even in the same lump of coal, where only a few millimetres apart one zone might show a preponderance of spores and another a preponderance of leaf or stem tissue, and another not any structure at all but a uniform glue-like texture. A brief summary of the rationale of this was given, based on the paper read before the Royal Society and published in 1919, when detailed descriptions, and diagnoses of fusain, durain, clarain and vitrain were first given. These four main types composing bituminous coal had since been the subject of a great deal of detailed chemical, physical and microscopical work. Recent very interesting work by Prof. Seyler had shown similar zones in anthracite by a method of examination by reflected light. Whilst we were still far from a really detailed knowledge of the actual nature of the ultimate compounds composing ordinary coal, this microscopic work in conjunction with detailed chemical research was actively being pursued and leading to very suggestive results.

The paper was followed by the first of a series of lecture demonstrations on the manipulation of the microscope. The first lecture dealt with the work-table of a microscopist who requires an ever-ready equipment; illuminants suitable for various classes of work were discussed.

PHYSICAL SOCIETY

The following papers were read at a recent meeting of the Physical Society:—

Dr. H. Chatley, D.Sc., described further work on cohesion, from which he concluded that the Born-Landé expression agrees with a linear expansion before rupture in solids of about 12 per cent. in any direction which conforms moderately well to the results of uni-directional tension experiments with non-plastic materials. The space-rate of change of compressibility deduced from the same expression was found to agree very fairly well with the experimental results obtained with fluids under high pressures.

Dr. E. A. Owen, M.A., and G. D. Preston, B.A., presented a paper on the "X-ray Analysis of Solid Solutions." The results obtained show that in solid solutions of copper-aluminium,

aluminium-magnesium and copper-nickel the solute atom replaces an atom in the lattice of the solvent. This substitution of atoms is accompanied in the cases examined by a distortion of the lattice, but the type of the lattice remains unaltered throughout a series of solid solutions until the limit of solid solubility is reached. In none of the cases examined was it found that the interstitial arrangement of atoms occurred, with the possible exception of copper-aluminium alloys rich in aluminium. In these alloys the atomic percentage of copper was so small that the accuracy of measurement was not sufficient to decide definitely between the two possible atomic arrangements. In the lattice suggested for the inter-metallic compound $CuAl_2$, the centres of the aluminium atoms are separated by 2·40A, which is smaller than the diameter of the atom (2·86A) deduced from the structure of pure aluminium. Similarly, the distance between the copper atoms, which is also 2.40A, is smaller than the atomic diameter of copper (2.54A) obtained from the pure element. A possible explanation of these results is that the atoms share electrons and are brought closer together than would otherwise be the case.

In a paper on "The Fine Structure of Some Sodium Salts of the Fatty Acids in Soap Curds," by S. H. Piper, B.Sc., and E. N. Grindley, B.Sc., experiments (not yet complete) were described which were originally undertaken to determine by X-ray methods whether the fibres observable in certain soap curds were crystalline in nature. X-ray photographs of certain sodium salts of the fatty acids (soap curds) were found to show lines due to reflections from planes with very wide spacings of the order 40 A.U. These planar spacings increase uniformly with the number of CH_2 groups in the molecule, indicating an effective length of 1·25 A.U. for the CH_2 group. These and other lines can be accounted for by assuming that the curds are in the smectic state described by Friedel.

A method of measuring the surface tension of a small quantity of liquid was described by Dr. A. Ferguson, M.A. If a small quantity of liquid—1 cb. millimetre or less—be placed in a vertical capillary tube, its surface tension may be ascertained by applying pressure to the upper end of the tube, and measuring the pressure necessary to force the liquid into such a position that the meniscus at the lower end of the tube is plane. Interfacial tensions may also be determined in this way.

S. P. Sharples, whose death at Cambridge, Mass., is reported, was professor of chemistry at Boston Dental College from 1875 to 1893 and did much work as a consultant. He was a member of the Society of Chemical Industry.

CORRESPONDENCE

ACTIVATED CARBON v. SILICA GEL

Sir,—In the issue of your *Journal* of September 7, 1923, under the caption, "The Use of Solid Absorbents," Mr. Rex Furness makes certain surprising statements as to the comparative merits of silica gel and activated carbon as gas absorbents for benzol and similar solvent recovery operations. These statements are explicable only upon the assumption that the disparity which existed during the war between the quality of British or Continental and American military adsorbent carbons—a disparity inherent in the processes of manufacture—still continues to characterise the commercial carbons made here and abroad. In other words, European and American activated carbons cannot be considered technical equivalents.

This explanation if true, however, scarcely justifies the reasoning by which Mr. Furness arrives at the astonishing conclusion that activated carbon is so inferior to silica gel as an industrial vapour adsorbent that its serious consideration is quite unnecessary.

He states that "The development of gas-absorption carbons or charcoals . . . . particularly during the later years of the world war has been paralleled only by the development of highly absorptive inorganic 'gels' such as silica gel . . . . and other compounds such as ferric hydroxide gel. The high efficiency naturally demanded when active carbon had to be used as a protection against toxic gases in the field has been equalled and even surpassed by that of silica gel and other inorganic absorbents."

The casual reader would naturally infer from these paragraphs that carbon and silica gel were twin brothers distinguishable only by the slight superiority of the latter. After this he would probably be surprised to hear that both silica gel and ferric hydroxide gel were and are absolutely worthless for military uses, whilst carbon is of irreplaceable value. In the face of such facts Mr. Furness's statement that "The phenomena of absorption are identical in all cases from a practical point of view," is evidently mistaken. From a practical point of view the difference in behaviour of the two absorbents is very great and directly affects such industrial applications as benzol recovery.

The basis of their difference in behaviour is that the powers of selective adsorption of carbon and silica gel are diametrically opposite in character. Silica gel is hydrophilic or selective for water vapour, whereas carbon is non-selective for water but possesses a very high "specific capacity" or selectivity for hydrocarbons and hydrocarbon derivatives, which latter include practically all of the ordinary solvents and vapours of industrial importance. If shaken into a mixture of water and benzol, active carbon will absorb the benzol and reject the water. Silica gel does the reverse. The efficiency of the latter therefore decreases enormously in the presence of water vapour, and a pre-requisite of its employment is a careful drying of the gases. On the other hand, the capacity of the activated carbon for absorbing benzol is practically independent of the presence of water vapour in the gases, or even of the saturation of the carbon itself with water.

The rate of absorption by wet carbon falls off somewhat, but this is easily compensated by proper design of the adsorbers. Thus, after steam distilling the solvent from a carbon absorber, drying of the carbon is quite unnecessary. These matters are discussed in detail in two recent papers from our Laboratories, one presented before the American Institute of Chemical Engineers in June of this year, entitled "The Properties of Activated Carbon which Determine its Industrial Applications," which will appear in full in the December issue of the *Journal of Industrial and Engineering Chemistry*, and the other by Dr. Ray in *Chemical and Metallurgical Engineering* of August 27, entitled "Industrial Adsorption of Gas and Vapour with Activated Carbon."

Mr. Furness specifically refers to the greater density and "space-time" absorptive capacity of silica gel in comparison with activated carbon. These comparisons are true only of low-density wood charcoal or of imperfect activation such as is obtained by the processes of simple calcination, with or without mineral additions. They do not apply to highly activated carbons having the correct porosity or "critical" apparent density corresponding to the maximum surface and consequently to the maximum adsorbent capacity per *unit volume* of carbon granules. The methods of preparing active carbons developed by the writer for the Chemical Warfare Service represent the practical utilisation of this principle of critical densities by applying a two-stage oxidation process to chars so prepared or selected as to have an initial density considerably above the critical density, which is then approximated, first, by a primary "selective" or "activating" oxidation which eliminates the adsorbed hydrocarbons and gives the unsaturated surface lattice or matrix characteristic of active carbon; and, second, by a stage of "limited" oxidation the sole purpose of which is to bring the carbon granules to the correct porosity or density for maximum surface exposure per unit volume. Ordinary wood chars are already below the critical density (about 0·41 for 8—10 mesh granules) before activation, and hence are inherently incapable of yielding the highest gas adsorbent carbons having regard to the "space-time" factor. It is also obvious that to obtain the best mechanical properties the density should be the highest possible consistent with effective surface exposure.

Gas adsorbent carbons for industrial use are manufactured in the United States exclusively by processes embodying these principles, as fully discussed in the papers referred to above.

Commercial activated carbons such as are made in this manner for gasoline recovery installations and the like are not approached in intrinsic adsorptive capacity either per unit weight or per unit volume of adsorbent by any inorganic gels so far placed upon the market.

Enough has been said, therefore, to show that activated carbon cannot be safely left out of the discussion when considering benzol and other solvent recovery problems—a suggestion which even Mr. Furness found impracticable, since he was subsequently reduced to the necessity of taking data from experiments and installations employing carbon in order to show how good silica gel would have been if it had been used.—I am, Sir, etc.,

N. K. Chaney,

Union Carbide and Carbon Research Laboratories, Inc.
New York,
Nov. 8, 1923

P.S.—You may find another paper of Dr. Ray's entitled the "Manufacture of Activated Carbon" (*Chem. and Met. Eng.*, June 4, 1923) of some interest in this connexion.

ELLIS'S PRACTICAL BACTERIOLOGY FOR CHEMICAL STUDENTS

Sir,—If your columns are still open to the continuance of this correspondence, I shall be glad of the opportunity of replying to Dr. Renshaw's reply. In the first place, I did not wish to attribute to him any personal ill-feeling: that under the circumstances was quite out of the question. But when the condemnation of a book is supported by ridiculous details which, when challenged, are found to be built on sand, one may reasonably suspect rather a malicious habit of mind. Were this the only ground for replying, I should not have deemed it worth while. What does make it worth while is the need of rectifying the distorted and ill-balanced point of view which underlies Dr. Renshaw's remarks. My experience in teaching bacteriology to chemical students has been consistently uniform. Whilst they are expert at manipulative details, they are at first hopelessly at sea whenever the biological side is presented to their notice. This of necessity must be the case from the very nature of their training and does not impute the existence of a defect in this training. But bacteria are plants and unless their study is conducted on biological lines, and the fundamentals laid down as they would be in a biology class, bacteriology will become to the chemist the purely empirical study which it is to the average medical student. In essentials it comes to this, that I am blamed for not sufficiently decorating the walls, and have busied myself with laying down the foundations. Why should I teach chemists matters like H-ion concentration which they are far more competent to tackle than I am? It is not for me to write a book of chemistry with a bacteriological bias. My business is to indicate how best to approach a biological subject with the best chances of success. Once the fundamentals are grasped, the chemist can himself undertake the building up and make the subject adequate to the purpose of his researches. Dr. Renshaw himself knows, and practically admits, that the bacteriological training of the medical student is very inadequate. His whole attitude seems to imply that he would desire the chemist to travel along the same empirical path. The educationalist is not yet born in him. He condemns the use of *Bac. megatherium* because this will not make a bacteriologist out of the chemist. This by the way is different from his former attitude that "this organism was not of much use in the laboratory." The change, however, shows that whilst he disagrees, he understands my point of view—and I am thankful for small mercies. I state, with the knowledge born of experience, that in taking the chemist along the line that he would be taken as a matter of course in a biology class, I can make him as near a bacteriologist as is possible in a 4s. 6d. book by heading the way I have taken. I should have been grateful had the matter at the start been taken up on this issue.

Not only has he misunderstood my object in general, he has brought forward statements of detail which are equally absurd. He cannot distinguish between the use of gelatin in a specialised medical laboratory, and its educative use as an instrument for showing students how one microbe differs from another. I wonder if Dr. Renshaw is aware, as a bacteriologist, of the fact that about 2000 different species of bacteria have been described over and above the fifty pathogenic organisms that come within the scope of the medical bacteriologist's work. The works chemist will be concerned with one or other of the 2000 and not, or very seldom, with the fifty pathogenic organisms. It is obvious that Dr. Renshaw is referring to the fifty pathogenics only when he states that gelatin media are useless for the cultivation of bacteria. Surely Dr. Renshaw is permitting himself a little extravagance when he refers to the "life and death responsibilities dependent upon accurate diagnosis in human bacteriology." The works chemist does not propose to specialise in human bacteriology. Is it not possible for your reviewer to turn his back on the medical laboratory? And if the *preliminary* training in bacteriology is a life and death matter, I tremble to think of the responsibility of those who drew up syllabuses in bacteriology for the medical student and even—greatly daring—for the D.P.H. My own work has demanded a very close attention to technique to have got the results which I did obtain, and I would be the last to advocate loose technique; but one does not condemn a 4s. 6d. book on general chemistry merely because it does not contain information which would be useful to a research chemist at Nobel's. Neither does one condemn the insertion of an easy exercise in chemistry because there are others which are more difficult.
—I am, Sir, etc., David Ellis

Royal Technical College,
Glasgow

THE DISCOVERER OF ZYMASE

Sir,—In the review of Prof. Harden's book on "Alcoholic Fermentation," Prof. A. R. Ling states: "Soon after the discovery of zymase by E. Buchner in 1897. . . ." Now is it not a fact that zymase was discovered by Béchamp, as he stated in a memoir on fermentation by organised ferments which he read before the Academy of Science on April 4, 1864?

Your reviewer continues to give a list of great names, including Pasteur, Buchner, etc., but no reference is made to Béchamp. Is this purely an oversight?—I am, Sir, etc.,

Eccles Chas. W. Duckworth
November 17, 1923

THE CHEMIST AND THE PUBLIC

Sir,—Referring to recent correspondence on this topic, would not the most practicable method of educating the public be for chemists to cooperate in federating all the isolated scientific and intellectual societies up and down the country and linking them to the Universities or to the British Association?

Already the British Association has five such federations linked to it—viz.:—The South-Eastern Union of Scientific Societies, the South-Western Naturalists Union, the Yorkshire Naturalists Union, the Joint Committee of Scientific Societies, Liverpool, and the Association of Science and Art Societies, Gloucester. If this movement were encouraged and became general, not only would public opinion be profoundly affected, but a political lever created capable of moving any Government, as such an organisation would influence a great number of votes, and might even adopt candidates for parliamentary honours. The time appears ripe for such a movement. Are chemists prepared to act?—I am, Sir, etc.,

Gloucester, Cornilius A. Hawkes
Nov. 19, 1923

August Merz, of Heller and Merz, has been elected chairman of the dyestuffs section of the Synthetic Chemical Manufacturers' Association, in the place of the late Fred Signer.

REVIEWS

Blanchîment, Teinture, Impression, Apprets. *By* P. Lederlin. *Edited by* Prof. C. Matignon. *Pp.* 543. *Paris: J. B. Bailliere,* 1923. *Price, paper,* 45 *frs.; bound,* 55 *frs.*

The facility of the French language for condensed statement is very well illustrated by this work, which sets out to give a practical account of the bleaching, dyeing and printing of cotton, in all forms, within the space of some 500 pages, many of which are taken up by diagrams and illustrations of machinery. Even with this facility of language at his command, and with a special gift for systematic arrangement of his material, the author has been able to treat many portions of his subject only in a very cursory manner. The practical man will find very little guidance in the portions devoted to machinery, and many of the descriptions of processes are merely such outlines as might be given to a visitor to a works in explanation of the machinery and activities he would see. On the other hand, the chemist in dye, bleach or print-works will find much to admire in the concise presentation of the facts and the lucid way in which the logical connexion between the chemical and physical properties of the materials used and the effects of their use in the works is made clear. The portions of the book which deal with the precautions to be taken to avoid damages and methods of tracing damages to their source (at any rate, when a chemical source is in question) are written and arranged with admirable orderliness and precision, and though, unfortunately, the phenomena which are observed in works do not always illustrate the same logical simplicity, yet the author's methodical review does afford a means and plan by which the main factors concerned can be rapidly reviewed. The section on dyeing, after a brief summary of the chemistry of dyestuffs, groups them according to their properties of fastness and suitability to particular goods. The account of the application of these dyes is arranged according to colour. The convenience of this arrangement as a guide to selecting a dyestuff for a particular purpose is obvious.

The book can be warmly recommended to all who have control of operations in these industries, or are preparing themselves for such a position, on account of the methodical arrangement into which it will bring their knowledge. It is refreshing, after reading the works of English and German authors on these subjects, to come into contact with a mind which has a different quality, eschews all that is tentative or speculative and avoids all padding, and though the book is far from comprehensive and often meagre in its descriptive parts, it is unusually concise, lucid and logical for a work of this kind. Benjamin Leech

Tables Annuelles de Constantes, etc., Art de l'Ingénieur et Métallurgie. *By* L. Descroix. *Pp.* 154. *Gauthier-Villars et Cie., Paris.* 1922. *Price* 40 *francs.*

There has been a considerable development during the last few years of the systematic study of metals and alloys, particularly from the point of view of their physical and mechanical properties. Innumerable measurements, the results of which are hidden away and difficult of access, remain unknown to a majority of technicians. The International Committee of the Annual Tables of Constants of Chemistry, Physics and Technology has been charged, as is well known, to collect all such information, both scientific and technical, and has thus been placed in a position to provide in the book mentioned above a great quantity of information which it is impossible to procure elsewhere.

The editor of this book, containing abstracts for the years 1913 to 1916 inclusive, was well prepared to undertake this work because of his work in connexion with the Revue de Métallurgie. In addition to metallurgy, this volume contains facts of every sort concerning the art of engineering. It contains information concerning the different building materials, textiles, fabrics, industrial products, machines, fuels, refractories, and so on. On the metallurgical side, besides mechanical constants, it contains valuable information relating to the constitutions of alloys, their physical and electrical properties, corrosion, and so forth. The "Tables Annuelles de Constantes" should become an invaluable aid for collecting and making known the new experimental data concerning engineering and metallurgy, and it is therefore certain that this volume, of which the price is very moderate in the present circumstances, will receive the most cordial welcome from the thousands of technicians for whom it has been prepared, and we must hope that the committee which directs this important publication will rapidly publish the abstracts during the last few years, so as to constitute Volume 5 of the "Tables Annuelles de Constantes," years 1917 to 1922.

The King has approved of the award by the President and Council of the Royal Society of a Royal Medal to Prof. C. J. Martin, F.R.S., for his researches on "Animal Metabolism." The President and Council have also awarded the Copley Medal to Prof. H. Lamb, F.R.S., for his researches in mathematical physics, the Davy Medal to Prof. H. B. Baker, F.R.S., for his researches on "The Complete Drying of Gases and Liquids," and the Hughes Medal to Prof. R. A. Mellikan for his determination of the electronic charge and of other physical constants.

PARLIAMENTARY NEWS

Anglo-Persian Oil Company (Government Holding)

Mr. Chamberlain, replying to Lieut.-Col. Hodge, said that a proposal for the acquisition of the Government holding in the Anglo-Persian Oil Company had been under consideration for some time. No decision had yet been reached, but no step would be contemplated by the Government which would have the effect of jeopardising the supply of oil fuel for the Navy and mercantile marine.—*Nov.* 15.

Dried Milk

In answer to Mr. Hurd, Sir W. Joynson-Hicks said that the new Regulations as to dried milk made provision for a minimum fat content and for suitable labelling, including the use of the words " Unfit for Babies " in the case of skimmed milk. It was necessary to allow a period of several months before bringing the Regulations into force, so as to enable manufacturers to comply with the requirements as to the composition of the product, to print new labels, and to put the milk into circulation in retail shops. The question of making Regulations affecting other milk products was receiving consideration.—*Nov.* 15.

Food Preservatives

Sir W. Joynson-Hicks, answering Mr. Barnes, said that he had received a number of resolutions from local authorities, expressing the opinion that the use of chemical colouring matter and preservatives in food constituted a menace to the community, and that the matter was being investigated by a Departmental Committee. *Nov.* 15.

DRIED MILK REGULATIONS

The Ministry of Health has issued an order (No. 1323 of 1923, price 2d.) entitled the Public Health (Dried Milk) Regulations, 1923, to come into force on May 1, 1924. The Regulations apply to dried milk to which no other substance has been added and to the dried milk contained in any powder or solid of which not less than 70 per cent. consists of dried milk, but not to sales of dried milk contained in a receptacle whose gross weight exceeds 10 lb., or to dried milk sold by weight but taken out of a receptacle that is properly labelled. It is forbidden to sell or expose for sale any dried milk unless the container is properly labelled or the milk contains, if dried full-cream milk, not less than 26 per cent. milk fat; if dried three-quarter-cream milk, not less than 20 per cent.; if dried half-cream milk, not less than 14 per cent.; and if dried quarter-cream milk, not less than 8 per cent. Methods of labelling dried milk, so as to protect the consumer, are set out in the schedule to the Regulations. A circular accompanying the Regulations compares them with those previously issued for condensed milk.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Nov.* 8 *and* 15)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina	Artificial silk yarns	554
Australia	Silk, artificial silk	525, 526
Brazil	Tinplate, chemicals	556
British India	Copper sulphate, steel	*
Chile	Newsprint paper	557
Czecho-slovakia	Metals and alloys	533
Egypt	Linotype metal (tender)	11807/F.E./E.C.
Germany	Steel, leather and kips	535, 537
Netherlands	Leather	538
,,	Medical supplies (tender)	20953/F.W./C.C./2
New Zealand	Cast iron pipes	528
Norway	Cast iron pipes	542
Poland	Steel goods, chemicals	543
Spain	Hollow ware, iron and steel	545
,,	Drugs, chemicals	546
Switzerland	Pharmaceutical products.	547
United States	Firebricks, leather goods	550
,, ,,	Glassware, leather goods	552
,, ,,	Fancy leathers	20990/F.W./M.C./(2)
Yugoslavia	Hides, skins	543

* The Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E.1.

TARIFF CUSTOMS EXCISE

New Zealand.—The current issue contains copy of the new Amendment Act, showing special rates of duty on certain goods.

Rumania.—Prohibition has been placed on the export of oils, paper, zinc, brass, metal, gold and silver, skins, ores, copper, platinum, copper sulphate, pig iron, pharmaceutical products, petroleum, and caustic soda.

South Africa.—The current issue gives a list of patent and proprietary medicines which are exempted from the stamping requirements.

Spain.—The importation of foreign pharmaceutical specialities is permitted.

Uruguay.—Import duties and additional *patente* charges have been levied on hardware, and pharmaceutical specialities.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

No material changes have taken place in the heavy chemical market, but a more hopeful tone has developed, with an improved demand from the textile trade.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 9d.—4s. 3d. per carboy d/d. North of England. £6—£7 per ton in London.
Acid Nitric 80° Tw.	£21 10s.—£27 per ton makers' works, according to district and quality.
Ammonia Alkali	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	5¾d.—6d. per lb.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£28 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Prices in this section are unchanged.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

With the exception of acetates of lime and lead the demand for wood distillation products keeps below normal.

Acetate of Lime—	
Brown	£12—£13 per ton d/d. Demand steady.
Grey	£22 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 5s.—£9 10s. per ton, according to grade and locality. Market quiet.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	6s. per gall. 60% O.P.
Solvent	6s.—6s. 3d. per gall. 40% O.P.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead	£42—£43 per ton. Demand more active.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s.—1s. 1d. per lb. Weaker with limited demand.
Crude 60's	3s.—3s. 3d. per gall. Limited business for spot delivery. No market for forward delivery.
Acid Cresylic—97/99	2s.—2s. 2d. per gall. Firm, with good demand.
Pale 95%	1s. 10d.—2s. per gall.
Dark	1s. 7d.—1s. 10d. per gall.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.
Anthracene Oil—	
Strained	9½d.—10d. per gall. Quiet.
Unstrained	9d.—9½d. per gall. Quiet.
Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Benzole, Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 3d.—1s. 4d. per gall.
Pure	1s. 9d.—1s. 10d. per gall.
Xylol	2s. 3d. per gall.

Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8½d.—9½d. per gall. according to grade and district. Good business being done.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 2d. per gall. Fair demand for export.
Solvent 90/190	1s. 2d.—1s. 3d. per gall. Business quiet.
Naphthalene Crude—	
Drained Creosote Salts	£5—£8 per ton. Demand increasing. Market scarce.
Whizzed or hot pressed	£9—£11 per ton. Quiet.
Naphthalene—	
Crystals	£19 10s. per ton.
Flaked	£19 10s. per ton.
Pitch, medium soft	125s.—135s. per ton, according to district and time of delivery. Little business.
Pyridine—90/140	21s.—23s. per gall. Demand good. Supplies short.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

The slight improvement in dyestuffs business has been maintained, but orders are still only for small quantities.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 9d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Much better demand.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 9d. per lb. 100% basis d/d
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Demand quiet.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£83 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6½d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	5¾d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	1s. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-o-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 2d. per lb. d/d.
p-Phenylene Diamine	12s. 6d. lb. 100% basis d/d.
R. Salt	2s. 7½d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
o-Toluidine	7d.—8d. per lb.
p-Toluidine	4s. per lb. d/d.
m-Toluylene Diamine	5s. 2d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The shortage of spot supplies of a number of products continues and prices are in consequence considerably higher for a few of the pharmaceutical chemicals which are in regular demand.

Acid, Acetic 80 % B. P.	£48 per ton.
Acid, Acetyl Salicylic	3s. 6d.—3s. 9d. per lb. In strong demand. Most makers fully sold ahead.
Acid, Benzoic	B.P. quality unobtainable.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Camphoric	17s.—19s. per lb.
Acid, Citric	1s. 4½d. per lb., less 5%, for ton lots. Firmer. Demand improving.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	6s. per lb. for 28 lb. lots.
Acid, Salicylic	2s. 6d. per lb. Very firm market.
Acid, Tannic	3s. per lb. for B.P. quality. Very firm.
Acid, Tartaric	1s. 1½d. per lb. less 5%. Rather more inquiry, but low prices being accepted for foreign acid.
Amidol	9s. per lb. d/d.
Acetanilide	Advanced to 2s. 9d. per lb. Small stocks.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	4s. per lb. for English make.
Atropine Sulphate	12s. 6d. per oz. for English make. Demand very poor.
Barbitone	17s. 6d. per lb.
Benzonaphthol	5s. per lb. Quiet.
Bismuth Salts	A steady market. Prices according to quantity :
Carbonate	12s. 9d.—14s. 9d. per lb.
Citrate	11s. 4d.—13s. 4d. ,,
Salicylate	10s. 2d.—12s. 2d. ,,
Subnitrate	10s. 9d.—12s. 9d. ,,
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	
Potassium	7½d. per lb. Remain very firm. Continental prices advancing.
Ammonium	8½d. ,, ,,
Sodium	8d. ,, ,,
Calcium Lactate	2s. 9d. per lb. for best English make.
Chloral Hydrate	4s. 3d. per lb. Position very firm.
Chloroform	2s. per lb. for cwt. lots. More active.

Creosote Carbonate	7s. 6d. per lb. Little demand.
Guaiacol Carbonate	Spot supplies very scarce. Present value 13s. 6d. per lb. Still advancing.
Hexamine	4s. 6d. per lb. Very firm market.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate	1s. 11d.—2s. 3d. per lb., according to quality.
Magnesium Carbonate—	
Light Commercial	£36 per ton net.
Magnesium Oxide—	
Light Commercial	£72 10s. per ton, less 2½%. Reduced by £5 per ton.
Heavy Commercial	£27 per ton, less 2½%.
Heavy Pure	2s.—2s. 3d. per lb., according to quality and quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 65s. per lb.
Mercurials	Firm and likely to advance.
Red oxide	4s. 11d.—5s. 1d. per lb.
Corrosive sublimate	3s. 8d.—3s. 10d. ,,
White precip.	4s. 6d.—4s. 8d. ,,
Calomel	4s. 1d.—4s. 3d. ,,
Methyl Salicylate	2s. 10d. per lb. for carboys. Brisk market. Higher values expected.
Methyl Sulphonal	Has further advanced to 23s. per lb. Small supplies.
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 6d. per lb.
Phenacetin	7s. 6d. per lb. Steady market.
Phenazone	8s. 9d. per lb. Again dearer.
Phenolphthalein	7s. 9d. per lb. Very firm.
Potass. Bitartrate— 99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Market firmer.
Potass. Citrate	1s. 8d.—2s. per lb.
Potass. Ferricyanide	3s. per lb.
Potass. Iodide	16s. 8d.—17s. 5d. per lb., according to quantity. Price advanced 1s. per lb. Demand continues.
Potass. Permanganate	10d. per lb. for B.P. crystal.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Salol	4s. per lb.
Sod. Benzoate	Practically unobtainable.
Sod. Citrate, B.P.C., 1923	1s. 9d. per lb. for cwt. lots.
Sod. Hyposulphite—	
Photographic	£15—£17 per ton, according to quantity, d/d. consignee's station.
Sod. Nitroprusside	16s. per lb. Less for quantity
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 10d. per lb., and Crystal at 2s. 11d. per lb. Firm and very active.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	17s. 6d. per lb.
Thymol	13s. 6d. per lb. quoted for synthetic and 14s. 6d. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 9d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine	3s. 3d. ,, ,,
Benzaldehyde free from Chlorine	3s. 3d. ,, ,,
Benzyl Benzoate	3s. 6d. ,, ,,
Cinnamic Aldehyde Natural	22s. 6d. ,, ,,
Coumarin	20s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	37s. 6d. ,, ,,
Geraniol	6s. 9d. to 13s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. 9d. per lb.
Linalol ex Bois de Rose	20s. ,, ,,
Linalyl Acetate	20s. ,, ,,
Methyl Anthranilate	8s. 6d. ,, ,,
Methyl Benzoate	6s. ,, ,,
Musk Ketone	47s. 6d. ,, ,,
Musk Xylol	13s. 6d ,, ,,
Nerolin	4s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	16s. ,, ,,
Rhodinol	60s. ,, ,,
Safrol	1s. 10d. ,, ,,
Terpineol	3s. ,, ,,
Vanillin	24s.—25s. per lb.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 11d. ,, ,,
Bergamot Oil	13s. 3d. ,, ,, spot.
Bourbon Geranium Oil	37s. ,, ,,
Camphor Oil	75s. ,, ,,
Cananga Oil, Java	9s. 6d ,, ,,
Cinnamon Oil, Leaf	5d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 9d. ,, ,,
Ceylon	Very little on offer.
Clove Oil	10s. 6d. per lb.
Eucalyptus Oil 70/75%	2s. 7d. per lb.
Lavender Oil—	
French 38/40% Esters	24s. 6d. per lb.
Lemon Oil	2s. 10d. per lb. Higher prices expected.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	11s. 9d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	26s. per oz.
Palma Rosa Oil	24s. 6d. per lb.
Peppermint Oil—	
English	70s. per lb. Market very unsteady.
Wayne County	15s. 6d. per lb. Market very unsteady.
Japanese	12s. 6d. per lb. Market very unsteady.
Petitgrain Oil	8s. 9d. per lb. Dearer.

TRADE NOTES

Trade Information

X-ray Spectrography is a province of science no longer belonging solely to the physicist, as it is utilised by chemists to study the molecular structure of crystals and powders, thus obtaining data from which the molecular weight can be calculated and hence the composition inferred. Materials used as anti-cathodes can also be analysed by means of the spectrum emitted, a method analogous to spectrum analysis with visible and ultraviolet radiations. In addition the method provides a valuable tool for the metallographer, the crystallographer and the radiologist. A pamphlet received from Adam Hilger, Ltd., 75a, Camden Road, London, N.W. 1, describes Dr. Müller's X-ray spectrograph, which is extremely compact, of simple design and sufficiently inexpensive for use by advanced students. The instrument can be used for work on crystals or powder by the three standard methods of Bragg, Debye, and Hull, and is supplied at the price of £44, the case costing £3 extra. An interesting feature of the pamphlet is the useful introduction written for those to whom the subject is comparatively new.

Plant.—We have received from Messrs. Manlove, Alliott and Co., Ltd., a series of illustrated folders describing various products of this Nottingham firm. Sheet No. 5571 illustrates various types of drying machines manufactured for the chemical and allied trades, such as vacuum, rotary, film, centrifugal and other driers. The selection of the most suitable type of dryer depends on the available source of heat, the nature of the material to be dried, its initial moisture content and the amount of moisture to be removed, questions on which the maker's experience is at the service of clients, who are supplied with a list of questions to answer. Further information can be obtained from the makers at Bloomsgrove Works, Nottingham. Sheets No. 5572 and 5573 relate respectively to machinery for the manufacture of compound feeding cubes for cattle and to washing machines, hydro-extractors, etc., used in the laundry industry.

Electric Furnaces are rapidly becoming commonplaces in industry, especially in the electrochemical and electrometallurgical industries. There is room for much improvement, however, especially in the direction of increasing the efficiency of electrodes, a subject which is treated in an interesting little book, "The Carbon Electrode," published by the National Carbon Co., Inc., of 30 East 42nd Street, New York. After a concise but well-documented review of the history of the electric furnace and the electrode, the manufacture, characteristics, handling and uses of carbon electrodes are described. Notes on methods of joining electrodes and securing minimum consumption are given, and a list of "don'ts" is followed by short chapters on specifications for electrodes, joint compound, the importance of furnace records, carbon resisters, carburite (a material used for bringing the carbon content of steel up to a desired point), carbon blocks, etc. The book closes with diagrams of wiring for electric furnaces, and a series of formulæ and tables. There is a useful index.

Water Softening is every day acquiring still greater importance as the result of the increasing use of higher pressures in boilers and the consequent necessity, if full efficiency is to be attained, of utilising feed water of the right quality. Attention may be drawn to three booklets issued by Sofnol, Ltd., Westcombe Hill, Greenwich, S.E. 10, and devoted to the chemistry of water softening, water testing and calcium hydrate. In the first booklet the chief facts relating to the softening of water are set out and the requisites of the necessary chemicals are given. As a rule, the mechanical part of softening is well cared for, but the chemical treatment is neglected, so Sofnol, Ltd., undertake to supply the necessary materials to soften any kind of water mixed in the right proportions and complying with a definite specification. The second booklet deals with apparatus and chemicals for testing waters, and in this connexion, again, the companies' laboratories and staff are placed at the disposal of clients who desire advice on the treatment of their water supplies. In the third booklet the advantages of using calcium hydrate or calcium-sodium hydrate (soda lime) for the softening of waters are given. The three booklets convey much interesting information, and should be read by those who are concerned with the problems under review.

Cost of Producing Sodium Nitrite in Norway

In an investigation made by the United States Tariff Commission, the cost of production of nitrite by the Norsk-Hydro Co., of Norway, was estimated at 2·183 c. per lb., at current exchange, or 3·275 c. per lb. at par exchange. The cost of transportation of sodium nitrite from Norway to the United States is slightly above ½ c. per lb., and if the estimated cost of production be accurate, the Norwegian producers are placing it in New York at a cost of less than 3 c. per lb. at current exchange values, including production costs, packing, freight and insurance. In March, April and May, the imports amounted to 1,073,000 lb., the average invoice value being 4·84 c. per lb., c.i.f., New York. Deducting transport charges, the average price received at the factory in Norway was 4·34 c. per lb. The spread between the landed cost and the selling price of at least 7½ c. per lb. must include 3 c. per lb. duty. The profit, according to these estimates, would be more than 100 per cent. The above-mentioned company has an annual capacity for sodium nitrite of about 24,000,000 lb. It uses the arc process, and also manufactures sodium nitrate, the daily capacity being 441 short tons of calcium nitrate, 44 t. of sodium nitrate, and 33 t. of sodium nitrate. In the United States calcium and sodium nitrate are not produced in connexion with sodium nitrite.—(*Chem. and Met. Eng., Sept.* 24, 1923).

Chilean Output of Copper

In 1922 the production of copper in Chile was 109,420 tons of copper in bars ; 116,645 t. of ore ; and 110 t. of manganate of copper. At the end of November 97,640 t. of bars, 104,025 t. of ore and 101 t. of manganate had been sold. Chile has thus regained her rank as second producer of copper in the world.—(*Ch. Comm. J., Sept.* 28, 1923.)

Sulphur Production in Australia

The Commonwealth Government has decided to pay a bounty of £2 5s. a ton on all sulphur produced in Australia from local pyrites and other sulphide ores or concentrates. When sulphuric acid is produced from Australian pyrites and other sulphide ores or concentrates, the bounty will be paid on as much sulphur as would be necessary to produce it. The Commonwealth Parliament have passed a bill providing for the appropriation of £100,000 each year for the payment of the bounty, and another bill allowing the free importation of sulphur as long as the bounty is payable. Several large companies have agreed to instal plants for the purpose, which will be sufficient to provide for all Australian requirements.—(*Comm. Int. J., Canada, Oct.* 20, 1923.)

Wages in Russia, 1922.

The following figures show the average wages in Russian industry before the war and in 1922, in pre-war roubles :—

		1922				
Industry	1913.	Jan.	Apr.	July	Oct.	Dec.
Metal	33·4	8·60	10·22	15·83	19·40	22·73
Textile	21·5	8·36	6·17	9·50	10·66	15·73
Chemical	23·0	8·03	9·37	13·88	16·31	19·84
Average	25·3	8·82	7·99	12·97	16·59	19·57

The following table gives the actual monthly wages in 1922 in millions of Soviet roubles of the old issue :—

Industry	Jan.	Apr.	July	Oct.	Dec.	Increase Dec. Jan.
Metal	3·38	34·62	89·26	177·72	409·29	121
Textile	3·29	20·90	53·55	97·69	283·06	86
Chemical	3·16	31·76	78·28	149·43	357·39	113
Average	3·47	27·09	73·14	141·99	354·22	102

Industrial Research.

At the recent annual meeting of the "Fachausschuss des Vereins deutscher Eisenhüttenleute," Prof. P. Göhren, speaking on industrial research, referred to the value of the close relations existing between the industry and universities and research institutes, and mentioned the method of statistical investigation devised by Dr. K. Daeves, by means of which a large number of isolated observations can by simple methods be brought at little cost into useful correlation. The speaker gave examples from his own plant experience of materials, processes and labour.

New Sugar-Mill for Queensland

It is announced that the Queensland Government is about to erect a State sugar-mill at the cost of £389,480 at Tulley River, North Queensland. The mill, which will take two years to erect, will have a crushing capacity of 150,000 tons of cane per season, and will be the largest in the Commonwealth.

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A Comprehensive Treatise on Inorganic and Theoretical Chemistry. *By* J. W. Mellor, D.Sc. *Vol. IV. Ra and Ac Families, Be, Mg, Zn, Cd, Hg. Pp. x*+1074. *London: Longmans, Green and Co.*, 1923. *Price* 63*s*.

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EDITORIAL

THE world of chemistry is represented in the present Election by a number of candidates, one of whom, Col. J. W. Weston, has already been returned as the Member for Westmorland. Mr. C. S. Garland and Mr. E. Brotherton Ratcliffe are opposing each other in South Islington. Mr. Miller-Jones is fighting the Limehouse Division. Dr. G. C. Clayton, one of the small chemical band in the last Parliament, is again standing for Widnes. Sir Alfred Mond and his colleague, Sir John Brunner, are standing for West Swansea and Southport respectively, while Mr. Henry Mond, Sir Alfred Mond's son, is a candidate for the Isle of Ely. Sir William Alexander and Mr. H. J. Tennant, who comes of a chemical family, though he would hardly call himself a chemist, are opposing each other in Central Glasgow. There are several others who have a connexion with the chemical industry, of whom we may mention Mr. R. S. Brown, of the Brimsdown Lead Company, a candidate for Edmonton, and Mr. R. J. Neville, the Chairman of the Brentford Gas Company, now standing for South Leeds, a seat he has already contested five times. No doubt there are others whose chemical interests have escaped our notice. It is of considerable importance to chemistry and the chemical industry that these should be adequately represented in Parliament, and we hope that this representation will grow until so fundamental and essential a constituent becomes of numerical importance. Chemistry plays a far more dominating part in industry than it did twenty years ago, and our statesmen will easily make a number of blunders in chemical matters, unless there are on the spot a few watchful men who can lend a hand.

* * *

A friendly critic has commented on a recent editorial note which contained some idle speculations on the inheritance of colour in plants and the possibility of some vital principles independent of ordinary chemical molecules. Very likely such notions are too crude to justify the use of our space and our reader's time, both of which are very precious, but there is a certain fascination—perhaps unduly developed in immature minds—in attempting to solve problems, the essential data of which are missing. Those who in the old days devoted much time to squaring the circle were not deterred by any doubts conveyed to them by mere academic men. "Prove to me that the thing is impossible," said one such man, "and I will at once attempt it." And it will probably be found that metaphysical theories on the origin and meaning of life, its persistence and the whole question of spiritual and psychical phenomena, will be promulgated without any regard to the evidence in support of them and the impossibility in our present conditions of obtaining any. Macaulay said: "Such speculations, on the contrary, are in a peculiar manner the delight of intelligent children and of half civilised men. The number of boys is not small who, at fourteen, have thought enough on these questions to be fully entitled to the praise which Voltaire gives to Zadig. 'Il en savait ce qu'on en a su dans tous les ages; c'est-à-dire fort peu de chose.'"

* * *

The announcement made some time ago that experiments were being made on the use of mercury vapour to furnish motive power for turbines was received with incredulity. Novelty is the dearest to us of all things, said Ovid, but his saying would seem to apply more to popular catchwords or amusements than to scientific research, which needs the support of no little and weighty fact before its results are accepted. In this case, the facts, or some of them, should soon be placed before us, as an experimental mercury-vapour turbine has actually been built and a second one put in operation in the United States, so it is understood. Yet on purely theoretical grounds steam, as was recently shown by Mr. W. J. Kearton, speaking before the Institution of Mechanical Engineers, is by no means ideal as a source of power for turbines, for an ideal vapour should possess a high boiling-point, a high pressure at the temperature of circulating water, and a high ratio between its latent heat and specific heat. Such properties are possessed by no single fluid, and this lead Du Tremblay, in 1850, to use two fluids, and resulted in the present attempt to employ mercury vapour as the fluid of high boiling-point, the condensation of the vapour, after passing through the turbine, being utilised to generate steam, which then is superheated and passed through a turbine. Although the overall efficiency of a turbine constructed on this principle would be less than that of the Diesel engine, it is still superior to that of the steam turbine; and, as the mercury system can be constructed in high powers, its use for the generation of electric power on a large scale becomes a suggestive possibility. Already, so it appears, the obvious danger of leakages of the extremely poisonous vapour has been overcome by the use of special jointing, and there ought thus to be no fear for the safety of workers should the mercury-vapour turbine be utilised as a commercial prime mover. Mercury is, of course, extremely expensive, but as there will hardly be any loss, and as it is stated that the quantity required is not excessive, the difficulty of prime cost should not present too formidable an obstacle. Truly, should the system prove capable of industrial exploitation, mercury will once more have shown itself to deserve its reputation.

* * *

It is, indeed, refreshing to find some attempt to leave the rut of the usual and to forget the obvious. The obsession of the known and proved has far too often obscured the value of the unknown, unproved, though possible. Science has provided industry with very many tools to try, but how few of them have received trial, and when worth has been demonstrated, how slowly have they been received in practice! Solvents, analytical methods, apparatus and many other materials or processes have their tale of neglect to tell. The history of chemistry is full of instances. But no student of chemistry need despair while there is so much work to be done, so many gaps to be filled, so many chasms to be bridged. Anyone who has hunted through the literature for information on any subject can at once recall the too frequent omissions, the strange neglect of details, the unsatisfactory nature of the data. It has been said, a dwarf standing on the shoulders of a giant may see farther than a giant himself. There were many giants of old in chemistry, but who would not be such a dwarf?

OUR WATER SUPPLIES *

By EDWIN THOMPSON

There are not many people in a town who give much thought to their water supply. They know that they can turn on a tap and get water that they can drink or bathe in or use for any other purpose, and there the matter ends for them. Suppose they could see microbes in it or if it was of bad colour or had a bad taste or smell, then they would feel they had just cause for indignation. Every city desires a supply of pure and wholesome water, that is to say, water which is delivered to the consumer in such a condition that it cannot cause typhoid, cholera, diarrhœa or other waterborne disease. It must also be free from chemical poisons and have no injurious action on metals. It should be bright, clear and sparkling, free from suspended matter, acceptable to the palate, reasonably soft, and the salts in solution should not be present in excessive amount.

Sources of Water Supply

There are many sources of water supply, such as rain-water, which is collected as it falls and runs into tanks. Gibraltar, for example relies on rain-water for its supply, there being water-collecting slopes of corrugated iron covered with concrete, draining into a channel that runs through a tunnel in the rock and out near the city. Surface wells only a few feet deep are used when there is gravel or other porous soil resting on hard rock or clay, and deep wells, where there is a great depth of porous rock. Use is also made of artesian wells, springs, rivers flowing through nearly level country and mountain rivers flowing through valleys which can be dammed so as to form reservoirs, which will give a steady supply of water all the year round.

The amount of water to be obtained from wells is always somewhat problematical, whereas it is possible to estimate correctly a river supply or the yield of a gathering ground. Up to comparatively recent times wells were preferred not only because of the apparent abundant supply, but also because the water so often had a constant temperature and was naturally pure. At one time France considered that the purity of springs was unquestionable, but frequent epidemics of typhoid in Paris caused a change of opinions and methods. Germany, however, had preferred filtered surface water, but some theorists started a campaign against it and the opposite direction to France was followed with disastrous results.

Purification of Water

The three chief ways of purifying water are filtration, storage and sterilisation, which can be used either separately or in conjunction. The slow sand filtration is the one most commonly used and it has really never been surpassed. There have been many inventors of patent filters and they all seem to say that sand filtration is the worst system, but as it is practically the only one in general use and is not patentable, the would-be inventors have not as yet made much headway. There are many styles of rapid mechanical filters, but these do not give first-class bacteriological results. At Chester, however, rapid filters have proved most useful in dealing with flood water and so prolonging the life of the secondary filter beds. They are also in use at Birkenhead and are very largely used in America. With nearly all rapid filters a coagulant, usually aluminium sulphate, is used in order to produce an artificial skin and to render the filtrate as satisfactory, both chemically and bacteriologically, as it would be if the water had been filtered slowly through the ordinary sand filters. The output of a rapid filter is about 150 to 200 gallons per sq. foot per hour. When water is coloured, *e.g.*, the brownish tinge from a moorland peaty soil, there is nothing so good as a rapid filter for removing the colour.

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* Address read before the Liverpool Section on November 16.

Liverpool obtains most of its water from Lake Vyrnwy, all the water passing through slow sand filter beds at Oswestry. Not only is there no need to sterilise the water, but the supply is abundant, exceedingly soft and remarkably pure.

In countries where the winter temperature is likely to fall much below freezing-point it is desirable that the filter beds should be covered. This adds very greatly to the cost of the filters, but the darkness tends to reduce the growth of algæ and so the scraping of the surface of the filter beds is not required so frequently.

In 1892 the city of Hamburg had a terrible epidemic of cholera, due to the use of unfiltered water from the River Elbe. Work on filter beds, in course of construction, was immediately pressed forward, working day and night, and since the introduction of filtered water the death rate has been lower than ever before in the history of the city.

Storage

The storage of water is nature's own way of purifying it up to a very high standard. A single day's storage in a reservoir has been found to reduce the number of microbes in river water by 40 per cent. Sir A. Houston, the water examiner to the Metropolitan Water Board, gives some striking instances of the effects of storage on certain microbes. For example, he put cholera microbes into river water to the number of 13 million per c.c. After one week's storage they were reduced to 20 per c.c. and in three weeks they were all dead. In a similar experiment with artificially cultured typhoid bacilli he put 8 million per c.c., and after one week the number was 3000 per c.c., after two weeks 30 per c.c., after three weeks 4 per c.c., and at the end of four weeks they had all disappeared. He found that uncultivated bacilli perish much more rapidly than the cultivated bacilli and it is of course only the uncultivated bacilli that could pollute our water supplies.

Sterilisation

The best method of sterilisation is by chlorination. Sir A. Houston, one of the pioneers of this process, showed that the addition of 15 lb. of chloride of lime to 1,000,000 gallons of Thames water destroyed the microbes derived from previous sewage contamination far more effectively than by passing the water through a reservoir containing 88 days' supply. It is usual now, however, when the water has to be sterilised to use chlorine gas. The advantages are that it can be used in a state approaching absolute purity, it can be stored under pressure in steel cylinders, and it is not subject to atmospheric influences. One to two parts in 5 million has been found sufficient to sterilise completely the water in an hour or so. When chlorinating water, taste is one of the main things to be avoided. The chlorinous taste usually occurs through over-chlorinating, and the iodoform taste through not chlorinating sufficiently; the latter can be removed by potassium permanganate in doses of 2 to 8 lb. per million gallons. The most certain way to overcome the taste trouble is to super-chlorinate and then to dechlorinate with sulphurous acid; this is, however, an expensive method. The wonderful and almost astounding results of water chlorination during the war and the consequent immunity from disease of the troops, both in France and in the East, brought this method of sterilisation rapidly to the fore.

Municipal Waterworks

Glasgow was the first great city in Great Britain to obtain its water from a distant upland source. In 1855 the Loch Katrine waterworks was commenced and the surface of the water was raised 4 ft. by means of a dam; the levels of Loch Vennachar and Loch Drunkie were also raised for use as compensation reservoirs. This gave a storage capacity of nearly 6000 million gallons. There is a service reservoir eight miles from Glasgow, and the distance from Loch Katrine to the service reservoir is 25¾ miles.

Manchester raised the level of the water in Thirlmere 50 ft. and it is 96 miles from its source of supply. Manchester also has five reservoirs in Longdendale about 16 miles away, and these are still used to supplement the Thirlmere supply. This water, like Thirlmere, is very soft and therefore suitable for dyeing and bleaching. It is said that in Manchester the change from hard to soft water effected a saving in soap and soda of between £80,000 to £100,000 a year.

Birmingham obtains its water from 73 miles away in the Elan valley, where three dams were built in 1904 to form three reservoirs. There are also plans for three more reservoirs in the Claerwen valley, but as yet they have not been required.

The supply of water for London comes from the Rivers Thames and Lea and from a great number of wells. The whole London basin is chalk; London itself is on clay, but underneath the clay is chalk generally 200 to 300 ft. deep, although near Regent Street it comes to within 60 ft. of the road level and at East Greenwich it comes to the surface. Roughly 1000 artesian wells draw water from this huge underground reservoir, but they are mostly privately owned. So much water is being drawn from these wells and springs that the rain cannot flow through the sand and chalk fast enough to keep up the pressure and cause the water to flow to the surface, so it has to be raised by high pressure pumps from a depth amounting sometimes to more than 200 ft. During the last 60 years the water in some of the London wells has fallen more than 100 ft. It has been falling at an average rate of 2 ft. a year for many years. Of the total water supply of London, the Thames affords about 60 per cent., the Lea 20 per cent., and the springs and wells 20 per cent. There are now 31 storage reservoirs on the Thames and 17 on the Lea.

The Metropolitan Water Board has to cater for a water supply to nearly 7 million persons, and considering that 80 per cent. of the water is drawn from the Rivers Thames and Lea, which are undeniably polluted, the immunity of London from epidemic waterborne diseases is very remarkable: the death rate from typhoid fever in London in 1922 was at the phenomenally low rate of 1 per 100,000.

In round figures the average daily water supply of London is 250 million gallons and 274 engines of 43,417 h.p. are required to collect and distribute it through 6577 miles of pipes. Possibly people would not waste water so much if it were realised that all the water had to be pumped once and a large proportion of it twice and that the cost of fuel for this purpose is tremendous. Taking the Thames river supply alone at 150 million gallons per day it would be sufficient at 35 gallons per head per day to supply the whole of Liverpool, Manchester, Glasgow, Birmingham, Sheffield, and Bradford. This gives some idea of the huge scale of the Metropolitan Water Board's undertaking.

When the Thames is in high flood the chlorination treatment is discontinued temporarily and Staines Reservoir water is used instead, but, as this water has been stored for six to nine months it is in a very high state of purity. With the New River, however, the results are so good during three-quarters of the year that chlorination is only practised during the flood months.

WATER SOFTENING

One advantage of storage is that it has quite an appreciable softening effect upon water. Water softening is, of course, almost entirely carried out by private enterprise for special purposes as the greater part of any city water supply is used for flushing and other purposes where it does not matter whether the water is hard or soft.

CONSUMPTION OF WATER

It is interesting to note the difference in consumption of water per head in this country and in America. Here we use from 30 to 40 gallons per head per day, whereas in America anything from 150 to 200 gallons per head per day is required. Few water undertakings in this country have a large margin over their requirements, and I anticipate that in 10 or 15 years' time the consumption per head in this country will have materially increased, and that many water engineers will be faced with a difficult problem.

IMPURITIES IN WATER

Since November, 1920, the suspended solids in Thames river water have been determined gravimetrically. The weight in lbs. of suspended matter per million gallons was 27 for the week ending September 3, 1922, and 629 for the week ending January 7, 1923, this showing, of course, the great difference at the end of the summer and middle of winter. This difficulty of suspended solids adds very greatly to the problems of filtration.

People do not often realise what a trial gulls may be to the water engineer. As the gulls fly up the Thames Estuary they regard the West Middlesex Works as a haven of rest and there are also plenty of fish there. As each gramme of their droppings may contain a million typical *B. coli* they are not particularly welcome. Even as far inland as Lake Vyrnwy the gulls are frequently a great trial.

The storage of water is not without its difficulties. It may kill certain microbes and bacilli, but on the other hand it may encourage the growth of plant and animal life. Sponges, polyzoa and mollusca in endless variety may get into the storage reservoirs and block up the mains to an alarming extent. At Newton Abbot a polyzoan (*Plumatella*) got into the mains and within a year was found in every part of the district of supply. A similar thing happened in Torquay, and in another case an important metered supply was blocked up on four successive days and an electric lighting station was forced to close down at the time of maximum load, because the meter was blocked. The trouble, however, was overcome by the installation of mechanical filters near the reservoirs.

Trouble arose in the Cardiff waterworks owing to the presence of sponges and in 1911 the growth was so extensive as to cause great anxiety, not only by the reduced flow in the pipes, but also on account of the unpleasant odour. The chief trouble was in a 36 in. main, which was encrusted with a luxuriant growth of sponges, some eight inches long. Local scouring and treatment with strong brine proved successful.

Fresh-water mussels may suddenly appear and in the spring of 1912 the diameter of a 36 in. unfiltered water main at Hampton-on-Thames was reduced to 9 in. It is said that 90 tons of shells were removed.

Minute crustaceans, such as *Cladocera* and *Copepoda* and others may appear in overwhelming quantities. On one occasion in Antwerp the water flea, one of the *Cladocera*, appeared in such swarms that they continually clogged the screens through which the water passed on to the filters. During several weeks six men were employed day and night changing the screens. Ten tons of these organisms were removed. These are only a few instances, but there are scores of other animals that depress the soul of the water engineer.

Algæ are of considerable importance in waterworks, sometimes beneficial, but sometimes the reverse. They purify the water by means of the oxygen they liberate and also are most useful as a purifying film in sand filters. On the other hand they may taint the water by their decomposition and clog the filters by their remains and sometimes cause disagreeable tastes and odours. Diatoms are found in large numbers and the skin or film which forms on the surface of sand filters is to a large extent composed of diatoms, which, on account of their gelatinous coating, stick to the sand grains and gradually fill up the interstices, thereby forming an effective mechanical filter. There are also many floating plankton forms of life that cause great trouble.

The plant life just referred to can only live and thrive in uncovered reservoirs where there is light, but there are bacteria, such as *Crenothrix*, which infest reservoirs and pipes, especially where iron and organic matter is present in solution. It flourishes both in the light and the dark and will suddenly make an unexpected appearance, becoming a great nuisance. The water becomes discoloured by the iron, putrid owing to the decaying protoplasm and the pipes become choked with gelatinous and hardened deposits. The remedy is to aerate the water in order to oxidise the ferrous salts with the insoluble ferric salts, which can be removed by sand filtration. There have been several serious outbreaks of *Crenothrix*. It suddenly appeared at Cheltenham in 1896, and Berlin and Rotterdam have both had to face great difficulties from this cause.

The Liverpool Water Supply

The Lake Vyrnwy undertaking was completed in 1893, the watershed covering 123,150 acres, and the water travels 18 miles to Oswestry, where it passes through sand filters and then travels another 60 miles to Liverpool. There are twelve filter beds at Oswestry with a total area at the top of the sand of 9¾ acres. After about five weeks' use the surface of the filter gets so clogged up that it has to be cleaned by scraping away the surface. After this has been done a number of times the filter has to be re-sanded. The scrapings are taken to a washing machine and the clean sand can be used again. The pipes from Oswestry to Prescot have never given serious trouble, which shows the efficiency of the sand filters.

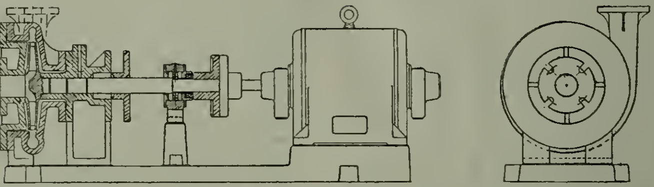
The Liverpool Corporation owns the gathering ground surrounding Lake Vyrnwy and very great care is taken in order that the water shall not be polluted in any way. No houses, of course, are allowed near the Lake unless they drain off the watershed below the dam. It was undesirable to have so much land unproductive if it could be used for some purpose that would not damage the purity of the water, so an afforestation scheme was started and is being extensively carried out with Government help, 1290 acres having been planted. The species of trees which have given the best results are Douglas fir, common spruce, Sitka spruce, European and Japanese larch, whilst other varieties planted include Corsican pine, silver fir, Weymouth pine and beech. The trees are grown from seedlings and several plantations nearly 20 years old have been cut down and replanted. The wood is sold mostly for pit props. There is, however, a large quantity of thinnings and waste that has to be got rid of somehow, so a small plant has recently been installed for the manufacture of wood wool and also hurdles. About 250,000 trees are planted each year now and it will not be long before there are 4000 acres under cultivation. It is a much debated point whether the forests help towards increasing the quantity of water or help its purity; at any rate the land cannot be used for any other purpose and it is a pity that in this country there are not far more and larger tracts of land under forestry cultivation.

Rivington gathering ground covers 10,000 acres, and there are eight reservoirs with a total water area of 600 acres, the total storage capacity being 4105 million gallons. The water is filtered through sand filters at Horwich.

Dr. H. E. Cox has resigned the office of Hon. Secretary of the South Wales Section, which he has held since its inception as part of the old Bristol and South Wales Section some six years ago, on account of his removal to London. The Committee has nominated Mr. H. W. Webb, M.Sc., the present Hon. Treasurer, to be Hon. Secretary, and Mr. Webb has consented to take over the duties from December 1 next.

ACID-PROOF CENTRIFUGAL PUMPS

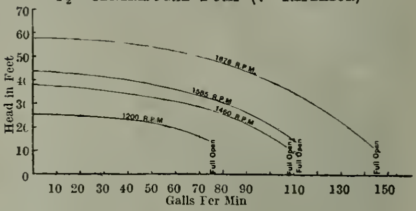
As is well known by bitter experience to technical chemists and chemical engineers, one of the most difficult operations has been the pumping of strongly acid and corrosive liquors. Within recent years, however, remarkable progress has been made with the invention of acid-proof metals, such as, for example, special cast iron with a very high silicon content, and in this connexion one British firm that has done much valuable work is Messrs. Meldrum Bros., Ltd., of Timperley, near Manchester, the well-known makers of destructors and steam jet furnaces, hand or mechanically fired. Messrs. Meldrums commenced the manufacture of acid-proof metals some years before the war, and supplied various simple parts such as pipes and bends. It is not particularly difficult to invent an acid-proof cast iron, but the trouble is that the majority of such metals are almost impossible to work, as they will not pour properly in the foundry, and are intensely hard and brittle, so that castings of any complexity cannot be machined. However, very extensive experience obtained during the war has enabled Messrs. Meldrums to produce a metal that will resist attack by not only sulphuric, nitric, and acetic acid of any strength and temperature, but also even more difficult materials such as chlorine liquors, and which at the same time, by means of special machinery, can be worked satisfactorily in the foundry and the machine shop. As a result there is now available a whole range of centrifugal pumps, particularly difficult work, made entirely of "Meldrum" non-corrosive metal, in which the volute and delivery branch is in one casting, manufactured in standard sizes, the largest being 8 ins. diameter, with a delivery pipe for a height of 120 ft.



2″ M.M. Pump-Motor Driven.
Scale 3″=One Foot.

The set of curves illustrated show the performance of a typical motor-driven pump of this character running at four different speeds, the dimensions of the pump being 2-in. suction pipe, $1\frac{1}{2}$-in. delivery pipe, and 7-in. impellor. As will be seen, the duty of this small pump at 1585 revs. per minute corresponds to about 112 gallons per minute to a height of 44 ft., and in general the performance indicated by these representative curves is quite equal to that of an ordinary centrifugal pump made of cast iron or bronze.

$1\frac{1}{2}$″ Centrifugal Pump (7″ Impellor)



A metal of this character is, of course, useful in all kinds of ways, as for example in the construction of compressed-air mechanical elevators, in which a metal plunger is used operated by the air so that the latter does not come into contact with the acid, and altogether most of the difficult problems connected with the automatic handling of acids can now be regarded as solved.

BRITISH DYESTUFFS CORPORATION, LTD.

It is announced that a scheme of reconstruction of the capital of the Corporation is under consideration by the Board, and an announcement will be made to shareholders as soon as definite proposals can be made. The Corporation has an authorised share capital of £10,000,000 in £1 shares, made up of £4,500,000 preference, £4,500,000 preferred ordinary and £1,000,000 deferred ordinary, of which £4,119,952 preference, £4,090,760 preferred ordinary and £994,190 deferred ordinary shares have been issued. The Government holding consists of 850,001 preference and 850,000 preferred ordinary shares.

FORTHCOMING EVENTS

Dec. 3. Society of Chemical Industry, *London Section*, in the Chemical Society's Rooms, Burlington House, W. 1, at 8 p.m. (1) "The Use and Preservation of Building Stone," by J. A. Howe. (2) "The Chemical Aspect of Building Stone Decay," by Dr. J. J. Fox and T. W. Harrison.

Dec. 5. Society of Public Analysts, The Chemical Society's Rooms, at 8 p.m. (1) "Crystalline Bromides of Linseed Oil," by H. Toms, M.Sc. (2) "The Plea for Standardisation," by M. S. Salamon, B.Sc. (3) Note on the Estimation of Chromium," by H. T. S. Britton, M.Sc. (4) "The Colorimetric Estimation of Lead in Cream of Tartar," by R. L. Andrew. Dinner to be held at 178, Piccadilly, at 6.30 p.m.

Dec. 6. The Chemical Society, Burlington House, Piccadilly, W. 1, at 8 p.m. (1) The additive formation of four membered rings. Part III. A system of nomenclature for heterocyclic four membered rings and the formation and properties of some derivatives of β-methylenediimineoxide. C. K. Ingold. (2) The dependence of polarisation-overvoltage on hydroxyl and hydrogen ion concentration. Part I. Polarisation-overvoltage of an antimony cathode in aqueous alkaline solution. H. J. S. Sand and E. J. Weeks. (3) Stereoisomerism and local anæsthetic action in the β-eucaine group. Resolution of β- and iso-β-eucaine. H. King. (4) β-alizarin. An isomeric form of alizarin. A. Green. (5) The isomerism of the oximes. Part XV. The supposed fourth benzildioxime. O. L. Brady and F. P. Dunn. (6) The alternation in the heats of crystallisation of the normal monobasic fatty acids. W. E. Garner and F. C. Randall.

Dec. 6. Society of Chemical Industry, *Bristol Section*, The University, Woodland Road, Bristol, at 7.30 p.m. "Some Reminiscences of an Alkali Inspector," by R. D. Littlefield.

Dec. 7. Society of Chemical Industry, *South Wales Section*, The Technical College, Cathays Park, Cardiff, at 7.30 p.m. "Coke Ovens," by T. G. Watts, B.Sc.

Dec. 7. University of London, University College, Gower Street, W.C. 1, at 8 p.m. "The Fundamental Concepts of Natural Science," by Prof. G. Dawes Hicks.

Dec. 7. Society of Chemical Industry, *Manchester Section*. Joint Meeting with the Manchester Section of the Institution of Rubber Industry, Midland Hotel, Manchester, at 7.30. "The Analysis of Rubber Vulcanising Accelerators," by T. Callan, M.Sc.; "Methods to be Adopted in Comparing the Activity of Various Accelerators," by G. Martin, B.Sc.

SOCIETY OF CHEMICAL INDUSTRY

HARRISON MEMORIAL PRIZE

In accordance with the trust deed governing the Harrison Memorial Fund, a Selection Committee consisting of the Presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry and the Pharmaceutical Society will meet shortly to consider the first award of the Harrison Prize.

The Prize, which is of the approximate value of £150, is to be awarded to the chemist of either sex being a natural born British subject and not at the time over thirty years of age, who, in the opinion of the Selection Committee, during the previous five years has conducted the most meritorious and promising original investigations in any branch of pure or applied chemistry and published the results of those investigations in a scientific periodical or periodicals.

Provided that in the opinion of the Selection Committee there is a candidate of sufficient distinction to warrant an award of the Prize, the first award is to be made in December, 1923.

The Selection Committee is prepared to receive applications, nominations or information as to candidates eligible for the prize. Any such communication must be received by the President of the Chemical Society, Burlington House, Piccadilly, London, W. 1, not later than Monday, December 10, 1923.

GLASGOW SECTION

The second meeting of the session was held in the Institution of Engineers and Shipbuilders, Elmbank Crescent, on November 23, Mr. W. E. Moodie, in the chair, when a paper on "Artificial Resins" was read by Dr. H. Hepworth.

The subject was introduced by brief reference to the natural resins, and it was pointed out that, despite the advanced state of modern organic chemistry, practically nothing was known of the constitution of these bodies since their amorphous nature made investigation by the usual methods impossible. Dr. Hepworth then touched on the early history of artificial resins, saying that no doubt the first chemist to make such a substance was just the first worker on organic chemistry. The various types of resinous condensation products were briefly described; of special interest were the resins from furfural, now available in large quantities as a product of hydrolysis of corn cobs and from acrolein, a compound closely studied by French workers during the war and employed by them in gas warfare. The application of tetrahydronaphthalene as a solvent for synthetic resins was mentioned.

During the discussion which followed Mr. W. H. Nuttall pointed out that synthetic resins were definitely superior to natural resins in electrical transformer work.

NOTTINGHAM SECTION

Mr. S. F. Burford presided over the meeting held on November 21, and a paper was read by Dr. H. S. Holden and Mr. J. E. T. Gilbert, entitled " Observations of some Micro-organisms growing in Glycerol." In general glycerol has a lethal action on bacteria and this fact is made use of in the sterilisation of calf lymph (for use in vaccination). A 50 per cent. solution of glycerol is commonly used in biological laboratories and examination of a stock solution which had not been used for some time showed a white flocculent precipitate. Microscopical examination of this substance revealed one dominant mould (a species of *Pencillium*) and several kinds of yeast. Investigations of two of the most important of these yeasts showed one which produced smooth circular white colonies in agar, and the other which was pink and had similar characters. The white yeast grew well in all the ordinary laboratory media, but most freely on beerwort agar at 34° C. It did not ferment lactose, but maltose and saccharose were fermented very slowly. Glucose was fermented rapidly with the formation of acid and gas, and glycerol was fermented with the production of traces of alcohol and formic acid. It grew freely in solution from 5 to 20 per cent. concentrations with the formation of acid, and more slowly even in 50 to 75 per cent. solutions. The pink yeast resembled the white one in its tolerance of high concentrations of glycerol, but fermented glucose only of the carbohydrates mentioned. The effect of the yeasts was to produce general cloudiness in the glycerol, and the flocculent deposit was developed as a result of infection by moulds. Probably both the pink yeast and fungus were due to air contamination, though the white yeast might be derived from the glycerol itself. It had not been found possible to identify this white yeast with any known species, although it resembled the *Saccharomyces Hanseni* isolated by Zopf from cotton-seed oil. The growth of both yeasts and mould was inhibited by the addition of two drops of chloroform water (B.P.) to 10 c.c. of the culture solution.

Mr. H. Droop Richmond said that Dr. Holden had mentioned that the lethal action of glycerol in micro-organisms was possibly due to the precipitation of the proteins. Mr. Richmond was not aware that glycerol acted as a protein precipitant, and considered that it produced plasmolysis, especially as the attenuated growth indicated an increase of osmotic pressure within the cell.

In reply, Dr. Holden stated that Mr. Richmond's view of the plasmolytic influence of glycerol was not at variance with his suggestion as to the protein-precipitating action of glycerol. Glycerol in dilute solutions caused the living matter to shrink inwards from the cell wall, the reverse process occurring if the cell was subsequently immersed in water. A state of irreversible plasmolysis resulted from the immersion in higher concentrations of glycerol and was probably accompanied by protein precipitation.

A second paper was read by Mr. Lambourne on " Organic Compounds of Tin," in which he described some properties of methyl-stannonic acid as first prepared by Mayer. The constitution of this substance was represented by the formula $CH_3 \cdot SnOOH$, and he described a new class of acyl derivatives, which were of a decidedly more complex type—probably derived from a condensation of three molecules of the ortho form of the methyl stannonic acid $CH_3Sn(OH)_3$. Two distinct types of such derivatives had been prepared, each containing three tin and three oxygen atoms alternately combined. One type appeared to be a straight chain of such atoms, and the other of cyclic structure $(CH_3SnOOR)_3$. Further work was proceeding which seemed to show that other derivatives existed of even higher polymerised constitution, where six tin and six oxygen atoms were alternately combined as represented by $(CH_3SnO.OR)_6$.

Dr. Prideaux then gave a demonstration of a universal regulator of acidity, with some suggested uses in analysis. After a short explanation of the symbol p_H and of the advantages of this function in quantitative work, it was shown how rapid changes of p_H with added alkali, etc., correspond to good titrations, whilst gradual changes corresponded to good hydrion regulations such as were given by buffer mixtures. The principle of improving the regulation by the introduction of acids having intermediate dissociation constants was illustrated by means of the "B.D.H." Universal buffer mixture and Universal indicator. In examining beer in this way, pure litmus should be added which should give a red, and to another sample bromphenol blue which should give a violet, thus proving that the p_H lay between the normal limits of 3·9 and 4·7. The exact p_H could then be determined with the universal buffer, *e.g.*, methyl red. The accuracy could be improved by placing behind the buffer standard a test tube of beer without indicator, in order to compensate for the natural colour of the beer. Suggestions were also made for testing the p_H of milk, and of vinegar.

Mr. Burford enquired what was the advantage in taking the p_H of ordinary drinking water. Mr. Calam mentioned that the p_H values of vinegar and beer were very similar but the two substances tasted very differently. What was the sensibility of the palate towards liquors of low acidity ? Dr. J. B. Firth said that the buffer mixture invented by Dr. Prideaux was very good, but he would like to see a universal indicator produced which would show greater sensitiveness. At present the universal indicator was limited, as between certain ranges of p_H only slight colour changes resulted.

In reply, Dr. Prideaux said that the determination of the p_H alone in drinking waters would not give much information except in certain special cases, but it was a very useful datum, when taken in conjunction with the other chemical properties of the water. The sensitiveness of the palate to p_H had been found; his impression was that 0·001 N was about the limit, but it varied considerably according to whether the p_H was produced by a strong acid in low concentration or a weak acid in higher concentration. There was great difficulty in devising a universal indicator which should be equally sensitive in all ranges of p_H, since the colour of each changed two-colour indicator tended to mask that of the next. Work was proceeding with the object of improving the indicator.

YORKSHIRE SECTION

The second meeting of the session was held in the Queen's Hotel, Leeds, on November 19, when an address on "The Work of the Chemist in Connexion with the Textile Industries" was delivered by the chairman, Mr. L. L. Lloyd.

In the opening portion Dr. Lloyd dealt with the production of artificial fibres, discussing the Chardonnet, cuprammonium and viscose silks, their oxycellulose content, variation in composition of the thread, dyeing properties and the question of the non-replacement of all the nitrogen in the Chardonnet thread by any reduction method. After touching upon the facing of cotton with artificial silk, Dr. Lloyd described the treatment of cotton. Treatment with soda and the phosphoric esters of cellulose to modify printing was mentioned, and the want of permanent effect was ascribed to the formation of free acid. The Swiss sulphuric acid treatment gave a permanent effect on the other hand, produced a flexible, linen-like fibre which possessed good dyeing properties and good modification was given by formaldehyde.

Far less work has been done with vegetable than with animal fibres. The bisulphite treatment of coarse fibres to produce the more valuable finer ones was successful in the laboratory, but it had not yet been put into practice and the whole question demanded the attention of the chemist. Further, there was ample scope for the chemist in attempting to fix properties such as elasticity in combinations of vegetable and animal fibres. Again, scouring practice efficiency was far ahead of theory owing, in the first place, to the large amount of experimental work with a large number of substances, often somewhat indiscriminately chosen and which resulted ultimately in good efficient methods. For physico-chemical reasons one colloid would be expected to be as good as another, but it was not so, and when a mixture of colloids was used, there was a gain in efficiency. The use of solvents, dichlorethylene and mixtures, and the work of Sugden and McBain were examined. The scouring efficiency was not entirely due to lowering of the surface tension and merely to colloid action, but was due also to chemical action as the fibre was altered into a form more suitable for technical purposes. The action of alkali was cited in support of this conclusion.

The address was highly successful in provoking a good discussion, nearly every member present taking part. The discussion largely concerned wool; methods of increasing the lustre and the causes of uneven dyeing being the chief points.

AMERICAN SECTION

At a recent meeting of the Perkin Medal Committee, Dr. F. M. Becket, of the National Carbide and Carbon Co., Niagara Falls, N.Y., was elected to be the recipient of the medal, which will be awarded at the meeting on January 11. We append a few notes on Dr. Becket's work that have been furnished by the Honorary Secretary of the American Section. Due to his unusually busy life and a modesty which has found satisfaction in successful endeavour rather than public approval, Dr. Becket's work has been published through his many patents rather than in technical papers. Probably his most noteworthy achievement was the discovery and development of the process for reducing ores by silicon. The method has a wide application to many ores of the most valuable metals, and makes possible the economic production of a superior quality of low carbon alloy well adapted to the manufacture of high-grade engineering and tool steels.

Dr. Becket was the first producer of ferro-vanadium on anything approaching a commercial scale, certainly in the United States, and probably in the world; he was one of the first producers, if not the earliest, of molybdenum by direct smelting methods, and by his work on calcium-carbide manufacture, he has done much to make possible the increase from 500 h.p. production units to the present-day furnaces of over 20,000 h.p. During the war he solved important problems in connexion with the production of zirconium, and he has now shown that zirconium is likely to prove one of the most beneficial of the scavenging and alloying elements in steel manufacture.

Although his greatest achievements have been in the electro-metallurgical field he has also accomplished notable work in the electro-chemical and chemical-engineering fields. His connexion with the experimental stages of the Acker Process was certainly partly responsible for its ultimate development to a manufacturing scale. Various methods for the elimination of harmful impurities from ores, particularly in the treatment of tungsten ores, are due to him, and he has also devised valuable methods of analysis for various alloys and the impurities usually found with them. The above is but a brief résumé of Dr. Becket's varied activities and the list of patents issued to him will illustrate better the scope, and particularly the practicability, of his activities. As well as for his technical ability, Dr.Becket, is esteemed for his many charming qualities and for his high ethical standard

MANCHESTER SECTION

The Annual Dinner was held on November 23, and there was a very large number of guests, including the Mayor of Salford (Alderman J. P. McDougall); Prof. H. B. Dixon, C.B.E., F.R.S.; S. J. Pentecost, Esq.; Alderman F. J. West, C.B.E., M.I.Mech.E.; Dr. E. F. Armstrong, F.R.S., President of the Society of Chemical Industry; Dr. H. Levinstein, Chairman of the Manchester Section; Dr. E. Ardern, Vice-Chairman of the Section; Prof. F. L. Pyman, D.Sc., F.R.S.; Mr. J. Huebner, M.Sc.Tech.; Mr. L. Guy Radcliffe, M.Sc.Tech., and others. The proceedings were characterised by a pleasant informal spirit which made them particularly enjoyable.

The Mayor of Salford (Alderman J. P. McDougall) proposed the toast of "The Society of Chemical Industry and the Manchester Section" in a humorous speech, which was responded to by Dr. E. F. Armstrong and Dr. H. Levinstein in a similar manner.

Dr. H. Levinstein then proposed the toast of the "Allied Societies," coupled with the names of Prof. H. B. Dixon, C.B.E., F.R.S., President of the Manchester Literary and Philosophical Society, and Mr. S. J. Pentecost, President of the Society of Dyers and Colourists, and referred to the felicitous relations which had always existed between the three societies. The toast was responded to by both Prof. Dixon and Mr. Pentecost.

Dr. E. Ardern, in proposing the toast of "The Guests," coupled it with the name of Alderman F. J. West, C.B.E., M.I.Mech.E., and said they were all very proud to welcome in their midst, the civic head of the neighbouring royal Borough of Salford. They were also especially pleased to welcome the President of their Society, and also their General Secretary, Dr. Longstaff, who had laboured so earnestly and faithfully in the interests of the Society. They also welcomed Alderman West, who came among them as the representative of the Manchester Corporation and who was one of the busiest industrial men in Manchester as well as Chairman of the Rivers Committee, a body dealing with the disposal and treatment of the waste products of the city. Manchester owed a great debt of gratitude to Alderman West for the highly efficient way in which he had fulfilled his municipal duties. Alderman West, in acknowledging the toast, referred to the ever-increasing closeness of relationship between the present-day chemist and engineer. Both professions realised that it was absolutely necessary for each side to understand the point of view of the other if there was to be adequate coordination of effort and resultant perfection of output.

The third meeting will be held in the Textile Institute, 16, St. Mary's Parsonage, Manchester, on Friday, December 7, at 7 p.m. This meeting has been arranged jointly by the Manchester Sections of the Society of Chemical Industry and the Institution of Rubber Industry. Dr. H. Levinstein will be in the chair, supported by Mr. J. H. Mandleberg, M.A., chairman of the Manchester Section of the Institution of Rubber Industry. The following papers will be read:—

(1) "Methods to be adopted in comparing the activity of various Accelerators," by G. Martin, B.Sc. (Superintendent, Rubber Investigations, Imperial Institute, representing the Institution of Rubber Industry). The simplest and most generally applicable method for the determination of the potency of an accelerator consists in mixing rubber with sulphur, zinc oxide and an accelerator and vulcanising in steam. The effect of the variable factors on the figures obtained for potency is considered in detail.

(2) "The Analysis of Rubber Vulcanising Accelerators," by T. Callan, M.Sc., Ph.D. and N. Strafford, B.Sc. (representing the Manchester Section of the Society of Chemical Industry). The identification and quantitative determination of the chief commercial organic rubber vulcanising accelerators, including phenolic and nitroso compounds, the aryl guanidines thiocarbanilide, the metallic and alkyl ammonium salts of alkyl dithiocarbamic acids and the alkyl thiuram disulphides.

CHEMICAL INDUSTRY CLUB

The fifth annual dinner was held on Monday, November 26, at the Connaught Rooms, Great Queen Street, London. Mr. H. Edwin Coley (chairman of the Executive Committee of the Club) presided, and there were a number of distinguished guests present, including Lord Exmouth, Sir Lionel Phillips, Bart., and Sir Arthur Duckham. The company also included Mr. W. Cullen, Mr. A. G. Craig, Mr. C. J. Goodwin, Mr. F. W. Harbord, Prof. J. W. Hinchley, Sir W. J. Pope (president of the club), Dr. B. Dyer, Mr. C. A. Ellis Richards and Mr. J. Arthur Reavell.

The loyal toasts having been duly honoured, Sir Lionel Phillips, Bart., proposed the toast of "The Profession and Industry of Chemistry." and coupled with the toast the names of Sir Arthur Duckham and Mr. Harbord.

Mr. F. W. Harbord, C.B.E., F.I.C., responding, said there was no profession—not even the engineering profession—which was brought into more intimate relation with all the industries of the country than the chemical industry. Even engineering would have been impossible but for the chemist; without a Bessemer or a Siemens engineering as we know it to-day would have been impossible.

Sir Arthur Duckham, K.C.B., said he was an engineer who had possibly learned how to talk to the chemist, which was an extremely difficult thing to do. He was very glad to have been asked to attend the dinner, because he was very interested in the chemical industry, and was instrumental, more or less, in forming the new Institution of Chemical Engineers, of which he was the first president.

Sir William Pope, K.B.E., M.A., LL.D., F.R.S. (president of the Club), proposed the toast of "The Chemical Industry Club." After expressing his appreciation of the fact that he had been elected president, he said the Club was looked upon as providing a social link between all the great interests of chemistry, the great corporate interests which were represented by the large chemical societies, and all chemists who had the interests of chemistry at heart hoped that, sooner or later, we should be able to convert all those societies into one great homogeneous whole, housed in a palace which, however magnificent, would never be quite appropriate to what chemistry deserved. The membership of the Club included a variety of different types of people—the chemical manufacturer, the business man and the downtrodden professional class, which he had the honour more intimately to represent. The Club had been going on for, roughly, five years, and had become very important; he believed that it was going to become a sort of "key" Club to the whole of the chemical fraternity. But the members of the Club ought to conserve very carefully a recollection of the men who founded it in face of a good deal of opposition, and should be everlastingly grateful to those men. One of the founders was Mr. Coley (the chairman), whom he (Sir William Pope) hoped to see in the chair for a long time to come. He paid a tribute to Mr. Coley and coupled his name with the toast.

The toast was honoured with enthusiasm.

The Chairman, in response, said that a great deal of work had been done on behalf of the Club by others as well as himself, and he paid a personal tribute to Capt. C. J. Goodwin for the great efforts he had made as Treasurer, from which office he had found it necessary to resign, and to Dr. Hodgkinson and Mr. A. C. Craig, the previous chairmen. It had always seemed to him that those connected with the industry, and particularly the profession, were so immersed in knowledge that they had no time to rest, but it was the object of the Club to provide them with a resting place in which they would have an opportunity of relieving their minds from the constant strain to which they were subjected. As to the future, he believed that, on the Club, the chemical industry could build a real organisation which would be an honour to the industry, and a centre for the whole industry and profession. The Club was the one concern connected with the industry and profession which was unbiassed and uninfluenced by any particular person or persons connected with the trade, and it was on that, he believed, that the future Club would be built.

Mr. W. Cullen then proposed "The Guests," to which Prof. J. W. Hinchley replied.

Mr. A. G. Craig proposed the final toast of "The Chairman." Those who had been connected with the Club for seven years knew the amount of work he had done. On behalf of the members of the Club, he presented to Mr. Coley a gold half-hunter watch, as a mark of appreciation for his untiring work as the Club's first Honorary Secretary.

The toast was honoured enthusiastically, and the Chairman briefly replied.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

During the recent Congress held in Paris (*cf. Chem. and Ind.*, pp. 1082 and 1107, 1923) some interesting discussions took place before Group XI (cellulose and plastic materials), under the presidency of Monsieur de Chardonnet, the inventor of the artificial silk which bears his name. Monsieur M. Jaffard described researches on the preparation of cellulose from the wood of *Pinus maritima*, and gave the results obtained on nitrating it. Monsieur H. Gault gave an account of new mono-, di-, and tri-esters of cellulose, and of the higher fatty acids. The mono-esters are usually insoluble in the common solvents, whereas the di-esters are soluble and can be obtained in yields of 80 per cent. The latter are insoluble in alcohol and acetone. Specimens were shown of dilaurate, distearate and dipalmitate of cellulose, as well as films obtained by evaporating solutions made with volatile solvents. These products promise to be useful industrial materials as the films obtained from solutions in benzene or chloroform are translucent, supple, non-inflammable and resistant to water. Mixed celluloses of definite composition were also obtained that showed properties differing according to the acid radicles which they contained. Interesting di-esters were also obtained from starch without previously rendering it soluble. In a paper on the analysis of synthetic camphor, Monsieur Zelger stated that the true camphor was estimated by precipitation in the form of semi-carbazone, the reaction being almost quantitative. The same author also dealt with the dynamometry of plastic materials, and discussed the conclusions that could be drawn from the yield point of a plastic material, and from its breaking point. MM. L. Clément and C. Rivière read communications on the colloidal nature of cellulose and cellulose esters, in which they discussed the colloidal properties of the cellulose molecule in different compounds, paying particular attention to the researches of H. Gault, Maurice Deschiens and P. Guilleminot on certain related points (*Bull. Ser. Techn. de L'Aeronautique Militaire Francaise, No.* 27, 1919), comparing them with those obtained by Mardles (*cf. J.*, March, 1923). MM. Clément and Rivière also read a paper on the present state of the industry of plastic materials and artificial textiles

Before Group X (rubber and resins), the new method of treating latex and the theories of vulcanisation, and of the preservation of rubber, were discussed by MM. Bongrand, Bory and Bernstein. Oil of turpentine and rosin were dealt with by M. D pont, and M. Cunénot advocated dipterocarpus oil as a substitute for turpentine. Other subjects discussed were the new antimony and titanium pigments, the resistance of paint to sea-water, and new varnishes made from synthetic resins.

FARADAY SOCIETY

Summaries of the papers read at the meeting held on November 12 are appended :—(1) Part 1. "The Electrodeposition of Manganese," by Prof. A. J. Allmand, M.C., D.Sc., and A. N. Campbell, B.Sc. The electrodeposition of manganese from aqueous solutions of its sulphate and chloride was studied, and the effects of changes in composition of electrolyte, current density, temperature and type of cell investigated. It was found that pure manganese in coherent form could be prepared in small quantity with a current efficiency of 40–50 per cent. Attempts to prepare larger amounts in coherent form, however, were unsuccessful.

(2) "An Investigation of Smoluchowski's Equation as Applied to the Coagulation of Gold Hydrosol," by L. Anderson, B.Sc., Ph.D. Colorimetric determinations of the rate of coagulation of gold sols by hydrochloric acid, potassium chloride, barium chloride and aluminium chloride were carried out, using the method of Hatschek, and in agreement with previous investigators, a region of rapid coagulation was found in which Smoluchowski's equation holds fairly well. The equation held most satisfactorily with a certain concentration range of barium chloride as coagulant. A slower region of coagulation was found in which the equation is inapplicable. It was concluded that the Smoluchowski equation in its present form was strictly limited to rapid coagulation. Certain of the results obtained could be interpreted as indicating considerable variations in magnitude of the charge on individual primary particles of the sol.

(3) "The Cathodic Behaviour of Alloys. Part 1. Iron-Nickel Alloys," by S. Glasstone, M.Sc., Ph.D. The investigation brought to light a number of new facts concerning the electrode deposition, overvoltage and action of nickel-iron alloys in the presence of depolarisers. Suggestions were offered to account for some of the observed facts, but a fuller discussion of their significance in connexion with the theories of over-voltage, delayed cathodic deposition, and cathodic reduction, was postponed until further information was available.

(4) "The Catalytic Decomposition of Hydrogen Peroxide Solution by Blood Charcoal," by J. B. Firth, D.Sc., and F. S. Watson, M.Sc. It was found that blood charcoal previously heated to 120° C., showed moderate catalytic activity in the decomposition of hydrogen peroxide solution, the activity being considerably increased by previous heating in a vacuum at 600° C. and 900° C. and still further by previous sorption of iodine from solution, the iodine being subsequently removed. The activity of an activated charcoal consisted of two types : α activity which was very rapid, but ceased after a few minutes, and β activity, which may persist for several hours. Both types could be increased by activation methods. In ordinary blood charcoal α activity was absent. The introduction of iron into sugar solution prior to carbonisation considerably increased the activity of the charcoal, and it was suggested that the iron acts as a spacing agent, thereby increasing the activity of the carbon itself. The velocity of decomposition varied with the concentration of the hydrogen peroxide solution. The proportion of hydrogen peroxide decomposed was determined by *both* the activity of the charcoal and the concentration of the hydrogen peroxide solution. With highly active carbons, the heat generated by the rapid decomposition of the hydrogen peroxide, raised the temperature of the reaction, temporarily, thereby maintaining the velocity of reaction at a higher level until this heat was dissipated.

(5) "The Effect of Sucrose on the Rate of Coagulation of a Colloid by an Electrolyte," by Leonard Anderson, Ph.D. The author investigated the coagulation of gold sols by hydrochloric acid, barium chloride and potassium chloride in presence of varying amounts of sucrose, and concluded that sucrose exerts a definite peptising effect upon colloidal gold, and that it exerts a specific augmentation of coagulation in the case of hydrogen and barium ions over and above that of increasing the activity of these two ions. The experiments indicate in general, however, that the coagulation power of an ion depends upon its activity rather than upon its concentration, a conclusion which brings the typical colloid phenomenon of coagulation into line with the kinetics of

chemical change in homogenous (molecular) systems.

(6) " The Properties of Powders. Part VIII. The Influence of the Velocity of Compression on the Apparent Compressibility of Powders," by E. E. Walker, D.Sc. The Influence of the duration of the load on the volume ratio of compressed powder was investigated, and the isobaric curve was correlated with the value of the ratio resistance to impact resistance to static load, and further evidence for the validity of the classification of powders suggested in Part VI of these studies obtained.

(7) " The Volumes Occupied by the Solute Atoms in certain Metallic Solid Solutions and their Consequent Hardening Effects," by A. L. Norbury, M.Sc. Cold-hammering had the effect of closing up minute blow-holes in copper. Very severe cold-hammering set up stresses and strains in the metal, which probably caused local increases and decreases in density. Otherwise cold-hammering did not affect the density. Commercial copper had a distinctly lower density than cathode copper. When an element was distributed in solid solution as single atoms replacing single atoms of the solvent in the space-lattice of the latter, the hardening effect was, in general, proportional to the difference in size of the solute and solvent atoms. The above relationship did not hold in certain exceptional cases (viz., Si in Cu and Na in Pb), which appear to arise when the solute has an exceptionally strong " chemical affinity " for the solvent. In such cases the solute probably exists in solid solution in the form of molecules of an inter-metallic compound having a different space-lattice from that of the solvent, the interference with slip and consequent hardening being relatively much greater in this type of solid solution. When an element formed a solid solution with another element, there was a certain contraction or expansion which seems to be large or small according to whether the " chemical affinity " between the elements is large or small.

(8) " A Method of Measuring the Rate of Coagulation of Colloidal Solutions over Wide Ranges," by H. H. Paine, M.A., B.Sc., and G. T. R. Evans, B.Sc. The rate of coagulation of colloidal copper solutions was studied for a wide range of electrolyte concentrations by making use of the retarding effect of starch, very rapid coagulations thus being brought into the region of observation by ordinary methods. A " transformation factor " could be obtained with which it could be calculated what the rate of coagulation would have been for the pure colloid. The results of these experiments agree closely with the equation deduced by Freundlich for the variation of the rate of coagulation with the concentration of the electrolyte. In particular, they confirm the existence of a maximum rate of coagulation. Concentrations of starch below a certain minimum do not influence the rate of coagulation.

CORRESPONDENCE

THE DISCOVERER OF ZYMASE

Sir,—Mr. Duckworth's suggestion in your issue of November 23 that zymase was discovered by Bechamp in 1864 appears to rest on a misapprehension. In the paper in the *Comptes Rendus* to which he refers (1864, 58, 601, April 4), Bechamp, it is true, uses the name *zymase*, but applies it to the agent by which yeast " transforme . . . le sucre de canne en glucose." This agent had previously been extracted from yeast and precipitated by alcohol by Berthelot (*Comptes Rendus*, 1860, 50, 980, May 28), who termed it " ferment glucosique." Bechamp's *zymase*, therefore, had nothing to do with the agent which brings about the alcoholic fermentation of glucose.—I am, Sir, etc., Arthur Harden

The Lister Institute of Preventive Medicine,
Nov. 26, 1923

LINEAR v. LOGARITHMIC RATE OF CHEMICAL CHANGE

Sir,—The address given by the President of the Society of Chemical Industry to the South Wales Section, as reported in your issue of the 16th inst., raises the interesting question of linear *v.* logarithmic rate of chemical change, but I would venture to suggest that Dr. Armstrong presents only one aspect of the case. The statement is made in the report that " the first fact which has emerged from the detailed study of chemical action at a surface is that the action is not one of the so-called first order, in which the same fraction of the reacting substance undergoes change in successive equal intervals of time—a change expressed graphically by a logarithmic curve." Now, whilst this statement is no doubt true of a number of investigations of reaction velocity in presence of solid catalysts, it is by no means true of all, and I desire to emphasise the point that its validity is subject to the special conditions set out in the following sentence (taken from your report) : " when proper and sufficient care is taken to keep the surface active the rate of change is uniform, provided that the changing substance is present at the surface in sufficient quantity." Where, however, the surface is of constant activity, and the concentration of the changing substance is substantially maintained the rate of the reaction, as it seems to me, *cannot be other than linear* in character, irrespective of the mechanism of the change. The observation that the rate of change in some particular case is linear indicates merely, so far as I can judge, that a steady state is being maintained in respect of (1) the activity of the catalyst, and (2) the concentration of the real reacting substance. Such an observation, I submit, cannot by itself throw any light on the mechanism of the reaction.

On the other hand, in a reaction where the catalyst surface retains its activity, but the concentration of the reacting substance decreases with time (a case which surely merits consideration as well as the one put forward by Dr. Armstrong), the rate of change will not be linear in character. In a number of instances belonging to this category which have been examined experimentally and put on record the rate is logarithmic, and the course of the change is represented by the formula for a first order reaction.—I am, Sir, etc.,

James C. Philip

Imperial College, S.W. 7
November 25, 1923

SOLID ABSORBENTS FOR BENZOL RECOVERY

Sir,—May I thank Dr. Chaney for his criticism of my article on the use of solid absorbents for the recovery of benzol from gas? His comments are rendered only slightly less valuable by reason of his natural bias in favour of activated carbon, in the discovery and technical production of which he has played so conspicuous a part. Possibly for this latter reason, Dr. Chaney has failed to note that my article was intended to press the advantages of *solid absorbents in general* and to point to their claims to serious consideration as materials able effectively to replace oil, now generally used in the oil-washing process for benzol recovery. The fact that I devoted a considerable section of my article to a general description of the latter process, and emphasised its relative shortcomings should have been, in itself, sufficient to indicate the main theme of the article. *All* efficient solid absorbents demand attention in regard to their potential application in gas stripping and similar processes, and highly activated carbon is no exception.

The prices demanded for the activated carbons, available in this country, are high, and particularly so if their relative absorptive capacities be taken into account. I have not had an opportunity of testing the American carbon or of comparing it and its truly assessed technical value with inorganic gels, and can argue only upon my experience of English carbons. (I now have direct information that an English engineering company is hoping to work a new process for the production of a highly activated carbon, and expects to be able to produce an efficient material at a low cost. A substantial reduction in the price of a suitable carbon of high activity would materially influence any discussion on the relative merits of carbonaceous and inorganic gel absorbents. I notice, however, that Dr. Chaney gives us no idea of cost of the American carbon.)

For this reason, and this alone, I decided to illustrate the value of solid absorbents in benzol recovery by reference to inorganic gels. My broad view is indicated by the fact which, curiously enough, Dr. Chaney quotes against me, that I made use of data on the value of the solid absorbent, activated carbon, in the process of gasoline recovery from natural gas. I did not and I do not wish to place activated carbon without the pale of discussion in this general matter of the use of solid absorbents.

It would be a poor compliment to Dr. Chaney if I needed his letter to call my attention to many valuable papers on this question due to him and his associates. If I had intended to discuss the question of "Activated Carbon *v.* Silica Gel"—as Dr. Chaney heads his letter—much more space than is represented by a small section of one article would have been required. I have no intention, however, of returning to this matter, for, if the value of solid absorbents wins its rightful recognition, the technologist will soon decide for himself the question of the relative merits of carbon and inorganic gels, and will regard not only over-all efficiency and absorptive capacity per unit of cost, but also the important question of life of absorbent, space-time capacity, and all essential technical details. Inorganic gels, as the writer was fully aware, are water selective—indeed, they have been used with success for drying humid air—but they do absorb benzol from gas, and the interesting work of Dr. Chaney upon the relative selectivities of solid absorbents, whilst recognised and appreciated by the works chemist, will find its final trial in the balance sheet.

That my article was not generally misread has become evident from comments which have filtered through to me, and from the attitude taken by the reviewer in an important gas journal. The use of solid absorbents to replace oil in the process of benzol recovery from gas merits attention, and my article was intended to emphasise this general question and not to select a particular material and boom it. If I have succeeded in this, my purpose is gained.

Dr. Chaney has performed a service in advancing the discussion of the best solid absorbent to employ, but I cannot but feel that, had he been as fully acquainted with the most highly activated inorganic gels as he is with activated carbon, he would not have been so "surprised," as he claims to have been at my general treatment of the question of the use of solid absorbents for benzol recovery from coal gas and coke-oven gas. The carbonisation industries still hesitate to apply the principle of the new method, and more intimate discussion can profitably await a more general conversion to the basic process.—I am, Sir, etc.,

Rex Furness

November 24, 1923

THE DIFFICULT ENGLISH

M. the Editor.—This week, I make me the task to understand Mr. Chaney. I ask me—"What is the 'activated carbon,' indeed, what he mean by 'carbon'?" I find not in the dictionary the adjective 'activated', only 'active.' 'To activate', I see, is a verb of the much old time, used, by the Lord of Bacon, of a property, not a thing. When I read the Mr. Bone, I find it but he use it of the nitrogen and seem to say it mean 'energy-absorbing', not absorbing of the vapours. I have suspicion of the word ; it seem not of the nice english.

Mr. Furness, I see, speak of the charcoal not the diamond, which only is carbon, I suppose me. Perhaps, the 'activated carbon' is something american ? Mr. Chaney, indeed I notice, say—" Gas adsorbent charcoals are manufactured in the United States exclusively." The absorbing charcoal is long known and understood in England, I suppose. I have read much of the discovery of it by Sir Dewar and that it is used long ago in the world entire in the laboratories.

Mr. Chaney tell us—' Silica gel is hydrophilic or selective for water vapour'. Why speaks he not the american, if he likes not the english ? The so little word 'dry' would be so better than his so long sentence. The englishmen but few know the greek ; the Kakologophilic american not at all. I think, even the Mr. Coolidge, though he say it is good for him. Professor Percy Gardner, it is true, say to us in *The Times* paper, 'you know nothings because you have it not'. He is a big, simple man, I think, who *se broute*—what you say ? browse—on the so superior green lawn of Oxford ; he forget we have translate it all into the english and french more beautiful to us ; he know not perhaps we use it so much in the science that we us ourselves understand no longer and the peoples no word can read we say. We have try to make us understood for the classics men, I suppose—but as the little birds, they will not let us put the of science salt upon their tails. It is sad they live so only in the past.—Your reader most admiring of your efforts, "PARISIAN"

TO OUR PHARMACIST IN (1923+x)

SIR,—I enclose the following verses as a warning to your readers in case your leader of this week's *Chemistry and Industry* may have put queer ideas into their heads :—

Put up your shutters, and lock up your door,
Pharmaceutical Chemists are wanted no more ;
A kindly Bureau has decided to give
Drugs gratis, sufficient as long as we live.

When I sat down with Molly to breakfast to-day,
We had porridge, prepared from a packet marked "K" ;
For after November they mix with our feed,
Either Aspirin (I think) or Quinine-NH_3d.

Our tea has been treated with something they say,
To take the injurious Tannin away.
And I have a suspicion, from tests I have made,
They have kindly put Glauber's in my marmalade.

Since I filled in that form for the "Illness Bureau,"
The Inspector has saved us a chapter of woe ;
But I'm wondering still, when I see him again,
What on earth he will give for my Varicose-vein !

"ATHOS"

November 26, 1923

[It is of interest to note that, according to *Chemical and Metallurgical Engineering*, the authorities at Rochester, N.Y., have decided to eradicate goitre in the district by adding sodium iodide to the water supply, which will now contain 1 part of iodine per 1000 million of water.—ED.]

PERSONALIA

On October 30, the gold medal of the Royal Society of Medicine was presented to Prof. F. Gowland Hopkins.

Prof. F. O. Bower has been elected president of the Royal Society of Edinburgh, and the following have been elected office bearers : Vice-presidents, Major-General W. G. Bannerman, Dr. W. H. Tait, Principal J. C. Irvine, Lord Sadesen, Profs. J H. Ashworth and T. H. Beare ; General Secretary, Prof. R. A. Simpson ; Secretaries of Ordinary Meetings, Dr. A. Lauder and Prof. W. W. Smith ; Treasurer, Dr. J. Currie ; Curator, Dr. J. A. Chrichton Mitchell ; Counsellors, Profs. H. S. Allen, E. M. Wedderburn, T. H. Bryce, J. Y. Simpson, D'Arcy Thompson, Dr. J. Ritchie, Sir R. Greig, Sir J. Walker, Sir G. Whittaker, H. Briggs, W. L. Caldewood and Prof. T. J. Jehu.

The following awards have been made by the Académie des Sciences :—The Santour Prize, to Mr. L. de Forest, member of the American Institution of Radio Engineers ; the H. Wilde Prize, to Monsieur F. Delhaye, for his geological exploration in the Congo ; the Becquerel Prize, to Mr. W. B. Dawson (Canada), for his work on Tides ; the Grand Prix for Physical Sciences to Prof. L. Cayeux, for his work on Iron Minerals ; and the Hirn Prize, to Monsieur G. Eiffel, for his Aerodynamical Researches.

Dr. K. Schirmachen has assumed the direction of the Central Laboratory of the Lucius and Brüning Dye Factory at Höchst, in place of the late Prof. W. Roser. Dr. G. Haegermann, formerly manager of the Karlstadt Main Ludwig Roth A.-G., has been appointed Director of the Laboratory of the Union of German Portland Cement Manufacturers in Berlin. Prof. A. Hesse has resigned from the editorship of the *Chemische Zentralblatt*, and Prof. L. Spiegel has also resigned from the staff of that publication. The vacant places have been filled by Dr. N. Pilücke and E. Behrle.

NEWS AND NOTES

AUSTRALIA

Discovery of Silver-Lead Ore in Queensland

A new deposit of silver-lead ore described as a "second Broken Hill" has been discovered near Chillagoe, Queensland. The outcrop was approximately ¾ mile long and samples averaged 50 per cent. of lead and 50 to 70 oz. of silver. One sample of pure galena assayed 116 oz. of silver and 50 per cent. of lead. Three leases have been granted and arrangements made to treat trial loads.—(*Ind. Aust., Sept.* 6, 1923.)

CANADA

New Low-Temperature Coal-Distillation Plant

The Ford Motor Co. of Canada, Limited, is erecting a coal-distillation plant at Ford, Ontario, with an initial capacity of 400 tons per day, but intended eventually to handle 2400 t. daily. The coke produced will be pulverised and burned under the power-plant boilers, and the surplus gas (about 4000 cb. ft. per ton of coal) will be used in forging and heat-treating steel. Other products will be ammonium sulphate, creosote, benzol, gasoline and kerosene, and lubricating oils and greases, which will not be taken from the oils remaining after the recovery of gasoline, kerosene and cresote, but may be utilised later for burning as ordinary fuel oil. The amount of benzol resulting from high-temperature distillation reaches a maximum of 4½ galls. per t. of coal treated, but in low-temperature distillation, such as will be used at Ford, this amount will be increased to 12 galls. per t. and the resulting material both from a chemical and a physical standpoint will differ from gasoline obtained from petroleum only in that it will contain a larger percentage of unsaturated hydrocarbons. A large percentage of these unsaturated hydrocarbons, however, will be converted synthetically into true gasoline. Benzol production may thus reach 4800 galls. daily and it will be marketed as a substitute for gasoline. Facilities have been provided for the storage of 100,000 tons of coal on the river front. Canadian lignite and bituminous coal will be used. A similar plant on a somewhat larger scale is being erected at the River Rouge plant of the Ford Motor Co., Detroit, but the Canadian plant will be completed and in operation several months before the plant at River Rouge.—(*Can. Chem. & Met., Sept.*, 1923.)

UNITED STATES

Fuel Briquettes in 1922

Owing to the shortage of domestic coal due to the miners' strike, a new high record of production in the fuel-briquetting industry was established in 1922, the total output of briquets being 619,425 tons (valued at $5,444,926) compared with 220,476 t. ($1,812,625) in 1921. Although the total value increased, the average value per ton decreased from $9·10 in 1921 to $8·79 in 1922. Asphaltic pitch and coal-tar pitch continued to be the binders mainly used.

Scientific Research in the Iron Industry

Research in the iron industry meets with difficulties which do not occur in chemical industry proper. In the latter, processes are worked out in the laboratory, the laws governing the reactions involved are known, and each manufacturing stage is continuously under scientific control. The iron industry, however, has grown up in the course of the ages, not so much as a result of scientific research as through a very gradual accumulation of practical experience. Isolated instances of the application of research are, it is true, to be found (*e.g.*, the Bessemer process), but it is only nowadays that an attempt is being made to introduce scientific research in the iron industry, with a view to establishing the laws underlying metallurgical processes.

Against this policy is urged the costliness of research, but there can be no doubt that a generous outlook, such as is found notably in American works, would bring its own reward. Moreover, that research of a purely academic nature may prove of great commercial value is demonstrated by the etching process of A. Fry (*cf. J.*, 1921, 660 A), by means of which it has been possible to recognise stamped markings on steel even after their superficial obliteration by thieves. It is folly to call in the research worker only when something has gone wrong. Every facility should, on the contrary, be afforded him for the study of processes in normal operation, so that, by a careful accumulation of statistical data, he is at once able to detect any abnormality.

Much valuable information may be derived from "frequency curves." Take, for example, the case of a smelting process in which the metallic melt must have a specified carbon content. Analyses of a large number of consecutive melts are made, and a "frequency curve" drawn with carbon content as abscissæ, and the frequency of occurrence of different carbon contents as ordinates. The curve should fall away steeply on either side of a sharp maximum, and any irregularity is at once visible. The reliability of individual workers, including routine analysts, can similarly be checked by means of curves of this type.

The research man should be encouraged to take an interest in practical manufacturing details and may, in some cases, even be placed in charge of processes. It is certainly desirable that the same investigator who has worked out a process in the laboratory should be responsible for its inauguration on the large scale. Just as essential as scientific research itself is the collation of results obtained. The maximum of usefulness can only be attained by free interchange of observations and mutual criticism, for without exchange of ideas a certain narrowness of outlook is inevitable. Apart from works laboratories there should be a centralised institution to deal with the more general problems affecting the iron industry, and this, together with the former, should be in close touch with the work of the universities and technical colleges.—(*Stahl u. Eisen, Sept.* 13, 1923.)

BRITISH INDIA

Forecast of the Indigo Crop, 1923-24

The first forecast of the indigo crop of 1923-24 estimates the total area at 163,700 acres, or 45 per cent. less than the final estimate last year. The total yield of dye is at present estimated at 30,400 cwt., which represents a decrease of 44 per cent. on the final revised estimate of last year. The present condition of the crop is, on the whole, reported to be fair.

FRANCE

Wool Disinfection

The Central Committee for Wool in France has been studying anthrax in relation to the disinfection of wool, and proposes to start a campaign in countries which produce infected wool, as anthrax has entirely disappeared from the French flocks.

GENERAL

Preservation of Building Stone

Mr. J. Allen Howe, whose paper on "The Use and Preservation of Building Stone," is announced to be read before the London Section on Monday, December 3, is the joint author with Dr. J. Vincent Elsden, of a recently published little book, entitled *The Stones of London* (London: Colliery Guardian Co., Ltd. 205 pp.). This is a brief, but admirably concise and interesting descriptive guide to the various kinds of stone that have been used in the building of London, with selected examples, many illustrated from photographs, in which they may be seen.

"Dynalkol" in Czechoslovakia

A report has been issued by the Czechoslovak Ministry of National Defence on the use of "dynalkol," the commercial name given in Czechoslovakia to a composite motor fuel consisting of a mixture of 60 parts benzol and 40 parts alcohol, as a substitute for gasoline. This fuel, which is now being manufactured by the Czechoslovak alcohol refineries, is much cheaper than gasoline as domestic products are used in its manufacture. The present selling price is 3·50 Czechoslovak crowns per kg., in iron barrels of 170 kg., as compared with 5·40 crowns per kg. for gasoline in Prague, and "dynalkol" promises to become an important development of the domestic motor-fuel and alcohol industries.—(*U.S. Comm. Rep., Aug.* 27, 1923.)

REVIEWS

Kurzes Lehrbuch der Chemie in Natur und Wirtschaft. *By* Prof. Carl Oppenheimer. *Pp. xx*+258+862. *Leipzig: Georg Thieme,* 1923. *Price* 25*s. paper,* 29*s. bound.*

Books on the general applications of chemistry are usually written on one of two plans; either the chemical mechanism of the operations to which the science is applied is described, or references to the utility of the substances mentioned are inserted in a book on systematic chemistry. This book is of the second type. In a very interesting introduction the author states that his aim has been to write a text-book which shall be readable, and which shall show the facts of chemistry in their relation to human needs. It is thus a presentation of the facts of chemistry to such other workers in science as biologists, apothecaries, and physicians.

The first part of the book which, for a reason not specified, is separately paged, consists of an excellent introduction to general chemistry by Prof. Matula of Vienna. This section is so clearly written and so up-to-date that any chemist could read it with advantage. Crystals and crystal structure receive more attention and are better illustrated than is usual in an introduction of this size, and the chapters on structure and valency give only slight prominence to views which are rapidly becoming of merely historical interest. This part of the book should be published separately, as may, indeed, be the object of the separate paging.

The second part, on inorganic chemistry, is disappointing. The general arrangement is on the time-worn scheme of dealing with the elements in order, compounds being discussed after the free element has been dealt with. This method is suitable and necessary in dictionaries, but is scarcely desirable in a semi-popular book of this kind. Of minor matters the use of the (German) initial letter of an element or compound as an abbreviation, instead of the usual use of the formula, is very objectionable and certainly makes the book less readable. Thus S. is used for oxygen (and sulphur), St. for nitrogen, A. for ammonia and formic acid, and so on. The physiological and pharmacological properties of the substances are discussed in a useful and interesting manner, and the short historical references relieve the solid mass of chemical facts.

The author seems to be more at home in the third section, which runs to nearly 500 pages and covers the whole field of organic chemistry. The treatment is systematic and the result might perhaps have been achieved with fewer compounds as illustrative matter. The biological bias is naturally more noticeable in this section, and synthetic and natural drugs and the proteins are very effectively treated. There are also very good outlines of the organic industries such as the manufacture of soap, rubber, gelatine and dyes.

Prof. Oppenheimer is to be congratulated on a valiant attempt to deal with the general applications of chemistry on the basis of the pure science; and if the borderland workers for whom the book is intended can be induced to read it, it will be very good for them, for chemistry, and for the world in general.

P. C. L. THORNE

ORGANIC CHEMISTRY FOR ADVANCED STUDENTS. *By* PROF. J. B. COHEN, Ph.D., B.Sc., F.R.S. *Fourth edition.* PART I. REACTIONS. *Pp.* $v+423$. PART II. STRUCTURE. *Pp.* $vii=461$. *London: Edward Arnold and Co.*, 1923. *Price* 18*s. each volume.*

Probably few lecturers in advanced organic chemistry can dispense with Prof. Cohen's book. It is, in fact, the only work of its kind which can be recommended to students for the purpose of supplementing lectures, because, in effect, it is itself a compilation of lecture notes, and the student has therefore the advantage not only of filling in the inevitable gaps in his own course, but also of approaching the subject from another point of view. It has been said that, with this book in his hands, the advanced student is apt to consider that any effort on his part to prepare full notes of his lectures is superfluous, and that he is also liable to neglect his general reading. This has not, however, been the writer's experience as a teacher, for he has found that the manner in which Prof. Cohen presents his matter has always stimulated inquiry and has led advanced students to consult rather than to avoid original literature. It is true that with such an admirable series of notes in his possession the student of the lazier kind is liable to think that he has enough material for examination purposes, but this type of student has, since the war, become rarer, and, in any case, it is not difficult to deal with him. The chief disadvantage from which the book suffers is one common to all text-books dealing with a rapidly growing science; that is to say, it is out of date almost as soon as it is printed. Hence it is pleasant to find a new edition on the market so soon after the old one, and to realise that Prof. Cohen has done his best to leave out nothing of importance in the fields of modern organic research. The story he has to tell is very welcome and inspires high hopes for the future, for the most gratifying feature of this new research work is that most of it is British. Hitherto, the lecturer had shamefacedly to admit that, despite a few outstanding exceptions, organic chemistry was a German science. This did not imply any lack of appreciation of the German chemists, whose work during the past fifty years must, for ever, stand as a monument of industry and skill, but, rather, it showed that our educational institutions were not alive to the value of chemical research and that they were ignorant of, or indifferent to, the vast influence which scientific discovery had on our national existence.

All this has now changed and is still changing for the better. The size of the *Transactions* of the Chemical Society (and incidentally their cost) bears witness to the astonishing increase in British chemical research, and these volumes of Cohen's clearly demonstrate, to those who have eyes to read, the value of the work done. When it is remembered that all this has taken place within five years of the cessation of hostilities, it must be admitted that the future is promising, provided, of course, that we have the sense to utilise our new knowledge and to employ to advantage the trained brains which our educational institutions are supplying.

Among the subjects which find a place in the present edition are the theories of Lewis and Langmuir and Sir J. J. Thomson on the structure of the atom, with its application to organic chemistry by Robinson and Kermack, Lapworth, Lowry, Kenner and others. This is, perhaps, the least satisfactory portion of the book, because it is doubtful whether any useful purpose is served by burdening the students' mind with a mass of theoretical and practical detail much of which is non-proven and all of which is highly controversial. Many organic chemists consider that the Lewis-Langmuir hypothesis is not yet in a sufficiently concrete form to warrant its application to organic reactions, and that its intrusion at the present time is apt to lead to confusion, if only because its many votaries seem incapable of reaching agreement among themselves. Other work described is that of Irvine, Haworth, and Hudson on the constitution of the carbohydrates (why does this word still persist ?), the developments of Baeyer's strain hypothesis by Thorpe and Ingold, the use of Sir W. Bragg's X-ray spectograph for determining the crystal structure of organic compounds, the photochemical studies of Baly and Heilbron, and the biochemical work of Neuberg. A brief reference is also made to the newer theories of catalysis by Armstrong and Hilditch, Langmuir, Rideal, Taylor and others. In the section on stereochemistry will be found admirable accounts of the recent experiments by Senter and Drew on the Walden inversion, by McKenzie and Wren on racemisation, by Kenner and by Mills on the resolution of new forms of asymmetric molecules, and by Brady and Dunn on the inversion of the aldoximes.

As in previous editions, the volumes are well printed and the formulae are well set up and easy to follow. The third and final volume of the series is, it is understood, to appear at no distant date.

JOCELYN THORPE

According to *The Times*, Sir J. J. Thomson, the Master of Trinity, received an honorary doctorate from the Sorbonne on November 24.

LEGAL INTELLIGENCE

Damages for an Explosion at a Chemical Works. Belvedere Fish and Guano Co., Ltd., v. The Rainham Chemical Works Co.

A serious explosion which occurred on September 14, 1916, at the Rainham Chemical Works, as the result of which the adjoining works of the Belvedere Fish and Guano Company, Ltd., were practically wrecked, was recalled in the High Court on November 8, 1923, when a claim for £10,547 by the Guano Company against the Chemical Works Company was considered by Mr. G. A. Scott, Official Referee. The action was first heard in March, 1917, before Lord Justice Scrutton, who gave judgment in favour of the plaintiffs, and directed that the amount of damages due to them should be assessed by an official referee. This decision was upheld by both the Court of Appeal and the House of Lords and thus the case now came before the Official Referee.

According to the case for the plaintiffs, the defendants manufactured picric acid from dinitrophenol and the damage was caused by the explosion of large quantities of dinitrophenol and other explosives. The plaintiff company alleged that the defendant company kept and dealt with the explosives in a negligent way.

For the defendant company negligence was denied, and it was urged that the explosion occurred in the performance by them as agents of the Ministry of Munitions of the powers and duties of the Ministry. Evidence was adduced to show that the premises of the plaintiff company were absolutely wrecked. The freehold works and plant were purchased in 1915 for £21,143, and as the result of the explosion not only had the Guano Company lost those works but had to sell its depot at West Ham as it was no longer of any use.

At the conclusion of the hearing, which lasted four days, the Official Referee assessed the damages at £2,000 with costs.

The Carriage of Zinc Ash. A. Brandt & Co. and F. W. Vogel & Co. v. The River Plate Steam Navigation Co.

In the Court of Appeal on November 19, Lords Justices Bankes, Scrutton and Atkin heard an appeal (cf. *Chem. & Ind.*, May 18, p. 502) by the River Plate Steam Navigation Co. from a decision of Mr. Justice Greer holding that A. Brandt & Co., London, and F. W. Vogel & Co., Buenos Ayres, were entitled to recover damages from the appellant company (the defendants in the action) for delay in the carriage of a consignment of zinc ash from Buenos Ayres to Liverpool, and also £748 paid by Messrs. Brandt to the shipowners under protest in order to obtain delivery of the goods. After loading on the appellant company's steamship at Buenos Ayres, the zinc ash was found to be heated and the greater portion was unloaded. The ash was reconditioned, and a considerable time elapsed before arrival at Liverpool, and then Messrs. Brandt, in order to get delivery, were forced to pay £748, the cost of reconditioning the goods.

Lord Justice Bankes, in giving judgment, said he agreed with Mr. Justice Greer that Brandt & Co. had a cause of action against the shipowners because their offer, as holders of the bill of lading, to take delivery of the goods was accepted by the shipowners. That created a contract which included all the terms of the bill of lading, so far as they were applicable at the time of delivery. The goods were damaged by rain before shipment, but the fact that the shipowners gave a clean bill of lading, acknowledging that the goods were shipped in good order and condition, estopped the appellant company from alleging that the damage to the goods was caused before shipment and prevented them relying upon exceptions in the bill of lading which might otherwise have protected them. Furthermore, proper examination of the goods during unloading and on shore would have shown that a mistake had been made as to the extent of the goods damaged. The appeal, therefore, failed and was dismissed with costs.

REPORTS

Report on the Financial and Industrial Conditions in Chile. *Dated April*, 1923. *By* J. M. Macleod, H.M. Consul-General, Valparaiso. *Department of Overseas Trade. Pp.* 6. *London: H.M. Stationery Office*, 1923. *Price* 2s.

Chilean resources are mainly agricultural and mineral, though during the past few years efforts have been made by the Government to foster manufacturing industries. The principal wealth of the country is nitrate, which provides 75 per cent. of the total revenue. Owing to the wide range of latitude, practically every kind of agricultural product is grown, and growers are in the ordinary way assured of a ready market in the mining areas, though the bad state of the mining industry has recently reduced this market. At present sugar is obtained from Peru though efforts are being made to establish a home industry.

The coal found in the country is of good quality, and supplies about half the demand, the remainder being imported from the United States, the United Kingdom, and Australia. In 1921, 477,752 tons were imported in all. In 1922 the following copper exports were made: bars and ingots, 53,425 t.; ore, 69,248 t.; gold, silver and copper ores, 1,172 t.; copper matte, 324 t. In 1922 there was renewed activity in the copper industry, large increases in output being arranged for. The important borate of lime deposits are worked entirely by an English firm; exports in 1922 amounted to 49,482 t. Iron ore, both magnetite and haematite, occurs in large deposits, though at present these are worked only to a limited extent. About 300,000 t. were exported in 1921. Though some encouragement has been given by the Government toward the establishment of a siderurgical industry, conditions are not suitable.

Trade in 1921 and 1922 was extremely weak (*cf. J.*, 1922, 270 R). The complete absence of demands for nitrate was chiefly responsible, but the drop in values of agricultural produce also had its effect. A reduction of imports, which in itself could have been advantageous was offset by a more than proportional drop in exports. The value of imports in 1921 was about £28,598,000, about 20 per cent. less than in 1920. Great Britain has regained her position of approximate equality with the United States, each sending imports worth about £7¾ millions.

A special annex deals with the nitrate industry The production from July 1, 1921, to June 30, 1922, was 1,071,297 t., against 2,772.254 t., in 1913. Exports for the year amounted to only 502,481 t., of which about 50 per cent. went to the United States.

Report on the Economic Conditions in Angola (Portuguese West Africa). *Dated March*, 1923. *By* A. B. Hutcheon, H.M. Consul-General, Loanda. *Department of Overseas Trade. Pp.* 42. *H.M. Stationery Office*, 1923. *Price* 1s. 6*d*.

Angola is essentially an agricultural country, its range of altitude permitting the cultivation of European as well as tropical crops. The most important crop is coffee. Oil-palms occur extensively, but recent neglect of the plantations has led to diminished production and the Government has had to take steps to organise the industry. The importance of rubber has decreased of recent years but sugar production has increased.

Apart from diamonds, the mineral resources of the country have been developed only on a small scale, though companies of various nationalities hold prospecting concessions for minerals and oil, and the copper mines at Bembe, long disused, are to be developed again. Prospecting rights are also being granted for coal, which occurs on the Benguella plateau. Some attention is being given to the possibility of developing further the water-power resources of the country.

The principal exports include maize, coffee, palm-kernels, sugar and wax. Imports are derived principally from Portugal, Germany, the United Kingdom, and the U.S.A. Cotton goods are in demand, whilst iron and steel goods are also imported, principally from the United Kingdom and Germany. The influx of Europeans has led to a demand for building materials, cement being the most important of these. The coal imported is obtained almost entirely from the United Kingdom.

COMPANY NEWS

ELECTROLYTIC ZINC COMPANY OF AUSTRALASIA, LTD.

After writing £20,000 off investigational research and general development account and carrying £90,000 to reserve for depreciation, the gross profit for the year ended June 30 was £401,808 (£93,841 for the previous year, during which the plant was only in operation for seven months.) After adding £2,614 for income from property and sundry receipts, and deducting profit and loss items including £48,000 as provision for income tax, the net profit was £285,406. The available balance (including £76,593 brought forward) of £361,999 has been disposed of as follows :—Writing off preference shares and debenture issue expenses, £74,482 ; by providing for co-operative council activities at Risdon, £7,500 ; carried to debenture sinking fund reserve, £12,640 ; carried to equalisation reserve, £40,000 ; and by the payment of dividends Nos. 1 and 3, £149,115, leaving a balance of £78,262 to be carried forward. The plant was completed during the year, and arrangements are in course to provide further installations which will ensure liberal supplies and enable a reserve to be accumulated. The output for the year was 31,283 tons electrolytic zinc, and silver-lead containing 4,344 t. lead and 691,052 oz. silver.

NORTH BROKEN HILL, LTD.

The profit and loss account has been credited with the sum of £673,521, made up of £597,215 for mine production, £48,190 for adjustment in respect of production previous period. and £28,116 for interest, rent and dividends. After deducting expenses, etc., a balance remains of £284,780, which, together with £30,000 (the balance forward), has been appropriated as follows :—Dividends Nos. 52 to 54, in all 6s. per £1 share, £180,000 ; debenture sinking fund, £13,333 ; appropriation for plant expenditure, £52,000, leaving a balance of £69,447. Surplus liquid assets, excluding shares and debentures in other companies valued in the balance-sheet at £448,525, amount to £532,454.

CASSEL CYANIDE CO., LTD.

The directors of the Cassel Cyanide Co., Ltd., having considered the accounts for the year ended September 30, 1923, recommend the payment of a final dividend of sixpence per share, making with the interim dividend paid in June last, ninepence per share for the year, less income tax at 4s. 9d. per £. It is proposed that this dividend be paid on December 17 to all shareholders on the register on November 20.

CELLULOSE HOLDINGS AND INVESTMENT CO., LTD.

The first ordinary general meeting was held on November 16, the chairman, Mr. A. W. Tait, C.B.E., presiding. The net profit from May 4, 1922, the date of incorporation, to June 30, 1923, was £6182, from which was deducted £1822, payable to debenture holders. The net profit accruing to the shareholders was £4359, of which £3825 would be used to write off preliminary formation and new issue expenses, leaving £534 to be carried forward.

The company took over arrangements made by Dunn, Fisher and Co. with the British Cellulose Co. for supplying further working capital required by that company, and subscribed for £500,000 8 per cent. first mortgage debenture stock and took over £750,000 participating preference shares in the British Cellulose Co., together with a royalty agreement with the manufacturing company under which the holdings company was to receive 2½ per cent. on the net sales up to an agreed figure, and 1 per cent. thereafter. To purchase the generating station at Spondon the holdings company surrendered to the manufacturing company £200,000 of the debentures which it had subscribed, and resold the power-station to the Midland Counties Electric Power Supply Co., Ltd., for £100,000 in cash, and £225,000 fully-paid ordinary shares in that company.

Early in 1923 the holdings company subscribed a further £400.000 7 per cent. first mortgage debenture stock out of a total authorised issue of £1,000,000. The holdings company now holds £700,000 of this debenture stock, the balance to be issued by the manufacturing company at its discretion for the general purposes of the company. Interest on the first mortgage debentures is to be reduced from 8 per cent. to 7 per cent., but instead of being repayable at any time after 1927 at 105 per cent., the debentures are only redeemable by means of a cumulative sinking fund, commencing at that date, at £110 per cent. The royalty on sales from July 1, 1923, is increased to 3 per cent. on net sales up to £3.000,000 per annum, and 1 per cent. thereafter for 25 years from the date when the royalty amounts to £90.000 in any one year. The holdings company issued £500,000 7 per cent. participating first mortgage debenture stock, and 998,000 ordinary shares of 1s. each, to enable the original financial arrangements to be carried out. The company now holds £700,000 7 per cent. first mortgage debenture stock of British Celanese, Ltd. : £750,000 Participating 7½ per cent. preference shares of British Celanese, Ltd. ; £225,000 ordinary shares in Midland Counties Electric Power Supply Co., Ltd. ; and a royalty agreement with British Celanese, Ltd. The company has issued £750.000 7 per cent. participating first mortgage debentures redeemable at 120 per cent., and 1,060,500 ordinary shares of 1s. each.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Nov.* 22.)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Austria ..	High grade steels ..	567
British India	Wrought iron piping ..	*
,, ,,	Caustic soda, copper and brass, sheets, etc. ..	*
Canada ..	Pottery	560
,, ..	Tools, cutlery, hardware	561
Egypt ..	Paper, Bristol board ..	11832/F.E./M.C./2
New Zealand	Plate girder spans (tender)	12569/E.D./E.C.
,, ,,	Galvanised earthrods ..	12573/E.D./E.C./2
United Kingdom	Lead cable, zinc, copper and bronze wire, lead, tin, brass, etc. (tender)	†

* The Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E.1.

† Postmaster-General, General Post Office, E.C.1.

TARIFF CUSTOMS EXCISE

Egypt.—Revised tariff valuations have been issued, for use in assessing import duties on copper, brass, tin, lead, zinc articles, and on phosphor bronze, antimony and mercury.

Nicaragua.—The reduction of 25 per cent. of the customs duties accorded to France will, after December 1, be extended to similar goods of British manufacture.

Nigeria.—Export duties on palm kernel oil, palm oil, palm kernels and ground-nuts have been reduced.

Poland.—A manipulation fee of 5 per cent. of the Custom duty is payable, in addition to the duty, on various goods, not including coal, brown coal, charcoal, peat coal, briquettes, coke and peat. The export "manipulation" fee is 10 Polish mk. per kg., the minimum charge being 10,000 Polish mk. on each consignment.

INTERNATIONAL CUSTOMS CONVENTION

The issue for November 15 contains the sixteen operative clauses of the International Convention on the Simplification of Customs Formalities, which was signed at Geneva, on November 3, by the representatives of twenty-two States.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

Germany having repudiated her reparations agreement, and consequently having defaulted in providing the 26% levy on exports to Britain which has been ruling for the last 2½ years, there has been a general rise in those chemicals which have of late been largely imported from the Continent.

The heavy chemical market maintains a steady tone, both home trade and export continuing to take tolerably satisfactory quantities. Prices are firm.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry. Small stocks held by importers.
Acid Hydrochloric	3s. 9d.—6s. per carboy d/d., according to purity, strength and locality.
Acid Nitric 80° Tw.	£21 10s.—£27 per ton makers' works, according to district and quality.
Acid Sulphuric	Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 65s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
Ammonia Alkali	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d.
Potash Caustic	£30—£33 per ton. Poor demand.
Potass. Bichromate	5¾d.—6d. per lb.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£27 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Prices in this section are unchanged.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

With the exception of acetates of lime and lead the demand for wood distillation products keeps below normal. German charcoal is again being offered.

Acetate of Lime—	
Brown	£14—£14 10s. per ton d/d. Demand active.
Grey	£22 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£9 per ton, according to grade and locality. Market quiet.
Iron Liquor	1s. 7d. per gall. 32° Tw.
	1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	5s. 6d. per gall. 60% O.P. Competition being met with.
Solvent	6s. per gall. 40% O.P. Fair demand.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead	£42—£43 per ton. Demand more active.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s.—1s. 1d. per lb. Weaker, with limited demand.
Crude 60's	3s.—3s. 3d. per gall. Limited business for spot delivery. No market for forward delivery.
Acid Cresylic—97/99	2s.—2s. 2d. per gall. Firm, with good demand.
Pale 95%	1s. 10d.—2s. per gall.
Dark	1s. 7d.—1s. 10d. per gall.

Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.
Anthracene Oil—	
Strained	9½d.—10d. per gall. Quiet.
Unstrained	9d.—9½d. per gall. Quiet.
Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s, 4d. per gall. ex works in tank wagons.
Benzole, Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 3d.—1s. 4d. per gall.
Pure	1s. 9d.—1s. 10d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8½d.—9½d. per gall. according to grade and district. Good business being done.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 2d. per gall. Fair demand for export.
Solvent 90/190	1s. 2d.—1s. 3d. per gall. Business quiet.
Naphthalene Crude—	
Drained Creosote Salts	£5—£8 per ton. Demand increasing. Market scarce.
Whizzed or hot pressed	£9—£11 per ton. Quiet.
Naphthalene—	
Crystals	£19 per ton.
Flaked	£19 per ton.
Pitch, medium soft	125s.—135s. per ton, according to district and time of delivery. Little business.
Pyridine—90/140	21s.—23s. per gall. Demand good. Supplies short.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

The slight improvement in dyestuffs business has been maintained, but orders are still only for small quantities.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 8d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Much better demand.
Acid Sulphanilio	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 8d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Demand quiet.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dimethylaniline	2s. 7d. per lb. d/d. Drums extra.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£83 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	5¾d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	11¾d. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. lb. 100% basis d/d.
R. Salt	2s. 7½d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
o-Toluidine	7d.—8d. per lb.
p-Toluidine	4s. 6d. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The shortage of spot supplies of a number of products continues and the market remains extremely firm.

Acid, Acetic 80 % B. P.	£48 per ton.
Acid, Acetyl Salicylic	3s. 7d.—3s. 9d. per lb. In strong demand. Makers fully occupied.
Acid, Benzoic	B.P. quality almost unobtainable.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Camphoric	17s.—19s. per lb.
Acid, Citric	1s. 5½d. per lb., less 5%, for ton lots. Dearer.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst	6s. per lb. for 28 lb. lots.
Acid, Salicylic	2s. 6d. per lb. Very firm market.
Acid, Tannic	3s. per lb. for B.P. quality. Very firm.
Acid, Tartaric	1s. 1½d. per lb. less 5 %. Firmer.
Amidol	9s. per lb. d/d.
Acetanilide	2s. 9d. per lb. Small stocks. Strongly held.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	4s. 3d. per lb. for English make.
Atropine Sulphate	12s. 6d. per oz. for English make. Demand very poor.
Barbitone	17s. 6d. per lb.
Benzonaphthol	4s. 9d. per lb. Weaker.
Bismuth Salts	A steady market. Prices according to quantity :
Carbonate	12s. 9d.—14s. 9d. per lb.
Citrate	11s. 4d.—13s. 4d. ,,
Salicylate	10s. 2d.—12s. 2d. ,,
Subnitrate	10s. 9d.—12s. 9d. ,,

Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	Remain very firm. Continental prices advancing
Potassium	8d.—9d. per lb.
Ammonium	9d.—10d. „
Sodium	8½d.—9½d. „
Calcium Lactate	2s. 9d. per lb. for best English make.
Chloral Hydrate	4s. 3d. per lb. Position very firm.
Chloroform	2s. per lb. for cwt. lots. More active.
Creosote Carbonate	6s. 6d. per lb. Little demand.
Guaiacol Carbonate	Spot supplies very scarce. Present value 13s. 6d. per lb.
Hexamine	4s. 6d. per lb. Very firm market. Spot supplies decreasing.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate	1s. 11d.—2s. 3d. per lb., according to quality.
Magnesium Carbonate—	
Light Commercial	£36 per ton net.
Magnesium Oxide—	
Light Commercial	£72 10s. per ton, less 2½%. Reduced by £5 per ton.
Heavy Commercial	£27 per ton, less 2½%.
Heavy Pure	2s.—2s. 3d. per lb., according to quality and quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 65s. per lb.
Mercurials	Firm and likely to advance.
Red oxide	4s. 11d.—5s. 1d. per lb.
Corrosive sublimate	3s. 8d.—3s. 10d. „
White precip.	4s. 6d.—4s. 8d. „
Calomel	4s. 1d.—4s. 3d. „
Methyl Salicylate	2s. 11d. per lb. for carboys. Brisk market. Higher values expected.
Methyl Sulphonal	23s. per lb. Small supplies.
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 7d. per lb.
Phenacetin	7s. 6d. per lb. Steady market.
Phenazone	8s. 9d. per lb. In short supply.
Phenolphthalein	8s. per lb. Very firm.
Potass. Bitartrate—99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Market firmer.
Potass. Citrate	1s. 8d.—2s. per lb.
Potass. Ferricyanide	3s. per lb.
Potass. Iodide	16s. 8d.—17s. 5d. per lb., according to quantity. Demand continues.
Potass. Permanganate	9½d. per lb. for B.P. crystal.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Salol	4s. per lb. Supplies more plentiful.
Silver proteinate	10s. 6d. per lb. Quiet.
Sod. Benzoate	3s. 6d. per lb. Very scarce.
Sod. Citrate, B.P.C., 1923	1s. 5d.—1s. 9d. per lb., according to quality.
Sod. Hyposulphite—Photographic	£14—£15 per ton, according to quantity, d/d. consignee's station in 1-cwt. kegs.
Sod. Nitroprusside	16s. per lb. Less for quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 11d. per lb., and Crystal at 3s. per lb. Firm and very active.
Sod. Sulphide—Pure recryst.	10d.—1s. 2d. per lb., according to quality.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	17s. 6d. per lb.
Thymol	13s. 6d. per lb. quoted for synthetic and 14s. 6d. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. „ „
Amyl Acetate	3s. „ „
Amyl Butyrate	7s. 3d. „ „
Amyl Salicylate	3s. 6d. „ „
Anethol (M.P. 21/22° C.)	3s. 9d. „ „
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. 3d. „ „
Benzyl Alcohol free from Chlorine	3s. 3d. „ „
Benzaldehyde free from Chlorine	3s. 3d. „ „
Benzyl Benzoate	3s. 6d. „ „
Cinnamic Aldehyde Natural	22s. 6d. „ „
Coumarin	20s. „ „
Citronellol	19s. 6d. „ „
Citral	9s. 6d. „ „
Ethyl Cinnamate	10s. „ „
Ethyl Phthalate	3s. 9d. „ „
Eugenol	11s. „ „
Geraniol (Palmarosa)	37s. 6d. „ „
Geraniol	6s 9d. to 13s. 6d. per lb.
Heliotropine	8s. per lb.
Iso Eugenol	15s. 9d. per lb.
Linalol ex Bois de Rose	20s. „ „
Linalyl Acetate	20s. „ „
Methyl Anthranilate	8s. 6d. „ „
Methyl Benzoate	6s. „ „
Musk Ketone	47s. 6d. „ „
Musk Xylol	13s. 6d „ „
Nerolin	4s. „ „
Phenyl Ethyl Acetate	10s. „ „
Phenyl Ethyl Alcohol	16s. „ „
Rhodinol	60s. „ „
Safrol	1s. 10d. „ „
Terpineol	3s. „ „
Vanillin	24s.—25s. per lb.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 11d. „ „
Bergamot Oil	13s. 3d. „ „ spot.
Bourbon Geranium Oil	37s. „ „
Camphor Oil	75s. per cwt.
Cananga Oil, Java	9s. 6d. per lb.
Cinnamon Oil, Leaf	5d. per oz.

Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 9d. „ „
Ceylon	Very little on offer.
Clove Oil	10s. 6d. per lb.
Eucalyptus Oil 70/75%	2s. 6d. per lb.
Lavender Oil—	
French 38/40% Esters	24s. 6d. per lb.
Lemon Oil	2s. 10d. per lb. Higher prices expected.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	11s. 9d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	26s. per oz.
Palma Rosa Oil	24s. 6d. per lb.
Peppermint Oil—	
English	70s. per lb. Market very unsteady.
Wayne County	15s. 6d. per lb. Market very unsteady.
Japanese	12s. 6d. per lb. Market very unsteady.
Ptitegrain Oil	8a. 9d. per lb. Dearer.

TRADE NOTES

Midland Bank, Ltd.

The shareholders of the London Joint City and Midland Bank have confirmed the resolution changing the name of the company to Midland Bank, Limited. The new title will be effective as from Tuesday, November 27. Existing share certificates at present in the hands of shareholders are not being exchanged for fresh certificates bearing the new name.

The German Iron and Steel Industry, 1913-1920

The number of blast furnaces in Germany in 1920 showed a decrease compared with the figure for the previous year, and more markedly with that for 1913. The causes lie in the decreased use of pig-iron; although, owing to greater output per furnace, more pig-iron was produced in 1920 than in 1919, the total did not then reach the 1913 figure. The following table gives some particulars of the industry :—

	1913 (*a*)	1913 (*b*)	1917 (*b*)	1919 (*b*)	1920 (*b*)
Works in operation	93	75	71	69	63
Furnaces existing at end of year	330	238	242	232	228
Do. in operation	313	221	203	152	146
Total No. of weeks worked	15,130	10,555	9,363	6,514	6,504
Consumption in 1000 t. of ore, slag, and flux	47,597·5	28,930·6	23,357·0	15,355·6	16,931·9
Do. coke and charcoal	19,123·7	12,925·7	10,818·3	7,716·5	8,094·3
Production in 1000 t. :—					
Total	16,763·8	11,528·9	8,703·3	5,654·2	6,387·6
Pig iron	3,374·8	2,639·7	1,618·6	1,372·5	1,324·0
Cast iron	104·5	7·0	1·3	—	—
Bessemer pig-iron	375·4	375·4	139·6	61·0	64·2
Thomas pig-iron	9,867·6	5,512·6	4,250·2	2,593·6	3,006·2
Steel, etc.	2,550·7	2,550·6	2,497·5	1,521·4	1,862·8
Puddled iron	463·9	441·6	195·7	104·6	130·2
Scrap iron	26·9	1·8	0·5	1·2	0·3

(*a*) Pre-war Empire. (*b*) Within present boundaries, excluding Saar.

The relative quantities of the different varieties of pig-iron have changed greatly. The smaller production of Thomas pig-iron was caused by the decrease in the use of phosphorus-bearing ores, whilst the production of steel increased owing to the extended use of the Martin process.

Market News from France.

The metal market became still weaker during the month, and quotations were greatly reduced, without, however, leading to any increased demand.

The turpentine and resin harvest is now over, so prices are firm and standing 10 frs. higher at 500 frs. on November 19. Resins are quoted higher owing to the demand by soap boilers, especially for the better qualities, which are becoming scarce.

The German Wrought Iron Industry

Whereas in 1890 about one-half of the steel made in Germany was obtained from wrought-iron (" schweisseisen "), since then its production from this material steadily decreased till the outbreak of war, mild steel being used instead. Since the war the decrease has continued. In 1920, in spite of a decrease in the number of furnaces alight, the production of wrought-iron increased from 3200 tons to 54,003 t. That the industry is losing its importance is shown by comparison of these figures with the output for 1913, viz., 199,000 t.

German Reparation (Recovery) Act

By a decree of the German Government, dated November 15, all payments for the reimbursement of the levy under the German Reparation (Recovery) Act, 1921, are suspended. The decree came into force on November 17 and contracts concluded before this date are excluded from its provisions, provided the contracts are notified to the " Friedensvertrag-Abrechnungsstelle G.m.b.H. Charlottenburg, Berliner Strasse 17," before December 1, and a certified copy of the contract is enclosed. In the case of such contracts, the amount of the levy will be reimbursed provided that the British Customs receipt is presented to the " Friedensvertrag-Abrechnungsstelle " by March 31, 1924. The German Government reserves the right to reimburse in cash or in loan or other Government obligations.

Exports of Copra and Rubber from Java

H.M. Commercial Agent at Batavia reports that exports of copra from Java and Madura in 1922 were 53,233,000 kg., as compared with 93,009,000 kg. in 1921, whilst during the March quarter of 1923 exports amounted to 13,187,000 kg. as against 11,543,000 kg. in the corresponding quarter of 1922.

Exports of rubber in 1922 and 1921 amounted to 31,659,000 kg. and 29,400,000 kg. respectively whilst during the March quarter of this year they amounted to 8,561,000 kg. as against 6,980,000 kg. in the March quarter of 1922.

Canadian Output of Non-Metallic Minerals in 1922

The Dominion Bureau of Statistics issues the following finally revised statistics on the production of Non-Metallic Minerals in Canada during 1922. With the exception of arsenic there were no outstanding differences between the production of 1922 and the previous year of the commodities listed below as miscellaneous non-metallic minerals. The production of arsenic increased by 42 per cent. as compared with 1921. Large quantities of this product are being used in the United States to make insecticides for combating the cotton boll weevil.

		1922.	
		Quantity	Value $
Actinolite	Tons	50	575
Arsenic (white) produced from Canadian ores	,,	2,576	321,037
Barytes	,,	289	9,537
Chromite	,,	767	11,503
Feldspar	,,	27,727	248,402
Fluorspar	,,	4,503	102.138
Graphite	,,	597	31,353
Grindstones	,,	1,005	43,742
Magnesite	,,	2,849	76,294
Magnesium sulphate	,,	1,021	24,017
Manganese	,,	73	2,044
Mica	,,	3,349	152,263
Mineral water	Gals.	221,433	14,220
Natro-alunite	Tons	50	2,500
Iron oxides	,,	7,285	110,608
Peat	,,	3,000	14,500
Phosphate	,,	190	1,796
Pyrites	,,	18,143	74,303
Quartz	,,	109,947	208,598
Sodium carbonate	,,	202	3,027
Sodium sulphate	,,	504	11,980
Talc	,,	13,195	188,458
Tripolite	,,	219	5,781
Total			1,658,676

An Improved Ozonizer

The usual form of ozonizer in which air or oxygen is passed through an annular tube, between the walls of which a silent discharge is passed has recently been improved by A. Starker, of Danzig. The apparatus is essentially the same as at present, but instead of the usual discharge frequency of 50-100 periods per second one of about 10,000 is used. The yield, about 10 per cent., is no higher than that obtained at present, but a larger volume of gas can be treated with an apparatus of a given size, so that overhead costs are considerably reduced.

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EDITORIAL

BY the time this issue appears a large number of election results will be known, and we shall be able to have some idea as to the nature of the Government which will guide our destinies for the immediate future. Our readers will naturally and properly hope that nothing will be done which will harm the great industry with which we are connected. The merits of Free Trade and of Protection have been hotly debated, and from isolated statistics during brief and exceptional periods many unjustified deductions have been drawn. Scientific men should be cautious in drawing conclusions from imperfect data, and one of them, Huxley, has pointed out the sort of error which may result. " Robinson Crusoe," he said, " did not feel bound to conclude, from the single human footprint which he saw in the sand, that the maker of the impression had only one leg." If we look back during the last few hundred years, not only in this country, but in many countries, we find that both tariffs and free imports have been tried, not once or twice, but repeatedly in several, and the results neither justify the golden hopes offered by their advocates nor the gloomy forecasts of ruin which the opponents prognosticate. The country adapts itself to new conditions, and so long as the dislocations to trade are not too sudden and too fundamental, the adaptation takes place without inflicting irreparable damage on a large proportion of the population. There is no indication at the moment that any political party will have the power, even if it have the desire, of making any calamitous dislocation in our industrial and commercial conditions.

A general election during a spell of cold and unpleasant weather has made many of us discontented and inclined to be critical. Even chemists, notwithstanding the philosophical remarks of Dr. E. F. Armstrong, have grumbled at the slow progress of civilisation, at their distant prospect of making a fortune, at the lack of courage of the Federal Council, of the Chemical Society, of the Society of Chemical Industry, and even at the dulness of this Journal. Be of good cheer. If winter comes, can spring be far behind ? Those who investigate whether 'tis folly, pride or knavery that makes this discontented land appear less happy now in times of peace than war, may reflect that wise men affirm it is the English way never to grumble till they come to pay. Is not this the prime cause of the troubles of our chemical organisations as well as of the nation ? We know there are some people, even among the chemists, who are critical by disposition and who would say to our great metropolis : " Let but thy wicked men from out thee go, and all the fools that crowd thee so, even thou who dost thy millions boast, a village less than Islington will grow, a solitude almost." Some of us would rather see London as it is than distilled, filtered, and fractionated to such a degree of purity. We cannot all be as wise as Nestor, wisdom cannot be passed from one having it to another not having it We suffer, perhaps, from too much liberty ; of all the nations in the universe, none can talk on't more, or understand it less. This has been a year of difficulties and troubles, most of them already overcome. Even editors have their disqualifications; did not Dr. Johnson say, no man is appointed to an office because he is the fittest for it? We refuse to be discouraged, and indeed such advances have been made during the last year or so that chemists have no right to be other than proud and happy.

* * *

Science has conferred innumerable material benefits upon humanity, and this very utility has served to obscure its finer qualities from those without the pale. Without doubt, wireless, underground railways, tinned milk and denicotinised tobacco will provoke the scorn of the æsthete, and the modern poet who wrote of how he "saw sweet Poetry turn troubled eyes on shaggy Science nosing in the grass" is quite typical of a common attitude towards research, but few who have had no scientific training have troubled to inquire into its intellectual significance. Chemistry has certainly been subject to more than a fair share of misunderstanding, though it is true that the atomic theory has attracted speculative minds throughout the ages and our present Poet Laureate has questioned "whether each element is a coherency of equal Strictly symmetric atoms, or among themselves the atoms are Like animals in a herd, having each an identity distinct."

If chemistry is really misunderstood, it is in part the fault of its highly-specialised terminology, and this difficulty is further increased by the general indifference to the use of plain, perspicuous English. It was thus with no surprise that we read, in a paper recently set for the "school-leaving examination," the requests: "Define the terms deliquescent and efflorescent, naming, with their formulæ, two examples in each case"; "State exactly what you would *observe* in each of the following cases and what tests you would apply to each in order to show that reaction had taken place,"—*e.g.*, "Ammonia and chlorine gases are brought into contact"; "Describe and *explain* as far as you are able the appearance presented when copper turnings and sulphuric acid are heated together in a flask." The italics are not ours, but the "appearance presented" by the paper had it been properly revised "in the case of" at least five out of eight questions would have shown that "reaction *had* taken place." It is long since Newman wrote that "thought and speech are inseparable; matter and expression are parts of one," but the recent taunt, Is it consonant with the high dignity of science to make her talk like a cheap showman? remains unchallenged. The wording of examination questions may have a dire effect on the candidate, and it is but reasonable to ask that his psychological processes, already strained, be not unduly disturbed.

LOW - TEMPERATURE TAR FROM BITUMINOUS COAL

By JEROME J. MORGAN, M.S., Ph.D.

When coal is heated out of contact with the air but at about atmospheric pressure, a point is finally reached at which decomposition, as evidenced by the rapid evolution of gases and vapours, becomes marked. This is the temperature of the formation of primary tars, and varies for different coals. According to L. C. Jones[1], this temperature ranges from 230° for brown lignites to 330° for bituminous coal. Apparently, it varies inversely with the oxygen content of the coal. In ordinary high-temperature carbonisation, either in the coke oven or in the gas retort, the vapours of this primary tar are heated in contact with the hot coke and walls of the chamber to temperatures of from 800° to 1100°. At these temperatures the compounds of the primary tar are cracked and yield gases, and the secondary or high-temperature tar with which we have long been familiar. It is only recently that new methods of carbonisation have made available commercial quantities of primary or low-temperature tar, and regarding its nature there has been a great deal of speculation and misunderstanding. In presenting a few facts which may help to clear up this misunderstanding, the writer will limit himself to such tar obtained from bituminous coal.

Processes for Low-Temperature Carbonisation

It is not the intention of the writer to go into details regarding the various processes of low-temperature carbonisation. Almost every possible form of apparatus has been tried or proposed, ranging from heating a thin layer of coal in a large intermittently-charged muffle to floating the powdered charge on the surface of a molten metal bath. Without attempting to make a complete classification, the following may be mentioned as representative processes:—

German Processes.—The Thyssen rotating horizontal retort[2] somewhat resembles a cement kiln and has been used for brown coals. The Ehrhardt and Sehmer process[3] distils the coal in rotating vertical retorts which are situated in the top of a modified Mond gas-producer and through which a portion of the producer-gas is diverted to heat the coal and sweep out the products of distillation. The Pintsch process[4] proposes to combine the recovery of low-temperature tar with the consumption of the semi-coke under the steam boiler. A portion of the hot combustion gases is used to pass through the carbonising chamber.

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[1] J. Franklin Inst., 177, 311 (1914).

[2] A. Faber, *Z. angew. Chem.*, 36, 11 (1923).

[3] Pamphlet of Aktiengesellschaft für Brennstoffvergasung, Berlin NW 40, Roonstrasse 4.

[4] A. Faber, *Z. angew. Chem.*, 36, 12 (1923).

English Processes.—The improved Coalite process[5] makes use of an intermittent vertical retort in which thin layers of coal are held against the sides of the retort by a pair of movable perforated iron plates. The MacLaurin process[6] employs a tall producer, but only enough air is used to burn about one-third of the coke. The hot producer-gas formed at the bottom passes up through the fuel column and distils the coal in the middle section. At the top the oils are deposited on the cool fuel and tapped off. The Mond gas-producer has been modified by the Power Gas Corporation[7] so as to combine low-temperature carbonisation with the recovery of ammonia and the production of gas.

Processes in the United States.—The Carbocoal process[8] utilises a cardioid-shaped horizontal carborundum muffle through which the coal is advanced by twin paddle shafts so constructed that the paddles mutually clean themselves of the sticky fused coal. The Parr-Layng process[9] proposes to control and employ the exothermic decomposition of certain high oxygen coals to transfer heat to the centre of the charge in a coke oven. In this way it is expected that low temperature conditions will be maintained and the cracking of primary tar avoided. Finally, the Doherty complete gasification process[10] combines the recovery of low-temperature tar with the production of producer and blue gas. This process promises in the near future to give us a very large supply of low-temperature tar.

Comparison of yields of products, and especially comparison of the quantity and character of the tars from these different processes, is a dangerous proceeding and likely to lead to wrong conclusions. This is true because, in the first place, the processes have not been tried on the same fuels, and, second, because the main objects of the processes have usually been different. Then, too, there have usually been minor operating conditions which render such comparisons unfair and misleading. It will only be when the processes are compared by the standard of the best economic results from a given fuel and under a given set of conditions that the comparison becomes fair. Such a comparison has never been made, and certainly cannot be made from the data now available in the literature. In treating the question of low-temperature tar, therefore, it is proposed to review the information about the tar which has been most thoroughly investigated—namely, carbocoal tar.[11] We may then infer to some extent how other low-temperature tars will differ from this.

COMPOSITION OF CARBOCOAL TAR FROM BITUMINOUS COAL

The coal used in producing the carbocoal tar in question was the Pennsylvania gas-coal which is known as "Pittsburgh Terminal" and which, analysed on a dry basis, contained, per cent., volatile matter 35·3, fixed carbon 57·9 and ash 6·8. In the carbonisation the coal was exposed for three hours to a temperature of 500° to 600°. The yield of crude dry tar amounted to 11·3 per cent. of the weight of the coal, or about 25 gallons per ton. The composition of this tar along with tars from coke ovens and gas retorts is given in Table I.

TABLE I

Comparison of Carbocoal Tar with High Temperature Tars

	Carbo-coal	Coke oven	Gas works
Crude, dry tar—			
Sp. gr. 15·5/15·5	1·0676	1·1845	1·2172
Free carbon, per cent.	0·71	6·93	20·1
Distillate, per cent. by weight			
up to 170°	0·64	0·70	1·19
170—230°	9·19	8·27	9·22
230—270°	12·50	12·44	10·12
270—300°	6·94	6·21	3·78
300—310°	2·90	2·53	1·93
Pitch by difference	67·83	69·85	73·76
Sp. gr. 15·5/15·5	1·134	1·263	1·312
Free carbon, per cent.	2·17	16·8	31·1
Air melting point, ° C.	53	69	89

The results of further examination of the distillate of this tar by a scheme of analysis developed in the course of the investigation of its composition[11] are given in Table II.

TABLE II

Composition of the Distillate from Carbocoal Tar

	Percentage by weight on the basis of	
	Distillate	Crude, dry tar
Phenols	42·7	13·7
Nitrogen bases	1·9	0.6
Hydrocarbons	55·4	17·8
Cyclic unsaturated	41·5	13·4
Saturated	13·9	4·4
Naphthenes	8·8	2·8
Paraffins	5·1	1·6

CONSTITUTION OF THE COMPOUNDS IN CARBOCOAL TAR

Phenols.—The composition of the tar acids from the distillate of the tar is given in Table III, in which the large percentage of phenols with boiling points higher than the xylenols is to be noted.

A comparison of the distillation curves for the carbocoal tar acids and the mixed tar acids from coke-oven and gas-works tars is given in Figure 1. From the shape of the curve it is evident that the low-temperature phenols are a mixture of a large number of compounds with gradually-increasing boiling temperatures.

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[5] *Colliery Guardian,* 122, 1207–8 (1922).

[6] *Iron Coal Trades Rev.,* 104, 575–6 (1922).

[7] *Colliery Guardian,* 123, 1042 (1922).

[8] H. A. Curtis and Assistants, *Chem. Met. Eng.,* 28, 11–7, 60–2, 118–23 and 171–3 (1923).

[9] *Gas Age-Record,* 50, 531–4 (1922).

[10] Proceedings Amer. Gas. Assn. Convention, 1922; Report of Complete Gasification of Coal Section, R. G. Porter, Chairman.

[11] J. J. Morgan and R. P. Soule, *Chem. Met. Eng.,* 26, 923–8, 977–81 and 1025–30 (1922).

The flattened portion of the other curve is due to the preponderating amounts of phenol and the cresols in the high-temperature tar acids.

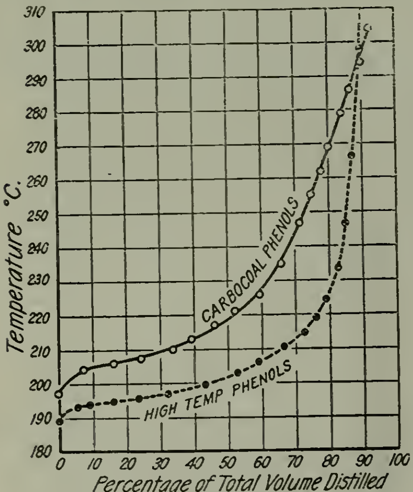
TABLE III

Composition of Carbocoal Tar Acids

	Percentage by weight on the basis of		
	Tar acids	Distillate	Crude tar
Phenol	4·2	1·9	0·6
Cresols (*a*)	33·4	15·2	4·9
Xylenol fraction	19·0	8·7	2·8
Higher homologues	34·8	15·9	5·1
Pitch (acid resins)	8·6	3·9	1·3
Totals	100·0	45·6	14·7

(*a*) Ratio: 27% ortho-, 19% meta- and 54% para-cresols.

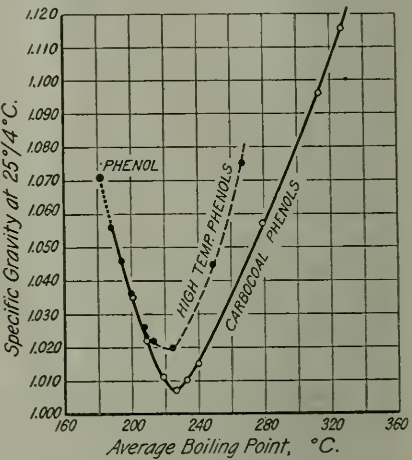
Considerable information about the nature of the tar acids can be obtained from a study of the curves showing the relation between the gravity and boiling points of the fractions. These curves are given in Figure 2, and from them it is seen that the lower boiling phenols are the same in both low and high-temperature tars. The lower density of the high-boiling phenols of the carbocoal tar is partly due to the presence of alkyl side chains and partly to extra hydrogen in the ring in these compounds. In the high-temperature tars these side chains and the hydrogen are split off with the formation of simpler phenols having a higher density for the same boiling point. Not all the phenols of low-temperature tar, however, are thus converted into the simpler phenols of high-temperature tar. In a considerable portion of these compounds the hydroxyl as well is split off with the formation of hydrocarbons, or the ring may be ruptured, giving rise to gas and carbon.



DISTILLATION OF PHENOLS

FIG. 1

Nitrogen Bases.—The nitrogen bases of carbocoal tar were found to consist of 20 per cent. of secondary bases and 80 per cent. o tertiary bases. Primary bases were absent. Comparison of the boiling point—specific gravity curve for these bases with that for high-temperature bases shows a similar state of affairs as in the case of the tar acids. There is no predominating low-temperature base to correspond to quinoline in high-temperature tar. Also, the lower density of the low-temperature bases points to the presence of side chains and extra hydrogen in the ring.

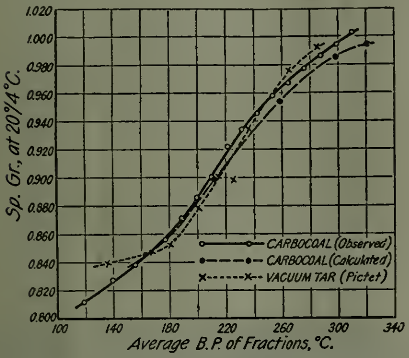


BOILING POINT—SPECIFIC GRAVITY OF PHENOLS

FIG. 2

Neutral Oils.—As was shown in Table II, the neutral oils of carbocoal tar are about three-quarters cyclic unsaturated compounds. The saturated hydrocarbons, which comprise less than 5 per cent. of the tar, are only about one-third paraffins. The remainder of the saturated hydrocarbons are naphthenes. Aromatic hydrocarbons are absent or, at most, present only in traces. No solid compounds separated even when the neutral oil was cooled to –35°. The boiling point—specific gravity curve for the unsaturated hydrocarbons is given in Figure 3, and for the saturated hydrocarbons in Figure 4.

With reference to the curves in Figure 4, it is interesting to note that the saturated hydrocarbons from carbocoal tar are very similar to those from a kerosene made from mid-continent crude. It is also noteworthy that the higher boiling portions of the saturated hydrocarbons from the kerosene contain more naphthenes than paraffins. On this point the writer wishes to register a vigorous protest against the careless and misleading practice of designating as paraffins any hydrocarbon oil which is not dissolved by 98 per cent. sulphuric acid at room temperatures. Naphthenes, which are saturated ring compounds, are equally insoluble in sulphuric acid of this strength. Failure to take account of this fact has led to endless confusion in the interpretation of experimental results from the cracking of hydrocarbons. When we recognise the presence of naphthenes in petroleums (and the writer believes that naphthenes are present to a greater or less extent in the majority of crude oils), there is no mystery in obtaining benzene and other aromatic hydrocarbons by the cracking of petroleum distillates. Nor in the light of this is it difficult to see why one water gas tar should contain greater quantities of aromatic hydrocarbons than another tar made in the same machine under similar heats but with a different carburetting oil.



Specific Gravities of Non-Saturated Hydrocarbons

Fig. 3

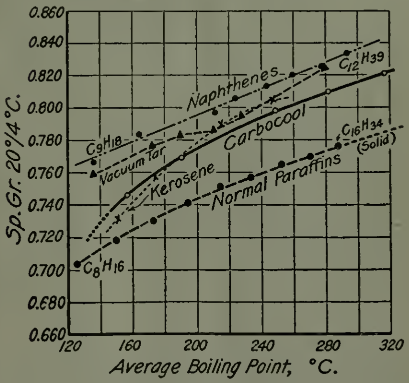
To sum up the work on carbocoal tar it has been shown that when the distillation of the tar is interrupted at a fixed temperature the pitch obtained has a much lower melting point and free carbon content than the pitch from high-temperature tars. If the distillation were carried on to give a pitch of the same melting point in each case, the percentage of pitch in the low-temperature tar will be considerably less.

The tar acids, constituting over 40 per cent. of the distillate of carbocoal tar, are mainly alkylated and hydrogenated derivatives of the familiar phenols of high-temperature tar. The nitrogen bases, about 2 per cent. of the distillate, are similarly related to the bases of high-temperature tar.

The neutral oils of carbocoal tar contain no aromatic compounds and only a small proportion of paraffins. The bulk of the neutral oils is made up of ring hydrocarbons with numerous side chains and more hydrogen in the ring than the aromatic hydrocarbons. If sufficient hydrogen is present to saturate the ring, these compounds are naphthenes, which are often carelessly confused with paraffins. If the amount of hydrogen in the ring is not sufficient to saturate, leaving one or more double bonds in the ring, the resulting compounds are unsaturated compounds of which di- and tetra-hydrobenzene are examples. This class of unsaturated cyclic hydrocarbons make up about 40 per cent. of the distillate of carbocoal tar.

Low-Temperature Tars from other Processes

In discussing other low-temperature tars we must recognise that first of all the nature of the tar depends upon the coal from which it is made. Low-temperature tar is tar as nearly in its primary form as it is possible to obtain under commercial conditions. Therefore it is more closely related to the coal substance itself than is any other form of tar. The low-temperature tars (*urteere*) of Germany, for instance, are made mainly from brown coal. They contain solid paraffins and are very different from the tar that has been described. In a similar way we would expect the low-temperature tar from our western (United States) lignites and from cannel coals[12] to be quite different.



Specific Gravities of Saturated Hydrocarbons

Fig. 4

The second point to be remembered in regard to the composition of low-temperature tars is that the vapours of primary tars, on account of the complexity of the compounds, are more sensitive to variations in temperature, pressure, gaseous atmosphere and contact surfaces than are the vapours of the simpler and more stable compounds of high-temperature tars. Hence differences in processes have a proportionally greater influence upon the composition of low-temperature tar than upon that of high-temperature tar. In this respect the main object of the process exerts a marked influence. In Germany the main object of low-temperature treatment is to obtain a substitute for petroleum. The processes have accordingly been regulated to give the highest yield of tar oils suitable for this purpose. It would be expected that even with the same fuel the low-temperature tar from German processes will vary considerably from the tar of English or American processes where the main object is to obtain either a suitable smokeless solid fuel or the best results in power gas. Again, we would expect the tar from a process designed to yield a smokeless fuel, such as the carbocoal, coalite or Parr-Layng process, to differ materially from the tar of a process working for complete gasification, such as the modified Mond or the Doherty processes. The MacLaurin process, whilst yielding a solid fuel, distils in the same way as the complete gasification processes and would be expected to give a similar tar.

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[12] C. R. Fettke, *Trans. Amer. Inst. Min. Met. Eng.* (1923).

In general, if operating on the same fuel, we might expect the tar from the coalite process to be similar to the carbocoal tar. The tar from the Parr-Layng process might also be much the same as a carbocoal tar made from a high oxygen coal. The Parr-Layng process, however, would hardly be applicable to the coal used in making the tar which has been described.

The exact nature of the low-temperature tar from complete gasification processes is hard to predict. Since the heat for the distillation in the Doherty, Mond and MacLaurin processes is furnished entirely by hot gases which also give a vacuum distillation effect by diluting and sweeping out the tar vapours, and since the tar vapours are never exposed to a higher temperature than that at which they were formed, it is to be expected that the tars from these processes will be even more primary in nature than carbocoal tar. Also, since the gases bearing the tar vapours pass through fuel which is cooler than the fuel from which the tar was distilled, we would further expect that there might be a slight fractionating effect on the tar, which would free it from some of the higher boiling compounds and pitch. It is the hope of the writer that he may soon have the opportunity to test these predictions by examining the Doherty tar.

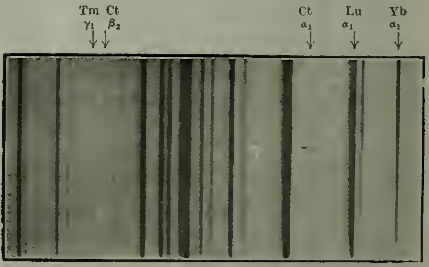
Fuel Research Laboratory, Department of
Chemical Engineering, Columbia University
New York

ON THE HIGH-FREQUENCY LINES OF CELTIUM

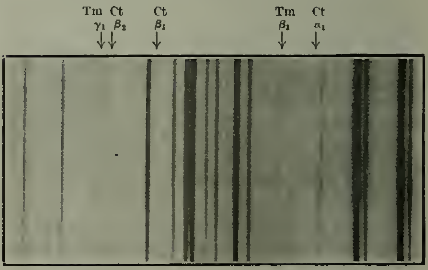
By A. DAUVILLIER

The value of X-ray analysis in proving the presence of a chemical element, even if it is only a trace, is due to the fact that merely one line, for instance, the ray $L\alpha_1$ is sufficient evidence. There is no line appearing on a photograph of such a spectrum whose origin cannot be identified. The problem is made easier because, if the proportion of the element is very small, there will only appear the line α_1, and generally one cannot distinguish more than four—α_1, β_1, β_2, γ_1.

The degree of precision in measuring a faint line, probably fairly diffuse in the case of the elements of the rare earths, has only a secondary importance if, in the spectral interval concerned, the lines of no other element appear.



No. 1



No. 2

The two photographic reproductions sent herewith have been taken directly from the original photographs. One can only just see in them the celtium lines, (No. 1) β_2, (No. 2) β_2 and α_1, but they show the general nature of the photographs obtained. The lines in question are clearly visible on the original plates to every reader, but have been very slightly strengthened to permit the accompanying illustration to be made. No 1 is the spectrum of the last fractionation of some ytterbium earths obtained by Prof. Urbain. The fraction contains twice as much lutecium as ytterbium and traces of thulium and celtium, the last two elements in equal quantity. No. 2 is an earlier fraction containing equal quantities of lutecium and ytterbium, the proportion of thulium is considerably larger, and that of celtium has not been altered.

It should be observed that the approximation obtained in our first determination for the lines β_2 and α_1 of celtium (nearly 4 units too little) is exactly the same as that obtained simultaneously for the strongest line β_2 of thulium (3·9 units too little, for γ_1 Tm 2 units too little), according to new measurements by Coster (*Phil. Mag.*, 46, Nov., 1923, p. 936). This difference well shows that this small error was due merely to the difficulty of "pointing" the lines correctly, as we had immediately perceived, for we referred to the probable values obtained by interpolation of Moseley's graph. The other possible attributions for the two lines of celtium have been discussed in previous notes. Mr. Coster finally suggests (*loc. cit.*) the possibilities: Pt Lα_2, Sr Kβ_1, and IKα_2, IKβ_1; but, besides the fact that these impurities are excluded chemically, the K lines could not be distinguished in the preceding orders and the stronger lines of platinum would have been distinguished before Lα_2 becomes visible. The other lines of celtium must be either too faint to be determined or masked by lines of lutecium and ytterbium. The photographs include, as will be seen, some 60 lines. They show the extreme intensity and dispersion which it is possible to obtain with a target of such oxides. The intensity of the lines of thulium aud celtium seems to correspond to a concentration of these elements of the order of a tenth of a thousand (10^{-4}), which is approximately the lowest limit which can be observed with the apparatus and method which we make use of.

In the case of metallic substances which are good conductors and refractory, like those of the platinum group, we have been able to reduce this limit to one-millionth, making use of a scale of intensity obtained by modifying the photographic factors. For an analysis which is at least qualitative there is no method more sensible or accurate than that of high-frequency spectra, by which each separate element appears precisely in proportion to its concentration. On the other hand, the sensibility of optical spectra depends very much on the chemical group concerned. Dr. Coster has searched for traces of celtium in a preparation of lutecium furnished by Auer von Welsbach, and has not observed any. Perhaps it never contained any, and there is no reason for such a content. But it is worthy of remark that our method has enabled us to show a very much larger number of lines in the L series than this author has observed. For instance, in the case of gold, Dr. Coster has only found 18 lines, whilst we have observed 36; in ytterbium he has found 14 against our 24, and for barium 20 against our 34. All our lines can be grouped in their proper series of optical types, in accordance with theory. This result is due to the fact that we have made better use of the anti-cathode material, that our dispersion is much greater and our efficiency much more greater, by reason of the use of homogeneous cathode rays. As to the presence of a trace of celtium, a tetravalent* element like *cerium*, in the last fractions of ytterbium earths, this is no cause for surprise if we consider how frequently tri-valent and tetra-valent elements are associated in nature. The detailed reasons justifying their occurrence have been the subject of a previous note. We need only mention that it is not exceptional, and that we have, on another occasion, observed the presence of a notable quantity of zirconium in a preparation of samarium, a pure trivalent element.

(*) We wish to point out that in all our previous papers we have always attributed 4 outer electrons to celtium and to cerium, as we considered them as higher homologues of zirconium.

PERSONALIA

Sir D. O. Masson, professor of chemistry in the University of Melbourne, has been elected the first president of the Australian Chemical Institute, which has now been incorporated.

Dr. Stephen Moulton Babcock, the originator of the Babcock test for milk, celebrated his eightieth year at his home in Madison, Wis., on October 22. Amongst work standing to Dr. Babcock's credit may be mentioned a viscosimeter, a gravimetric method for analysing milk, research on galactose, the digestive ferment in cheese and other problems relating to the treatment and utilisation of milk.

Professor Wyndham R. Dunstan, C.M.G., F.R.S., is resigning from the directorship of the Imperial Institute. He was professor of chemistry in the Pharmaceutical Society's School of Pharmacy from 1885 to 1896, a period during which he carried out, with Mr. F. H. Carr, researches on the alkaloids of aconite. Later he was appointed director of scientific and technical research at the Imperial Institute, finally succeeding Sir F. Abel as director of the Institute.

* * *

On December 1 the death occurred of Mr. S. K. Muspratt, formerly a member of the firm of Muspratt Brothers and Huntley, chemical manufacturers, and a nephew of the late Dr. E. K. Muspratt.

The net estate of the late Dr. E. K. Muspratt, of Seaforth Hall, Seaforth, Liverpool, President of the United Alkali Co., Ltd., amounted to £434,842.

With deep regret we announce the death of Mr. J. M. Wilkie last week after an operation. An obituary notice will be found on page 1189.

FORTHCOMING EVENTS

Dec. 10. The Biochemical Society, University College, Gower Street, W.C. 1, at 5 p.m. (1) "Bile of Hippopotamus," by J. A. Gardner. (2) "A Simple Apparatus for the Rapid Estimation of Alcohol in Blood," by R. K. Cannan and R. Sulzer. (3) "Influence of Diet on Vitamin A Concentration in Butter," by J. C. Drummond, J. Golding, S. S. Zilva, and J. Mackintosh. (4) "Influence of Diet on Composition of Butter Fat," by J. C. Drummond and H. J. Channon. (5) "The Nutritive Requirements of Marine Diatoms," by J. C. Drummond and E. M. Peach.

Dec. 10. The Royal Scottish Society of Arts, 117, George Street, Edinburgh, at 8 p.m. "The Carbonisation of Coal for Smokeless Fuel and Industrial Gas," by R. Maclaurin.

Dec. 10. University of London, University College, W.C. 1, at 5.30 p.m. "Some Chapters in the Recent Development of the Theory of Electrolytic Dissociation," by Prof. J. N. Brönsted. Also on December 12 and 14.

Dec. 10. Institute of Metals, *Scottish Section*, 39, Elmbank Crescent, Glasgow, at 7.30 p.m. "Cold Working of Metals, and its Influence on the Properties and Uses," by A. T. Adam.

Dec. 10. Institute of Chemistry, *Manchester Section*, the Textile Institute, St. Mary's Parsonage, Deansgate, Manchester, at 7 p.m. "The Chemist in Relation to Public Life," by F. E. Hamer.

Dec. 11. Institution of Petroleum Technologists, The Royal Society of Arts, John Street, W.C. 2, at 5.30 p.m. "The Modern Rotary Drilling System," by L. R. McCollum.

Dec. 11. Institute of Metals, *North-East Coast Section*, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. "Admiralty Gun-Metal," by S. G. Homfray and F. Adam.

Dec. 11. Society of Chemical Industry, *Edinburgh and East of Scotland Section*. Joint meeting with the East of Scotland Section of the Institute of Chemistry, at 36, York Place, Edinburgh, at 7.30 p.m. "H.M. Factory, Gretna," by Allin Cottrell, M.Sc.

Dec. 11. Royal Photographic Society, Scientific and Technical Group, 35, Russell Square, W.C. 1, at 7 p.m. (1) "The Sensitivity of the Silver Halide Grains of a Photographic Emulsion," by W. Clark, M.Sc. (2) "The Relation between Time and Intensity in Photographic Exposure," by L. A. Jones and E. Huse. (3) "A Motion Picture Densitometer," by J. B. Capstaff and N. B. Green.

Dec. 12. Chemical Engineering Group, Society of Chemical Industry. Joint meeting with the Liverpool Section of the Society at the Overseas League, 14, Elliott Street, Liverpool, at 6 p.m. "Extraction of Oils from Seeds, Nuts, and Kernels," by J. T. Brewis. Prior to the meeting a visit to the African Oil Mills, Flint Street, is arranged for 2.30 p.m. After the meeting Dinner will be held at 7.45 p.m., at the University Club, Mount Pleasant, Liverpool.

Dec. 12. Society of Chemical Industry, *Newcastle Section*. Chemical Lecture Theatre, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. "The Sterilisation of Preserved Foods," by Miss C. M. Dugdale.

Dec. 12. Institution of Mechanical Engineers, South Wales Institute of Engineers, at 6 p.m. "Mechanical Engineering in Modern Gas Works," by H. D. Madden.

Dec. 13. Institute of Metals, *London Section*. Joint Meeting with the Institution of British Foundrymen, Institute of Marine Engineers, 85-88, The Minories, Tower Hill, London, E. 1, at 8 p.m. "Some Foundry Problems," by A. H. Mundey.

Dec. 13. Society of Dyers and Colourists, Dyers' Hall, Dowgate Hill, E.C. 3, at 7 p.m. "Colour Solvents and their Application to Textile Fibres," by A. E. Woodhead, M.Sc.

Dec. 13. Society of Chemical Industry, *Yorkshire Section*. Joint Meeting with the Leeds Section of the Institute of Chemistry, Queen's Hotel, Leeds, at 7 p.m. "Practice under the Modern Patent Law," by G. Brewer, C.P.A.

Dec. 13. Institution of Mechanical Engineers, Connaught Rooms, Great Queen Street, London, W.C. Annual Dinner, at 6.45 for 7.15 p.m.

Dec. 13. Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C. 2, at 6 p.m. "Pulverised Fuel and Efficient Steam Generation," by D. Brownlie.

Dec. 13. Society of Chemical Industry, *Bristol Section*. Joint Meeting with the Institute of Chemistry, in the Chemical Department, Bristol University (Woodland Road), at 7.30 p.m. "Some Reminiscences of an Alkali Works Inspector," by R. D. Littlefield, F.I.C.

Dec. 14. Institute of Metals, *Sheffield Section*, the University, St. George's Square, Sheffield, at 7.30 p.m. "The Metallurgical Microscope—Some Notes on its Construction and Use," by J. H. G. Monypenny.

Dec. 14. Institute of Metals, *Swansea Section*, University College, Singleton Park, Swansea, at 7.15 p.m. "Some Applications of the Brinell Hardness Test," by A. L. Norbury, M.Sc.

Dec. 14. West of Scotland Iron and Steel Institute, Royal Technical College, George Street, Glasgow, at 7 p.m. "The Sulphur Content of the Acid Charge: Notes regarding its Variability during the Process," by J. H. Whiteley.

SOCIETY OF CHEMICAL INDUSTRY

LONDON SECTION

The preservation of building stone formed the subject of two papers at the meeting of the London Section on December 3. Dr. B. Dyer, Chairman of the Section, presided.

The first paper, by Mr. J. Allen Howe (Geological Survey of Great Britain), on "The Use and Preservation of Building Stone," was almost entirely of a geological nature, lantern slides being shown to illustrate the microstructure of various limestones and sandstones, and the manner in which these building stones are decaying on buildings in and near London.

In the second paper, Dr. J. J. Fox and Mr. T. W. Harrison gave an account of work done during recent years on the decay of building stone, especially in London, and particularly in relation to the question of bacterial action which has been revived recently. Apart from mechanical attrition the most potent decaying agent was water, not because it was water but because of the sulphur compounds it carried down from the air on to the stone. In the London atmosphere, the most destructive agent was the oxides of sulphur due to the coal fires. Experiments had been carried out to ascertain the amount of sulphur in the London atmosphere and also the amount of SO_2 in rain water, and it was concluded that sulphur dioxide and sulphur trioxide were the principal agents causing damage to building stone in London. Recently, the argument had been revived that decay of building stone is largely due to nitrifying bacteria, but the speaker's view was that this was not so in London and similar towns, and although this aspect might be important enough to demand investigation he did not think it could be regarded as of first importance. He did not believe that nitrifying organisms could resist the sulphur in the air.

None of the preservatives at present available for building stone were really effective. One school of thought said that the preservative should produce an impenetrable skin on the stone, whilst another alleged that this was wrong because it stopped the natural respiration of the stone. After examining many preservatives, he had come to the conclusion that all of them had objections. At the same time, it might be that they all did not have the objectionable features which were sometimes attributed to them and therefore it was time that large-scale experiments should be carried out to find out a suitable preservative. Such a series of large-scale experiments was recommended in 1861, but the proposal was turned down on the score of expense, the cost being estimated at £150. Practically all the preservatives now on the market were available in 1861, so that all this long time had been lost. The only thing to do now was to start such a series of experiments, not on a laboratory scale, but with a large piece of stone erected under ordinary conditions in the air. The results might not be available until the next generation but the experiment ought to be made.

The use of preservatives which alter the surface of the stone was objected to, for it would be just as well to use artificial stone, as this would last a considerable time if well made. Considering the use of organic or inorganic bodies for preservative purposes, he thought the most likely were inorganic colloids, although these had drawbacks. It had been advocated that a hard layer should be put on the surface of the stone, but as this layer would be of a different composition from that of the stone itself, it would not be a wise course to pursue.

Mr. Noel Heaton, who opened the discussion, commented on the fact that little, if any, progress has been made in the development of preservatives for building stone during the past 50 years and that many old preservatives, which have not been found suitable, kept turning up under new proprietary names. He agreed that too much stress had been laid upon the part played by nitrifying organisms in the decay of stone, and the arguments put forward to support such action were, to him, at any rate, absolutely unconvincing. The only way to deal with the whole problem was by exposure tests. Various laboratory methods had been suggested for testing preservatives for stone, but it seemed to him that these could never give a really reliable result. Several other speakers took part in the discussion. Mr. Walter Reid disagreed with the use of a preservative which put a film upon the stone; an account was given of some laboratory experiments by Mr. P. W. Blythe upon brick which, it was contended, indicated the possibility of arriving at a satisfactory laboratory method of dealing with the whole problem; and Mr. Howe in his reply emphasised the necessity for outside experiments upon stone in the form of actual pieces of building structures and exposed under the same conditions as buildings are.

BIRMINGHAM AND MIDLAND SECTION

The second meeting, held on November 27, in the University of Birmingham, was presided over by Dr. E. B. Maxted, and two papers were read.

The first paper, by Dr. D. F. Twiss and Messrs. F. Thomas and F. B. Jones, was entitled "Acceleration of Vulcanisation by Xanthates and the Influence of Metallic Oxides as Promoters." It was pointed out that in the presence of a zinc alkyl xanthate and zinc oxide, rubber can be vulcanised by sulphur rapidly at temperatures well below the boiling point of water. The zinc alkyl xanthate is the accelerating agent, but its effectiveness is greatly promoted by the presence of zinc oxide. The action is not catalytic. The zinc oxide acts as a "promoter" to many organic accelerators of vulcanisation. Cadmium oxide possesses similar power, but in a slightly less marked degree. The oxides of magnesium and mercury, metals of the same group of the Periodic Table, are themselves capable of accelerating vulcanisation, but have no appreciable activity as promoters. Remarkably little difference is detectable in the vulcanising power of soluble or insoluble sulphur respectively ($S\lambda$ and $S\mu$) between 88° C. and 188° C.

Dr. Twiss and Mr. F. B. Jones next gave a paper on "An Important Variable in Raw Rubber." Many physical characteristics have been made to act as a basis for testing the quality of rubber. A common method of examination is to vulcanise the material and measure the rate of vulcanisation or the mechanical features such as strength and extensibility of the vulcanised product. On vulcanisation with a generous proportion of sulphur, however, some samples of rubber attain a maximum tensile strength sharply after a certain period of heating, vulcanisation to a greater or a less degree resulting in a relatively great loss of strength; other samples, on the other hand, attain a high tensile strength over a relatively wide range of vulcanisation. Results were recorded in illustration of the variability in this direction. Indications were given of its importance and some factors were described which influence its development.

OFFICIAL NOTICES

ROTHAMSTED LIBRARY

By the courtesy of the Lawes Agricultural Trust, any member of the Society of Chemical Industry on presenting a card from the General Secretary shall be allowed access to this Library. The rules of the Library preclude journals and periodicals from being sent out, and these are therefore always accessible.

A catalogue of the journals and periodicals is in the Society's Offices, at Central House, and may be consulted there by members.

CHEMICAL SOCIETY'S LIBRARY

Members are reminded that, in accordance with arrangements entered into by the Council, they are now entitled to consult the Library of the Chemical Society, Burlington House, Piccadilly, W. 1, and to borrow books therefrom.

The Library is open daily from 10 a.m. to 9 p.m.; Saturdays, from 10 a.m. to 5 p.m. As hitherto, the Library will be closed on Bank Holidays, the day following, and on other such occasions as the Council may direct.

SOCIETY OF GLASS TECHNOLOGY

Three papers were read at the meeting held in Leeds on November 21, the President, Prof. W. E. S. Turner, D.Sc., in the chair. In the first paper, entitled "Notes on the Influence of Rapid Chilling on the Reversible Expansion of Clay," by H. S. Houldsworth, M.Sc., some results were given of measuring the reversible thermal expansion of fireclay test pieces cooled slowly and rapidly. Test pieces were moulded from Farnley fireclay, dried, fired to Cone 9 (1280° C.) in three hours, and maintained at that temperature for a further 2 hours. One test piece was plunged into cold water, another was left to air cool, and a third was allowed to cool slowly in the furnace for 17 hours. All the results were consistent with the explanation that solution of free silica occurred at the higher temperature of heating, that this separated out as cristobalite or tridymite on slow cooling, and exerted its characteristic influence on the expansion curve, but that it did not so separate on rapid cooling. Some imperfect separation was, perhaps, likely, but not in a sufficiently definite form as to be able to exert its proper influence on expansion.

A paper by P. Marson on "Glasshouse Pots: Some Notes on their Manufacture and Use," was read by Prof. W. E. S. Turner in the absence of the author. The grog used in pot-clay mixtures should not be burnt to less than 1350° C., and should be free from the faults of burning, such as black core and soft firing. The grading should also be kept within prescribed standards, viz., not coarser than 10 mesh for pot-clay grog, giving a residue of not more than 35 per cent. on a 16 mesh screen, and for the blend a mixture of 25 per cent. grog to 75 per cent. clay was the most suitable for general purposes. The dry clay, if satisfactory, was allowed to sour in water for a month, then trodden ready for use. Pots stored for two or three years after drying gave better results than new ones. and at least nine days should be occupied in heating up in the pot arch. After transferring the pot to the furnace, it should be left to mature for forty-eight hours before opening or filling on. Various faults developed by pots during manufacture and use were also discussed.

Prof. Kurd Endell, of the Technical *Hochschule*, Berlin, read a paper on "The Casting Process for Glasshouse Refractories in German Glass Plants." Prof. Endell considered that the casting process would give satisfactory results in practice. Success depended upon careful and trained supervision, as well as on the proper selection and preliminary treatment of the clay. When the articles were required for internal use, or when only certain standard sizes of pots or blocks were to be made, manufacture by casting was undoubtedly more economical than by hand. All tests hitherto made showed that cast pots were denser than hand-made ones, and he believed that cast pots were chemically more resistant to molten glass than hand-made pots. Tests both with Seger cones and under load showed no perceptible difference in heat resistance between cast pots and hand-made pots. He confidently anticipated that the use of the casting process for the shaping of refractory materials would gain an increasing number of adherents.

ROYAL MICROSCOPICAL SOCIETY

At a meeting held on November 21, Prof. F. J. Cheshire in the chair, Mr. F. I. G. Rawlins read a paper on "The Microscope in Physics."

Mr. Rawlins first considered the technique of conoscopic methods in microscopy as used for examining the effect of crystalline plates upon convergent polarised light. It was emphasised that surface structure had nothing to do with the phenomena observed—"interference figures," or the plane sections of a family of "isochromatic surfaces." In quantitative work monochromatic light was essential, though Wratten filters (especially Naphthol green) could be used to a limited extent. Suggestions were made for improvements in microscopes for use in the physical laboratory.

SOCIETY OF DYERS AND COLOURISTS

Mr. W. Marshall, presided over the meeting of the Manchester section on November 16, when a paper entitled, "Investigation into the Changes which occur in Cotton Fabrics during Calendering and Beetling," by J. Huebner, M.Sc., and V. Malwin, M.Sc., was read by Mr. Huebner.

The authors have investigated the changes which occur in cotton fabrics during calendering and beetling, and have found that hot calendering results in an increase in the ripping strain of the fabrics, whilst the tensile strain decreases. Hot calendering on one of the fabrics, after impregnation with a 10 per cent. starch paste, produced similar results as regards the tensile strain, but the increase in the ripping strain was less and more regular in the starched than in the unstarched fabric. Another starched fabric, however, showed an increase in both the ripping and the tensile strain after calendering. Cold calendering also increases the ripping strain, but it does not affect the tensile strain. Beetling is responsible for a very considerable increase in the ripping strain, whereas the tensile strain remains practically unchanged. Embossing of both unstarched and starched fabrics increases the ripping strain, but the decrease in the tensile strain of the unstarched fabric is greater than that which results from ordinary hot calendering. The tensile strain of the starched fabric, however, is less affected than that of the unstarched fabric. Immersion of both the calendered and beetled fabric in a weak solution of iodine in potassium iodide and water showed that the amount of iodine absorbed by the fabric increased gradually with prolonged calendering and beetling. The colouration of the fabric produced by the iodine also became darker after prolonged calendering and beetling. When fabrics which had been immersed in the iodine solution were exposed to the air, it was found that whilst the untreated fabric was of a light bluish tinge, the heavily calendered and beetled fabrics were tinted a pale blue. After prolonged exposure to the air the blue colouration disappeared from all the fabrics, but the fading proceeded less rapidly the longer the fabric had been calendered or beetled.

HULL CHEMICAL AND ENGINEERING SOCIETY

A paper on "Recent Advances in Colloid Chemistry" was read by Mr. A. V. Slater at the meeting held on November 27, with Mr. H. A. Scruton, B.Sc., in the chair. After a brief introduction showing the importance of colloid chemistry in industry, the author reviewed recent theoretical advances. The nature of surfaces considered in the light of the researches of Hardy, Langmuir and Harkins, was governed by (1) orientation of molecules and (2) residual valency, which could explain many of the anomalies of surface tension and interfacial phenomena, and therefore of colloidal behaviour. Sir W. Bragg considered that the colloid was built up in the same way as the crystal and only differed because the surface molecules had not slipped into their proper places, and this was further borne out by von Weimarn's work which indicated that the environment of the separating phase determined its crystalline or colloidal condition. The evidence brought forward by Hardy, McBain, Pauli and Loeb for the existence of an ionic micelle or colloidal electrolyte as the colloid unit was briefly presented, and the lecturer expressed his own view that the theory of colloids could be explained satisfactorily neither by the purely chemical nor by the physical adsorption concept. but that a correlation of the two by the light of recent research on surfaces and interfaces was necessary. The most recent industrial developments of colloid chemistry were reviewed and illustrated by charts and experiments.

ACADÉMIE DES SCIENCES

On October 29 a commemorative discourse on Maurice Le Blanc was delivered by Monsieur Haller, who said: "Inventor above all, Maurice Le Blanc brought to industry a wide and at the same time deep knowledge allied to a powerful creative imagination. His work on alternating current motors, on the theory of induction motors, and similar subjects places him on the first rank amongst modern electricians." He also did work on pumps and turbines, and constructed a refrigerating machine based on a novel principle. He will be remembered also for his work on the steam engine condenser.

An oration was pronounced on November 5 by Monsieur Haller in memory of Count Arnaut de Gramont, an academician who died on October 31. Monsieur Haller described de Gramont's work on spectroscopy, particularly on the dissociation spectra produced by the discharge from an electrostatic condenser sparking at the surface of a compound, and in which all the elements constituting the compound gave independently their particular spectra and lines. To him are also due numerous researches on the spark spectra of liquids, and on the use of the oxy-acetylene flame in spectroscopy.

A new theory of chlorophyll was described by M. Maquenne, based on a colloidal conception, and in opposition to the classic hypothesis of Baeyer. Monsieur Haller read a paper by Monsieur Zelenski, in which the author stated that from 1000 g. of tar he had obtained 350 g. of benzene, and a certain quantity of higher homologues, utilising the reaction discovered by Berthelot, for synthesising benzene from acetylene. In this process the acetylene passes over activated carbon and gives yields which hold out hopes of an industrial future for the method.

During the meeting held on November 12, the perpetual secretary, Monsieur Picard, communicated a note by Prof. Lorenz pointing out that in 1858 Solvay discussed the question of the variation of mass in chemical reactions, a variation which constitutes the chief objection that can be raised to-day against the classic law of Lavoisier. Lavoisier had attempted to ascertain experimentally this variation of mass both in chemical and physical reactions, but obtained no results. Lorenz therefore observes that this variation of mass expressed by the ratio of the variation of the energy to the square of the speed to its propagation, *i.e.*, the square of 300,000 km. per second, is necessarily an infinitesimally small quantity.

Monsieur G. Bertrand described a method of covering organic bodies with metal, due to Monsieur Zélinski, professor of chemistry of the University of Moscow. On heating, for example, an insect covered with powdered copper oxide in a current of carbon dioxide, it will be found after cooling to have undergone no change in shape, but to be completely metallised and, as it were, covered with copper. This phenomenon was explained by the formation of very unstable gaseous copper carbonyl which was quickly decomposed. The formation of this new gas makes it possible to explain and avoid certain errors common in the detection of copper in food materials. Monsieur Le Chatelier observed that he had obtained similar results.

Monsieur Breton communicated a paper by MM. Chevalier and Dantony, recommending the use of stalks and leaves of pyrethrum instead of the expensive leaves for the preparation of insecticides. A method of estimating lævulosans in cereal grains was described by Monsieur Lindet, and Monsieur L. Guillet read a paper on the electrical resistance of commercial aluminium.

On November 19 a note was presented by Monsieur Vinogradsky, describing a method enabling microbial action to be studied by direct microscopical observation in soil in which various chemicals had been incorporated. A note by MM. Lesiné, de Gennes and Guillaumin was communicated, dealing with the variations in blood phosphorus in patients suffering from rickets, and exposed to ultra-violet rays.

THE INSTITUTION OF THE RUBBER INDUSTRY

At the meeting held in London on December 3, 1923, at the Engineers' Club, a paper on "Rubber Accelerators" was read by Major V. Lefebure.

The speaker observed that there seemed to be a good deal of misunderstanding in the British rubber industry as to the position and value of rubber accelerators in general rubber practice. The bulk manufacture and use of rubber accelerators in all countries at present, and the enormous tonnage of rubber mix committed to the care of accelerators, permitted no doubt on this point. The question, rather, was the choice and proper use of the correct accelerator for a particular purpose. The simple facts that the world's consumption of organic accelerators was certainly more than 3000 tons per annum, and that reputable products varying from tyres to hard rubber had been based on accelerated cures for a number of years, meant that the industry which was backward in accelerator practice was ignoring one of the chief factors in successful competitive production. Accelerator practice had suffered in all countries, particularly in England, from the sale and use of unstandardised and disguised specialities, which admitted no intelligent control and certain standard output. Accelerators could be graded according to their relative speed in typical mixes, and it could be said that with proper use they had no harmful influence on milling, storage and ageing. England had been backward in the development of organic accelerators. Just as we failed to hold the great advantages which were once ours in the dye industry, so we had allowed other countries, in particular America, to forge ahead in a field in which, through the work of Peachey and others, we once held a dominating position.

CORRESPONDENCE

SILICA GEL

SIR,—My attention has been drawn to the letter by Dr. Chaney in *Chemistry and Industry* of November 23. I do not intend to begin a controversy on Silica Gel *v.* Activated Carbon, but exception must be taken to that part of his letter where, writing of silica gel and benzol, he says :—" A prerequisite of its employment is a careful drying of the gases." Either Dr. Chaney has misused the word " prerequisite " or he has no real knowledge of silica gel.

Silica gel is in use as a commercial proposition for the recovery and refining of benzol from coke-oven gases, and the gas enters the gel plant in exactly the same condition as it would enter the oil washers.

The fact that activated carbons have been more or less in use for so many years without making any substantial progress, while silica gel has in so short a time made such enormous strides, shows that it has passed what Mr. Rex Furness calls the final test—*i.e.*, the balance-sheet.—I am, Sir, etc.,

London, S.W. 1 J. ARTHUR REAVELL
December 3, 1923

BRITISH DYESTUFFS INDUSTRY

SIR,—In reply to the letter from Mr. C. M. Whittaker, published in your issue of 16th inst., we wish to correct the erroneous impression created by Mr. Whittaker in his earlier letter, that the price of British-made Direct Sky Blue, was, on the date he mentioned, twelve times the pre-war price.

As a matter of actual fact, the quality of Sky Blue made by this company is quite equal, in all respects, to the pre-war German types of Diamine Sky Blue FF., and Chicago Blue 6B., and the price was, and is, less than half the figure mentioned by your correspondent.—We are, Sir, etc.,

The Clayton Aniline Co., Ltd.
Manchester
November 28, 1923

THE CARRIAGE OF DANGEROUS GOODS

SIR,—From time to time the non-technical journalist supplies, in all good faith, misleading information, and I fear that it is seldom possible to catch up with items of news which are widely circulated and which contain statements of dubious accuracy.

A paragraph recently circulated and quoted by the Technical Press refers to a violent explosion which set fire to and sank the British steamer " Otterburn." The paragraph concludes by saying that the disaster was thought to be due to the explosion of barrels of chlorate of potash. I am informed, on what appears to be quite good authority, that there was no chlorate of potash on board the ship, but that there was a parcel of chloride of potassium.

The transport of dangerous substances is always a matter of difficulty, and it is therefore desirable that one should not unwittingly increase the difficulties by blaming a dangerous substance unnecessarily. To weigh down the statistics of explosions due to chlorate of potash by such items of news as that to which I refer would be misleading, and prejudicial to those firms who have to send abroad such goods—I am, Sir, etc.,

W. J. U. WOOLCOCK,
General Manager
Association of British Chemical Manufacturers,
166, Piccadilly, W.1
December 3, 1923

OBITUARY

J. M. WILKIE

John Matthew Wilkie was born at Montrose in 1876, and was educated as a pharmaceutical chemist. After passing his minor in Edinburgh he came to Derby as assistant to Mr. Frost, a high-class pharmacist of the old school. Later he went to London, and in 1900 was appointed as an assistant analyst in the laboratory of Boots Pure Drug Co., where he remained till his death. For many years past he was the deputy chief analyst, and was largely responsible for the work of the laboratory. By indomitable energy and by studying after a hard day's work he took the B.Sc. degree of the London University and the Associateship of the Institute of Chemistry by examination, taking the Fellowship in due course. Mr. Wilkie was always a keen investigator and numerous methods are known by his name. Perhaps the best known of his researches are the paper on the estimation of small quantities of lead, published with Mr. Harvey, the silver methods for the determination of phosphoric acid and the alkaline iodine oxidation of phenols, the two last researches being published in the *Journal* of the Society of Chemical Industry. He also devised a most ingenious method for the estimation of sulphur and oxidised sulphur compounds, which depended on the formation of acid by the bromine oxidation, but this research has only been published in abstract, as he was never quite satisfied that he had brought it to a satisfactory completion, and he shrank from publishing results which did not prove his point up to the hilt. These sulphur oxidation methods have, however, been in use at Boots' laboratory for some years with most satisfactory results. The last four years of his life was devoted to an almost monumental research on the determination of minimal quantities of arsenic. At the time of his death the work was concluded, and he was engaged in putting his notes into order for publication. This research was given to the world in abstract at the highly successful joint meeting of the Society of Public Analysts with the Nottingham Section of the Society of Chemical Industry. Wilkie was always a keen supporter of the Society, and as secretary to the Nottingham Section from 1914 to the present year he was largely responsible for the success of that Section and the great increase in the membership. He put his heart and soul into it, and it is safe to say that without him the interesting programmes of meetings, many of them joint meetings with other societies, would not have been held. He had just relinquished the secretaryship and had become chairman, and although he had only presided at one meeting he signalised that by inaugurating a discussion in which a large number of young members were persuaded to take part. It was always Wilkie's policy to encourage and bring forward the young talent, so much so that at Mrs. Wilkie's special request he was borne to his last resting-place by the young men that he used to encourage and talk about so often.

He was a highly informed man and talked English with great purity; highly conscientious, a hard worker, he persuaded others to work by his enthusiasm, and his colleagues all mourn him as a true and trusty friend. An accident in early youth partially deprived him of the use of the right arm, but nevertheless he was in his youth a keen football player and later in life an enthusiastic golfer. He died on November 29, after an operation.

NEWS AND NOTES

FRANCE

Petroleum

The proposal to establish an "office national du pétrole" has obtained a mixed reception. To meet the objection against State participation in the industry, it is proposed to establish a separate financial organisation with the help of companies and banks interested in the petroleum industry. Discussion between the Government and interested parties is now going on with a view to the formation of this organisation.

A natural-gas well, yielding an average of about 60,000 cb. m. a day, was discovered at Vaux en Birgey (Ain) in 1922. The gas contains 91–92 per cent. of combustible gas, 2–3 per cent. of carbon dioxide, and 4–5 per cent. of nitrogen, the heating value being 8600–9600 calories. The gas is now being supplied to the town of Ambérien, and it is also being stored under pressure in cylinders.

Metallurgy

Tests are being made at the Conservatoire National des Arts et Métiers at Paris of steel tempered after treatment in a new electric furnace devised by Messrs. Wild and Barfield, two English engineers. In this furnace, the moment when the steel reaches its transformation point is recorded automatically, and it can then be removed and tempered. The method is based on the fact that when steel reaches its transformation point it is no longer magnetic, and this is recorded, by means of suitable electrical wiring, by a galvanometer. The energy consumed by the furnace is 4·2 kw. per hour.

Beet Sugar

It is estimated that during the 1923–24 season, 95 beet-sugar factories will be operated in France, and that the production will be 480,000 metric tons of sugar, compared with a yearly consumption amounting to 700,000—800,000 t. In 1923 the area cultivated was 150,000 hectares, and the output of sugar in 90 factories was 445,000 t. In 1913–14 there were 209 factories, with a total production of 785,550 t. from 229,000 hectares, and the consumption was 710,000 t.

The "Quinzaine du Bois"

A number of interesting addresses were delivered during the fortnight devoted to the discussion of problems relating to wood during October in Lyons. Prof. Brot discussed the manufacture of cellulose pulp in France, and stated that the French production was 80,000 metric tons annually, whereas imports amounted to 2,100,000 t. The timber resources of Tunisia were described by M. Barriocilet, and Mr. Guinier dealt with French timber reserves, which cover over 10 million hectares, yielding 8·5 million cb. m. of timber and 17 million cb. m. of firewood per annum. The utilisation of the Landes pine for the production of cellulose for making paper and gunpowder was discussed by M. M. Jaffard. Such cellulose, obtained by the alkali and chlorination processes, was quite comparable to Kraft pulp, and could be used for making viscose and cellulose esters. Further, the yield (based on the wood) of 6 to 8 per cent. of resin suggested use for making resin soaps, dressing paper, etc.

UNITED STATES

Nomenclature of Petroleum Products

The joint committee of the American Society for Testing Materials and the American Petroleum Institute, established to consider the nomenclature of petroleum and its products, has issued a report containing the following definitions of the terms "crude petroleum," "weathered crude," "benzine," "petroleum naphtha," "gasoline," and "petroleum spirits."

Crude petroleum (crude oil, petroleum, crude). —A naturally occurring mixture, consisting predominantly of hydrocarbons, which is removed from the earth in liquid state, or is capable of being so removed.

Weathered crude.—A crude petroleum from which a perceptible quantity of the more volatile constituents has evaporated.

Benzine.—This term is archaic and misleading and should not be used.

Petroleum naphtha.—A generic term applied to refined or unrefined petroleum products and liquid products of natural gas, at least 95 per cent. of which distil below 500° F. when distilled in accordance with the tentative method of test for distillation of gasoline, naphtha, kerosene and similar petroleum products (serial designations: D 86–23 T of the American Society for Testing Materials).

Gasoline.—A refined petroleum naphtha which by its composition is suited as a carburant for internal-combustion engines.

Petroleum spirits. — A refined petroleum naphtha, with a minimum flash point of 70° F. (tag closed tester A.S.T.M. standard), with a volatility and other properties making it suitable as a thinner and solvent in paints, varnishes and similar products.—(*Chem. and Met. Eng., Sept.* 3, 1923.)

JAPAN

The Agar-agar Industry

During the period 1911-1920 the average annual output of agar-agar in Japan was approximately 3 million ℔. For the 1922-23 season the output was estimated at 2,400,000 ℔., but owing to unfavourable weather conditions in February, 1923, considerable quantities were discoloured and had to be sold as third grade. Agar-agar is usually marketed in three grades, the chemical composition of which is the same, the difference in quality being due to colour. It is also produced as shredded or "hoso kanten," or in the block form called "kaku kanten." About 75 per cent. of the output is exported, China and the Malay States taking 60 per cent. of the export, the remainder going to the United States, Great Britain, France and Germany. Shipments to Europe and America during 1923 have so far been very large, amounting to 1,600,000 ℔.—(*U.S. Comm. Rep., Sept.* 17, 1923.)

GENERAL

Projected Entente among Indigo Producers

It is believed that the recent agreement between American, British and Swiss indigo producers will develop into a chemical entente in order to meet the "economic accord" which is said to be projected by the French and German industry, and which may possibly be extended to Italy and Czechoslovakia. This arrangement will have the great advantage that it will enable research and development work to be co-ordinated. The value of association, if not the necessity of it, has been proved by the German cartel which was organised in 1916 and then extended in 1919 to 1999. The possibility that distribution may be allocated is foreshadowed, and it is stated that the chemical and allied industries in the United States, Switzerland and Great Britain are admirably adapted for association.—(*Chem. & Met. Eng., Oct.* 29, 1923.)

REVIEWS

Thermodynamics and the Free Energy of Chemical Substances. *By* Prof. G. N. Lewis *and* M. Randall. *Pp. xxiii*+653. *London: McGraw-Hill Publishing Co., Ltd.*, 1923. *Price* 25*s*.

This is a book on the application of thermodynamics to chemical problems. According to the authors it "is not a text book in the ordinary sense of the term." What authors generally mean when they say this is that most text books are bad, and theirs is good; and in this case there is some justification for the natural pride of the authors. Apart from this, the authors' statement is true in a sense which is not precisely what they intend to convey. An ordinary text-book would be expected to give due attention to all the important original work published on the subject; but the book under review, so far as recent developments of thermodynamics are concerned, consists largely of an exposition of the original work of Lewis and his colleagues and pays comparatively little attention to the work of other investigators. Particularly is this true of German work; Haber receives a few kind references, and a somewhat grudging bouquet is presented to Nernst in the opening chapter; but the work of the latter hardly receives the attention it deserves. Apart from this defect—and it is a defect—there can be little doubt of the value of the book. It is the product of the thought of years and nearly every page of it bears witness to the great care bestowed on it by the authors. It deserves, and will get, the closest attention of all serious students of the subject.

A most important feature of the book is the attention which is paid to the conception of the free energy of chemical reactions. There is often some confusion in other books in the treatment of free energy, but Lewis and Randall attack the subject boldly and successfully. In their discussion of the applications of the third law, they show, by the analysis of a large amount of experimental data, how the free energies of formation of chemical compounds from their elements can be calculated, and how from the figures so obtained, the state of equilibrium in any conceivable chemical reaction between these compounds can be calculated under different conditions. This system suffers from a defect which is unavoidable in the present state of knowledge of the specific heats of gases and liquids. The calculations of the free energies of formation of compounds can only be approximate at the best; hence, if the change in the free energy in any given chemical reaction is small, calculation of the state of equilibrium at any temperature must inevitably be very uncertain. On the other hand, if the change in free energy is large, calculations on Lewis' system will give results of the right order of magnitude. In this respect it seems to the reviewer, that the system expounded in this book is open to objections similar to those which the authors apply to Nernst's system of 'empirical chemical constants,' of which they remark that "the various efforts which have been made to square the calculations based on these constants with the results of equilibrium measurements constitute a regrettable episode in the history of chemistry."

The phraseology employed by the authors occasionally pulls the reader up with a jerk. Is there any real necessity for such elaborations as "partial molal free energy," "limiting molal lowering (of freezing point) "molality," etc ? As for the notation, the authors claim that their system has been tried out thoroughly for many years and has proved satisfactory. This may be so—and certainly once one gets used to the system, there is no ambiguity as to what the authors mean by their notation—but it is a real handicap to a student to find different authors using different conventions, and it does seem that the time has come when there should be some international agreement in this matter.

The book is well printed and produced, and has the merit of possessing a good index. It is a credit to the publishers as well as to the authors.

H. T. TIZARD

1. THE PROPERTIES OF MATTER. *By* BASIL C. MCEWEN, M.C., B.Sc. *Pp. vii*+316. *London: Longmans, Green and Co.* 1923. *Price* 10*s*. 6*d*. *net*.
2. MATERIE, ELEKTRIZITÄT, ENERGIE: DIE ENTWICKLUNG DER ATOMISTIK IN DEN LETZTEN ZEHN JAHREN. *By* WALTHER GERLACH. (*Wissenschaftliche Forschungsberichte. Volume VII.*) *Pp. viii*+195. *Dresden and Leipzig; Theodor Steinkopff,* 1923. *Price* 3*s*. 3*d*.

(1) Mr. McEwen's book follows the usual lines, except that he begins with gases and ends with solids (which seems to be an improvement on the usual order), and includes more Heat than is generally the case. The treatment is clear, and the mathematics simple. The descriptions of experiments are good, and the book is one which students for the Pass B.Sc. will find useful. The symbols are often unusual, *e.g.*, C_v for c'_v, Cm_v for C_v. No mention is made in the long discussion of specific heats of gases that these vary with temperature, and recent work is ignored. The discussion of critical solution temperatures along with the critical temperatures of liquids is confusing. There should have been a fuller discussion of the recent work on the determination of Avogadro's constant—in fact, the neglect of work done during the last ten or twenty years is the outstanding weakness of the book.

(2) Prof. Gerlach's book deals with some branches of the study of atoms, electrons and radiation which have been prominent during the last decade. In pleasing contrast with other works of this type the attention of the reader is invited to a diversity of experimental investigations, and the theoretical discussion is kept within moderate limits. The treatment, although quantitative, is generally non-mathematical, only the necessary formulæ (mostly simple) being introduced. After the discussion of atomic structure, isotopes and the electronic charge, there are interesting sections on matters such as the "super-conducting" state of metals, the radiometer effect, visible, infra-red and X-ray spectra (on the basis of Bohr's theory), photochemistry, etc. There are many literature references but no index. The book is one which all chemists should find interesting and intelligible.

J. R. PARTINGTON

SYNTHETIC INORGANIC CHEMISTRY: A COURSE OF LABORATORY AND CLASSROOM STUDY FOR FIRST YEAR COLLEGE STUDENTS. *By* ARTHUR A. BLANCHARD AND JOSEPH W. PHELAN. *Third edition: entirely rewritten and greatly enlarged. Pp. xiv*+321. *New York: John Wiley and Sons, Inc.*, 1922 *Price* 15*s*.

An authentic student's book of chemistry from so important a centre as the Massachusetts Institute of Technology (known familiarly by the intolerable contraction, "the Boston Tech.") must be of great interest to teachers on both sides of the Atlantic, and the one before us, which might, perhaps, as well have been called by the more familiar title of "Inorganic Preparations," is, indeed, worthy of very close examination. It is, of course, not a book to read in an arm-chair or at a desk, and it is unlikely that any honest reviewer could say that he had read it from cover to cover.

The chief thing a teacher or an ex-teacher looks for in such a work is new light—in beams, rather than in single rays. Does this new book show any broadly better ways of performing the old tasks ? If so, let us commend them to the world. The answer to this may, I think, be fairly said to be "in the negative," but I hasten to add that with still greater definiteness, but this time in the affirmative, would come the answer to a second question: does this book do the old work better than usual ? There is, indeed, evidence throughout of very great care, well collated experience, and an abundance of little novel things which collectively make the whole a pleasure to read and to commend to laboratory teachers.

It should be pointed out that the book is by no means limited to prescriptions, nor yet to rational teaching linked to isolated experiments. There is evidence, throughout, of a lure, which the authors acknowledge, towards a general expository treatment of inorganic chemistry as a whole, and, indeed, there are large stretches where the authors have as it were broken loose from the laboratory bench in their most forgivable ardour as chemical philosophers.

One may hope for large new ideas in the teaching of inorganic chemistry, but, perhaps, hardly expect them. In the details of methods and manipulation, the expectation of something new is more justifiable, and from America, which in so high a degree has been the country of invention (I confess to be thinking of mincing machines, sweepers, and perfect tea-pots). one has hoped particularly for improvements of the kind referred to. Whilst in the book before us there are here and there little modifications, it is not easy to find anything strikingly new which can be quoted. The thing which has stuck most in my mind whilst examining the book has been "the paper towel"—to me an unknown adjunct. It appears to be paper with the absorptive power of filter paper and the tenacity of parchment, but I am not sure. If the paper towels are really effective for wiping glass and for drying crystals; if they can be made at such a price that you can compel every student to have a new one as frequently as the member of a first-class club has a clean one of the older sort, they will contribute an ingredient to the practice of laboratory chemistry that is perhaps more usually lacking than any other.

As one believing most strongly not only in the virtue, but in the necessity of an extended training, of every chemical student whatsoever. in what our authors call synthetic inorganic chemistry, I gladly recommend the work under review. not, as already stated, that there is in it a great deal that is very new, but because it is a book written by earnest men which will certainly give to the watchful teacher a good yield of useful hints.

On the other side of the account one may, of course, point out what appear to be deficiencies, but these, where they exist, are mostly of detail and may best be noted direct to the authors. In a general way one may, and perhaps, must complain of the absence of an index, and on the slight tendency, apt to appear in American works, to what may be gently called a kind of pedantry. Why, for example, drag in "metathesis"? Who ever uses such a term in civilised life? Why say "molal" rather than "molar"? And what in the world is the man in the chemist's shop to understand by "a formal solution"? Such language is positively dangerous. On major questions I venture the opinion that under pre-war Teutonic influence American chemistry tended to "over-ionisation" and that there are still signs of it—I mean an overstrained use of that Ostwaldism which pushed Arrhenius into places far too narrow for his own or other people's comfort.

Arthur Smithells

L'Industrie du Gaz: Distillation de la Houille. *By* R. Masse and A. Baril. *Encyclopédie Léauté. Pp. vii*+292. *Paris*: *Gauthier-Villars et Cie.*, 1923. *Price* 20 *francs*.

L'Industrie du Gaz: Traitement des Produits et Sous-Produits. *By* René Masse and Auguste Baril. *Pp. xvii*+308. *Paris*: *Masson et Cie*, 1923. *Price* 20 *francs*.

The Gas Industry is one of the most important industries of this country, dealing, as it does, with a considerable proportion of our chief natural asset, coal. Not only is the industry itself a vast one, but it provides necessary raw materials for many other industries of prime importance. One of the most striking features of the industry is the wide scope of its operations, and those who read the works under review will be impressed with the skill which has enabled the authors to cover so wide a field in two comparatively small volumes.

The two volumes form part of a series of works (Encyclopédie Léauté) on technical subjects, and serve more by way of a general treatise than a specialised study of the diverse processes carried on. This is not to say that the specialist will not find information of service, as in a number of instances very worthy processes and plants are described to which it would be difficult to find reference in our own language.

The volume "Distillation de la Houille" deals with the process and plant required for carbonising coal and gasifying coal and coke. A short historical introduction repeats the erroneous derivation of the word "gas" from the Dutch "geest"* and gives undue prominence to the experiments of Lebon (1767) in carbonising sawdust. There appear to have been many men in many countries who disdiscovered gas, but no one prior to Murdoch had the audacity to expose himself in its light to the public view.

The consideration given to various types of coal appears inadequate and not in proportion to the excellent treatment given to the generation of heat and application of heat to carbonisation purposes. Thermal and carbon balance sheets are very appropriately inserted. Here and there is evidence that the authors are a little behind the times. The scale of Seger cone temperature indications is now out of date, whilst the Wanner pyrometer is now provided with two scales, one reading from 650–1130° C. and one from 840–2000° C. An improved instrument of similar type is made in this country.

The treatment accorded to the subject of refractory materials is disappointing, and one would imagine that the authors can hardly have been aware of the great improvement in quality and extension in use which silica materials have received in the last few years.

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* See *Chemistry and Industry*, 1923, 325, 349.

Different types of carbonising plant, including the coke oven, are described; and the design and function of many of the devices used are made particularly clear. Details of labour required for operation of plant is a noteworthy feature.

In the second volume the cooling of the gas, the extraction of tar, various types of exhausters, pressure-regulating governors, gas washers, and purification processes are dealt with in a useful manner. Theoretical calculations are introduced in quite a digestible form.

The measurement, storage and delivery of the gas from station holders are followed by a very brief chapter on the composition and physical properties of coal gas. The distribution of gas occupies some 21 pages, and brings the reader to the sections dealing with byproducts.

The recovery and manufacture of benzol products occupies a prominent place, and some attention is given to the too often neglected subject of the quality and condition of coke.

The working up of ammoniacal liquor with production of ammonium sulphate and concentrated pure ammonia solutions are briefly described, but it is surprising that no mention is made of the great attention recently given—in this country at all events—to improvement in the physical condition and neutrality of sulphate of ammonia.

Methods of treatment of coal tar are well described and short accounts given of the purification of the component liquids and solids.

Finally, the plan and position of the sites of gasworks are discussed. A copy of the model clauses of the "Concession" given to French gas undertakings is appended.

The most serious criticism that one can offer is that in a number of instances the matter is not quite up-to-date, notably in the theory of carbonisation, the subject of refractory materials, and the use of recording instruments. It would have rendered the work far more useful if in all instances references to literature had been added in footnotes, following a name which is mentioned in the text.

The printing is good and the illustrations are very clear, but in one or two cases on a very small scale. The paper is of poor quality. There is one advantage in the paper back, and that is that, in spite of the ingenious argument of the editor, one may remove the miscellaneous advertisements from the end of each volume before re-binding the books for one's bookshelf.

As a general descriptive work, concise and complete, the volumes can certainly be recommended.

GEOFFREY WEYMAN

REPORTS

REPORT ON THE ECONOMIC AND INDUSTRIAL CONDITIONS IN ESTHONIA. DATED JUNE, 1923. *By* J. E. P. LESLIE, *H.M. Consul, Reval, and* W. J. SULLIVAN, *Vice-Consul, Reval. Department of Overseas Trade. Pp.* 28. *London: H.M. Stationery Office.* 1923. *Price* 1*s.*

The economic and political conditions of this new country are strongly bound up, since financial developments are largely dependent on political events. The handling of the Communist element, which has been firm, and the avoidance of currency inflation show, however, that popular opinion is averse to extreme measures.

Agricultural conditions have improved recently and the 1922 harvest was normal. The altered situation in Russia has deprived Esthonian industry of much of its incentive to production. Timber is of prime importance, paper manufactured from wood-pulp making up a good proportion of the exports. The oil shale industry is still in the experimental stage. The output in 1920 was 483,000 tons, one-half of which was used in the cement industry, for which the shale has been found a suitable fuel.

Imports in 1922 included sugar, 14,413 t.; iron and steel, 15,698 t.; copper, 155 t.; glassware, 1532 t.; coal and coke, 90,906 t.; refined oil, 7169 y.; soda, 1192 t.; paints, 208 t. Exports are principally agricultural and textiles. There is a certain demand for British goods. Chemicals are imported mainly from Germany, though it is considered that crude chemicals of British origin, as distinct from drugs, might find a market.

SECOND ANNUAL REPORT OF THE SECRETARY OF MINES FOR THE YEAR ENDING DECEMBER 31, 1922, AND THE ANNUAL REPORT OF H.M. CHIEF INSPECTOR OF MINES FOR THE SAME PERIOD. *Mines Department. Pp.* 195. *H.M. Stationery Office,* 1923. *Price* 6*s.* 6*d.*

The first part of the Report is devoted to a review of the coal-mining industry in 1922, and it is pointed out that production steadily improved until a level approaching that of 1913 was reached, the total output being 249,606,864 tons. The increase in exports helped to compensate for the smaller home consumption. Altogether 229,725 surface and 933,029 underground workers were employed at coal mines, the numbers of persons killed and injured being 1105 and 185,497. The total number of workers employed at all mines in Great Britain was 1,175,280, in addition to 67,849 employed at quarries; 1160 persons were killed and 190,249 injured at mines and quarries.

The output of minerals in the United Kingdom is shown in the appended table.

	Output	
	1922	1921
	tons	tons
Iron ore and ironstone ..	6,867,512	3,477,955
Non-ferrous ores :		
Tin ore, dressed (black tin)	650	1,078
Lead ore, dressed	11,079	6,787
Zinc ore, dressed	1,620	814
Tungsten ore, dressed	3	—
Uranium ore, dressed	393	76
Copper precipitate	167	100
Manganese ore	250	514
Chromite, dressed	595	—

Minerals for Chemical and Allied Industries

	tons	tons
Arsenic (white) and arsenic soot	978	1,032
Arsenical pyrites	354	—
Iron pyrites	5,669	3,943
Bog ore	1,184	817
Ochre, umber, etc.	9,036	10,310
Salt	1,871,397	1,382,629
Barytes and witherite	40,949	24.669
Sulphate and strontium ..	4,711	6,622
Gypsum	257,460	264,840
China clay	666 834	435,844
Potter's clay	166,357	158,196
China stone	38,921	34,886
Alum shale	2,487	2,840
Soapstone	50	—
Oil shale	2,603,996	1,866,896
Petroleum	125	342
	cb. ft.	cb. ft.
Natural gas	100,000	100,000

Minerals used in Iron and Steel Making and other Smelting Processes

	tons	tons
Fluorspar	33,343	23,137
Ganister and silica rock ..	279,882	246,645
Fireclay	1,824,201	1,352,587

Minerals for Building and Roadmaking and for all other Purposes

	tons	tons
Limestone	9,418,678	7,334,064
Calcspar	6,453	1,798
Chalk	3,024,448	3,434,357
Sandstone (other than ganister and silica rock)	2,140,301	1,844,586
Slate	231,410	237,350
Clay and shale	6,407,715	8,348,367
Mica clay	12,984	3.083
Chert, flint, etc.	54,151	45,641
Gravel and sand	2,058,539	2,194,846
Moulding and pig-bed sand ..	195,345	238,852
Igneous rocks	5,927,964	5,700,770
Felsite, felspar and felstone ..	55,605	39,244

The report also contains sections devoted to reviews of the quarrying and mining industries (iron, tin, lead, zinc, radio-active minerals, minerals used in the chemical and allied industries, refractories, fluxes, building and road-making materials and oil borings), together with information on trade developments and prices. Health and safety in the mining and quarrying industries receive consideration, and research done to increase safety in mines or improve working conditions is described at length. The report concludes with a lengthy series of tables of statistics relating to the various industries.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for Nov. 29)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Centrifugal pumps (tenders)	12652 and 12653 E.D. E.C. 2
,, ..	Steel blooms (tender) ..	12634 E.D./E.C./2
Belgium ..	Paper	575
Egypt ..	Linseed oil substitutes	594
,, ..	Type metal (tender) ..	11887 F.E./G.C. 2
Europe ..	Wire ropes, wire netting, galvanised sheets, hardware	8844/T.E.
Finland ..	Steel (tender) ..	8350 F.R./E.C. 2
Latvia ..	Pumping machinery ..	582
Lithuania ..	Asbestos, chemicals, hardware, rubber	583
,, ..	Sugar, caustic soda ..	585
Netherlands	Iron and steel ..	586
New Zealand	Glass jars	12575 E.D./M.C. 2
South Africa	Disinfectants	574
Spain ..	Copper sulphate ..	589
Sweden ..	Chemicals, oils, pig-iron	591, 592
Switzerland	Oils	593
United States	China clay, leather ..	596, 598
Yugoslavia ..	Leather (tender) ..	11874 F.E./M.C.

TARIFF CUSTOMS EXCISE

Germany.—The sugar tax is to be levied on net weight, and is to correspond for glucose to a rate of 14 per cent., and for other sugar to a rate of 35 per cent., of the works price of molasses at Magdeburg.

Poland.—Exports of scrap tin are prohibited.

Spain.—Certificates of origin are required for asbestos, glassware, hardware, iron and steel, copper, tin and other metals, scientific instruments, soap, perfumery, chemicals, paper, silk yarns, and rubber.

The death of Dr. J. Rosenbloom, of Pittsburgh, marks the loss of a medical practitioner well known in bio-chemical circles in the United States.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The heavy chemical market maintains a steady tone, both home trade and export continuing to take tolerably satisfactory quantities. Prices are firm.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry.
Acid Hydrochloric	3s. 9d.—6s. per carboy d/d., according to purity, strength and locality.
Acid Nitric 80° Tw.	£21 10s.—£27 per ton makers' works, according to district and quality.
Acid Sulphuric	Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 65s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
Ammonia Alkali	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d.
Potash Caustic	£30—£33 per ton.
Potass. Bichromate	5¾d.—6d. per lb.
Potass. Chlorate	3d.—3½d. per lb. Inclined to stiffen in price.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£27 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton. Very little demand.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Prices in this section are unchanged.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

With the exception of acetates of lime and lead the demand for wood distillation products keeps below normal. German charcoal is again being offered.

Acetate of Lime—	
Brown	£14—£14 10s. per ton d/d. Demand active.
Grey	£22 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£9 per ton, according to grade and locality. Market quiet.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	5s. 6d. per gall. 60% O.P. Competition being met with.
Solvent	6s. per gall. 40% O.P. Fair demand.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead	£42—£43 per ton. Demand more active.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. per lb. Weaker, with limited demand.
Crude 60's	2s. 9d.—3s. per gall. Limited business for spot delivery. No market for forward delivery.
Acid Cresylic, 97/99	2s. per gall. Firm, with good demand.
Pale 95%	1s. 10d.—2s. per gall.
Dark	1s. 7d.—1s. 10d. per gall. A little inquiry for forward delivery.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.
Anthracene Oil—	
Strained	8½d.—9½d. per gall. Quiet.
Unstrained	8d.—9d. per gall. Quiet.

Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Benzole, Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 3d.—1s. 4d. per gall.
Pure	1s. 9d.—1s. 10d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil Heavy Standard Specification	8½d.—9½d. per gall. according to grade and district. Good business being done.
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s.—1s. 2d. per gall. Market weak.
Solvent 90/190	1s.—1s. 3d. per gall. Business quiet.
Naphthalene Crude—	
Drained Creosote Salts	£5—£8 per ton. Demand increasing. Market scarce.
Whizzed or hot pressed	£9—£11 per ton. Quiet.
Naphthalene—	
Crystals	£19 per ton.
Flaked	£19 per ton.
Pitch, medium soft	120s.—130s. per ton. according to district and time of delivery. Little business. Market difficult. Little inquiry forward.
Pyridine—90/140	21s.—23s. per gall. Demand good. Supplies short.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

The slight improvement in dyestuffs business has been maintained, but orders are still only for small quantities.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 8d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Much better demand.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 8d. per lb. 100% basis d/d
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Demand quiet.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dimethylaniline	2s. 7d. per lb. d/d. Drums extra.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£83 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	5¾d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	11¾d. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. lb. 100% basis d/d.
R. Salt	2s. 7½d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
o-Toluidine	7d.—8d. per lb.
p-Toluidine	4s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

English makers are steadily gaining ground in the manufacture of pharmaceutical chemicals with the aid of the Safeguarding of Industries Act, and whilst the present position in Germany continues supplies of chemicals manufactured abroad on a low exchange basis will gradually disappear from the market.

Acid, Acetic 80 % B. P.	£48 per ton.
Acid, Acetyl Salicylic	3s. 9d. per lb. Very firm. Makers fully occupied. Demand exceeds supply.
Acid, Benzoic	B.P. quality almost unobtainable. Commercial quality offered forward at 2s. 3d. per lb. for cwt. lots.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Camphoric	17s.—19s. per lb.
Acid, Citric	1s. 5½d. per lb., less 5%, for ton lots. Dearer.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst	6s. per lb. for 28 lb. lots.
Acid, Salicylic	2s. 6d. per lb. Very firm market. Expected to advance if demand continues.
Acid, Tannic	3s. 3d. per lb. for B.P. quality. Very firm.
Acid, Tartaric	1s. 1½d. per lb. less 5 %. Firmer.
Amidol	9s. per lb. d/d.
Acetanilide	Advanced to 3s. 3d. per lb. on a short market. No supplies from Continent.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	4s. 3d.—5s. per lb. for English make.
Ammon. Carbonate B.P.	£27 15s. per ton.
Atropine Sulphate	12s. 6d. per oz. for English make. Continental prices much higher.
Barbitone	18s. per lb. Slightly higher and in shorter supply.
Benzonaphthol	4s. 9d. per lb.
Bismuth Salts	A steady market. Prices according to quantity :

Bismuth Carbonate	12s. 9d.—14s. 9d. per lb.
,, Citrate	11s. 4d.—13s. 4d. ,,
,, Salicylate	10s. 2d.—12s. 2d. ,,
,, Subnitrate	10s. 9d.—12s. 9d. ,,
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	
Potassium	10d. per lb. Remain very firm. Continental prices advancing.
Ammonium	11d. ,,
Sodium	10d. ,,
Calcium Lactate	2s. 9d. per lb. for best English make. Inferior Continental supplies have ceased.
Chloral Hydrate	4s. 3d. per lb. Position very firm and active.
Chloroform	2s. per lb. for cwt. lots. More active.
Creosote Carbonate	6s. 6d. per lb. Little demand.
Guaiacol Carbonate	Spot supplies very scarce. Present value 14s. per lb.
Hexamine	4s. 6d. per lb. for foreign makes. Manufacture in England has been discontinued since formaldehyde was removed from the dutiable list.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate	1s. 11d.—2s. 3d. per lb., according to quantity.
Magnesium Carbonate— Light Commercial	£36 per ton net.
Magnesium Oxide— Light Commercial	£72 10s. per ton, less 2½%. Reduced by £5 per ton.
Heavy Commercial	£27 per ton, less 2½%.
Heavy Pure	2s.—2s. 3d. per lb., according to quality and quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 65s. per lb.
Mercurials	Firm and likely to advance.
Red oxide	4s. 11d.—5s. 1d. per lb.
Corrosive sublimate	3s. 8d.—3s. 10d. ,,
White precip.	4s. 6d.—4s. 8d. ,,
Calomel	4s. 1d.—4s. 3d. ,,
Methyl Salicylate	2s. 11d. per lb. for carboys. Brisk market. Higher values expected.
Methyl Sulphonal	22s. per lb.
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 7d. per lb. In shorter supply.
Phenacetin	7s. 6d. per lb. Steady market. English makers fully employed. Foreign supplies shorter.
Phenazone	8s. 9d. per lb. In short supply.
Phenolphthalein	8s. per lb. Very firm.
Potass. Bitartrate— 99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Market firmer.
Potass. Citrate	1s. 8d.—2s. per lb.
Potass. Ferricyanide	3s. per lb.
Potass. Iodide	16s. 8d.—17s. 5d. per lb., according to quantity. Demand continues.
Potass. Permanganate	9½d. per lb. for B.P. crystal. Shortage of foreign supplies has enabled English makers to regain lost ground.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Salol	4s. per lb.
Silver proteinate	10s. 6d. per lb. Quiet.
Sod. Benzoate	3s. 6d. per lb. Very scarce.
Sod. Citrate, B.P.C., 1923	1s. 5d.—1s. 9d. per lb., according to quantity.
Sod. Hyposulphite— Photographic	£14—£15 per ton, according to quantity, d/d. consignee's station in 1-cwt. kegs.
Sod. Nitroprusside	16s. per lb. Less for quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 11d. per lb., and Crystal at 3s. per lb. Firm and very active.
Sod. Sulphide— Pure recryst.	10d.—1s. 2d. per lb., according to quantity.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	17s. 6d. per lb.
Thymol	14s. 6d. per lb. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 9d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine	3s. 3d. ,, ,,
Benzaldehyde free from Chlorine	3s. 3d. ,, ,,
Benzyl Benzoate	4s. ,, ,,
Cinnamic Aldehyde Natural	22s. 6d. ,, ,,
Coumarin	20s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	9s. 6d. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	37s. 6d. ,, ,,
Geraniol	6s. 9d. to 13s. 6d. per lb.
Heliotropine	8s. 6d. per lb.
Iso Eugenol	15s. 9d. per lb.
Linalol ex Bois de Rose	20s. ,, ,,
Linalyl Acetate	20s. ,, ,,
Methyl Anthranilate	8s. 6d. ,, ,,
Methyl Benzoate	6s. ,, ,,
Musk Ketone	47s. 6d. ,, ,,
Musk Xylol	13s. 6d ,, ,,
Nerolin	4s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	16s. ,, ,,
Rhodinol	60s. ,, ,,
Safrol	1s. 10d. ,, ,,

Terpineol	3s. „ „
Vanillin	25s. 3d.—26s. 6d. per lb. Firm with steady demand. Raw materials dearer.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil..	1s. 11d. „ „
Bergamot Oil	13s. 3d. „ „ spot.
Bourbon Geranium Oil..	37s. „ „
Camphor Oil	75s. per cwt.
Cananga Oil, Java ..	9s. 6d. per lb.
Cinnamon Oil, Leaf ..	5d. per oz.
Cassia Oil 80/85% ..	11s. 6d. per lb.
Citronella Oil—	
Java 85/90% ..	4s. 9d. „ „
Ceylon..	Very little on offer.
Clove Oil..	10s. 6d. per lb.
Eucalyptus Oil 70/75%..	2s. 6d. per lb.
Lavender Oil—	
French 38/40% Esters	24s. 6d. per lb.
Lemon Oil	2s. 10d. per lb. Higher prices expected.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet ..	11s. 9d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	26s. per oz.
Palma Rosa Oil ..	24s. 6d. per lb.
Peppermint Oil—	
English	70s. per lb. Market very unsteady.
Wayne County ..	15s. 6d. per lb. Market very unsteady.
Japanese	12s. 6d. per lb. Market very unsteady.
Petitgrain Oil	9s. 6d. per lb. Dearer.

TRADE NOTES

Trade Information

Filter-Cel is a product introduced by the Celite Products Corporation, Victoria Street, London, to make it possible to filter dense liquors that formerly could only be handled by gravity filters of the bag type or by tedious settling processes. Dense liquors yield a tightly packed non-porous cake that prevents filtration, but if Filter-Cel is mixed with such liquor it builds up with the material on the filter cloth a thick porous cake with channels for the flow of the filtrate and filtration becomes possible. Only small quantities of Filter-Cel are added to the liquid prior to filtration, and after it is completely mixed filtration is begun. It should always be used with a retaining medium such as cotton, woollen or wire cloths or fine metal screens, and it can be used in conjunction with all types of filter presses. Sugars, syrups, molasses, glucose yield a clear sparkling filtrate when Filter-Cel is used in small quantity, and it also is employed in the filtration of cider, fruit juices, cereal beverages, fats and oils, dyestuffs, magnesia solutions, tannic acid, varnish, vinegar, waxes, and wines, to mention only a few of its many applications. With its use the capacity of the filter is increased, operating costs are reduced, recovery is increased and the appearance of the filtrates is improved. Filter-Cel, it is stated, is inert and does not affect in any way the chemical composition, taste, or odour of the liquor.

Gas Supply for laboratories situated in districts remote from town's gas has in the past been a serious problem. A solution is, however, provided by the oil-gas apparatus, supplied by Mansfield and Sons, Ltd., of Hamilton Square, Birkenhead. This apparatus enables an efficient substitute for town's gas in the form of oil-gas of some 1350 B.Th.U. per cb. ft. to be manufactured by unskilled labour from any kind of heavy oil or even animal or vegetable oil and fat. Such gas can be used for work varying from heating a test-tube to melting refractory ores, and the apparatus is designed to give durability as well as simple, efficient and economic working. In addition to oil-gas apparatus, Messrs. Mansfield also supply a variety of appliances, such as bunsens, burners, injector and combustion furnaces, ovens, blowpipes and other laboratory apparatus for use in conjunction with oil-gas.

Asbestos is one of those widely-used industrial materials of which little is heard. Yet, owing to its resistance to the attack of mineral acids, it is of particular importance to the chemical and especially the sulphuric-acid manufacturer. For such use it is imperative that the asbestos should be of 100 per cent. purity and free from organic matter. This requisite is, according to a circular we have received, met by the fibres, cloths and yarns manufactured by the Cape Asbestos Co., Ltd., of London, a firm which supplies asbestos in all shapes and forms for industrial use. Net cloth to hold the platinum catalyst in the oleum process, joints for fume mains in nitric-acid plants, packing for acid pumps, filter cloth or fibre for filtering corrosive liquors, acid-resisting cement, diaphragm cloths for electrolysis, asbestos clothing, heat insulation on pipe lines, mattress covers for vats, stills, ovens and the like are but a few examples of the many uses to which this versatile material is put by the Cape Asbestos Co., and even then new uses for asbestos in chemical industry are continually arising.

A Gold Medal has been awarded at the Barcelona Trade Exhibition to P. V. Brand leather cloth, which is made by the British Pluvinsin Co., of Manchester, a company under the control of Nobel Industries, Ltd., of London.

Rubber Supplies

The United States Rubber Co. has concluded a contract with a number of large companies (including two Belgian firms) of Kuala Lumpur, for the supply of 300 tons of rubber monthly. Some of this rubber will be treated by the Hopkinson process at Port Swettenham (Malaya), where a factory will be installed by the American company. Stores will be established, so that latex can be sent by rail to Port Swettenham.

Development of Copper Deposits in India

As a result of recent investigations in the Singbhum district of Chota Nagpur (the property of the Cordoba Copper Co.) a bed of rich mineral territory has been discovered, a section of which has already been prepared for development. Special attention has been given to the Mosaboni mine, where 1576 feet have been driven on copper-bearing lodes. Of this distance, 691 ft. were on ore of an average assay value of 4·66 per cent. copper over an average width of 46 inches. In consequence of the work accomplished at Surda and Dhobani, applications for mining leases have been made for these two areas and also for the Mosaboni mine.

German Petroleum Output in 1922

Natural oil production in Germany is very small. The 1922 output, 45,044 tons, amounted only to 0·04 per cent. of the world's total. Apart from the loss of Alsace-Lorraine, an important source, production has declined from the pre-war figure. In 1908 140,900 t. was obtained within the old boundaries. By 1913 this had fallen to 121,000 t., or 71,400 t. without Alsace-Lorraine, and in 1920 the output was only 34,800 t. The recent increase in output is due to fresh borings in Hanover, the most important oil-bearing district of Germany.

Fertiliser Industry in Germany

A report from Berlin states that in consequence of the depreciation of the mark, an agreement has been made by the representatives of the Government, agriculturists, and the nitrogen industry that the price of rye is to be the basis for fixing the price of nitrogen, the price of 140 kg. of rye being taken as that of 100 kg. of ammonium sulphate. While the nitrogen industry is forced, on account of political conditions, to purchase raw materials from abroad, a supplementary charge for these will be made. The price of calcium cyanamide is to be fixed at eight-ninths and that of sodium nitrate at one and one-ninth of the price of sulphate of ammonia.

Sugar Beet Crop in Hungary

It is estimated that the 1923 beet crop will yield 100,000 tons of sugar. Of this quantity, 60,000 t. are required for domestic consumption, and the remainder will be exported at an approximate value of £800,000 according to present London market prices. Despite the autumn drought, the quality of the beet and the sugar content are reported to be good. The area sown in 1923 was 94.728 cadastral yokes which produced 8·81 million quintals of beet, as compared with 62.598 cadastral yokes and 7·11 million quintals in 1922. Although there is a considerable demand for Hungarian sugar in the Levant and the East, it is probable that some portion will be sent to the London market.

French Company News

The Société de Petits Fils de F. de Wendel et Cie is about to erect a new battery of coke ovens at Moyeuvre-le-Grand (Moselle). This company has now lit six out of ten blast furnaces in its works at Patural.

The "Société générale pour la fabrication de matières plastiques" and the "Société industrielle du celluloid" are to amalgamate under the title "Société industrielle des Matières Plastiques."

PUBLICATIONS RECEIVED

Industrial Alcohol, the Production and Use of Alcohol for Industrial Purposes, for Use as an Illuminant and as a Source of Motive Power. *By* J. G. M'Intosh. *Second edition, revised and enlarged. Pp.* 400+*xii. London: Scott, Greenwood, and Son,* 1923. *Price* 12*s.* 6*d.*

Dangerous Goods. *By* Dr. J. Aeby. *Second edition. Pp. xi*+319. *London: Crosby Lockwood and Son,* 1922. *Price* 30*s.*

Mechanical Stoking. *By* D. Brownlie. *Pp. x*+234. *London: Sir Isaac Pitman and Sons, Ltd.,* 1923. *Price* 5*s.*

Lead, its Occurrence in Nature, the Modes of its Extraction, its Properties and Uses, with some Account of its Principal Compounds. *By* J. A. Smythe, Ph.D., D.Sc. *Pp. vi*+343. *London: Longmans, Green and Co.,* 1923. *Price* 16*s.*

The North of Scotland College of Agriculture, An Experiment on the Control of Finger-and-Toe by Liming. *By* J. Hendrick, B.Sc., F.I.C. *Bulletin No.* 29. *Pp.* 15. *Reprinted from the Transactions of the Highland and Agricultural Society of Scotland,* 1923.

Publications of the Imperial Mineral Resources Bureau. *Statistics* 1919-1921. *The Mineral Industry of the British Empire and Foreign Countries. H.M. Stationery Office,* 1923:—
Arsenic. *Pp. iv*+18. *Price* 1*s.* 3*d.*
Diatomaceous Earth. *Pp. iv*+6. *Price* 6*d.*

Textile Exposition Number of Dyestuffs. *Vol. xxiv., No.* 10. *Pp.* 190—220. *New York: National Aniline and Chemical Co., Inc.,* 1923.

Einfache und Fraktionierte Destillation in Theorie und Praxis. *By* Prof. C. V. Rechenberg. *Pp. xv.*+814. *Leipzig: Schimmel and Co.,* 1923. *Price, paper,* 17 *gold marks, bound,* 18 *gold marks.*

Taschenbuch fur Gerbereichemiker. *By* Prof. H. R. Procter, M.Sc. *Third edition. Pp. xv*+283. *Dresden and Leipzig: Theodor Steinkopff,* 1924. *Price* 4*s.*

Bollettino Ufficiale della R. Stazione Sperimentale per l'Industria delle Pelli e delle Materie Concianti. *No.* 3. *Pp.* 32—48. *Torino: Stabilimento Grafico ditta eredi Botta,* 1923.

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EDITORIAL

IF we rest a moment from our distillations, crystallisations, resolutions and precipitations, and take stock of the present state of chemistry, we can hardly fail to be astonished by the disparity between the enormous number of observational facts known, and the extreme paucity of the theories which vivify them. It was not always so: in the days of alchemy the theories were legion and the facts were comparatively few—and both states are bad for chemistry. There are, indeed, two factors essential to scientific progress—ideas and observations. It is idle to discuss which of the two is the more important, since it is perfectly clear that each is indispensable to the other. But it is necessary to insist upon the value of the one when the other appears to be unduly worshipped. The alchemists paid far too much attention to the products of the imagination and far too little to those of the laboratory; at the present day the pendulum has swung very largely to the other side, and a constant stream of more or less uninspired routine work issues with a mechanical and depressing regularity. The output of fruitful ideas bears no sort of relation to the mass of empirical data available, except in one or two conspicuous cases which will occur to our readers at once.

Consider, for example, the ionic theory. Here we have a theory which has remained in practically the same state in which it was first suggested by Arrhenius nearly forty years ago. The comparatively few facts it was intended to cover in its early days it certainly explained fairly well, but what real progress has it made since? Except for dilute solutions it has had to be supported in almost every direction by subsidiary and often fantastic hypotheses, and even with the aid of these it does not give a very convincing picture. In short, to us it appears to be in very much the same kind of position as that which was occupied by the phlogiston theory in its declining days. Both theories explained, to contemporary satisfaction, the facts which led to their formulation, and both became vaguer and vaguer as the number of relevant facts increased. The ionic theory, of course, is based upon a much larger and much more varied absolute number of facts than those correlated by phlogiston, yet is it any greater if compared with the whole contemporaneous field of chemical knowledge? How long will it be before the theory of ions goes the same way as the theory of phlogiston—the common way, indeed, of all scientific theories? It is a platitude to say that no theory is immortal, but it may not be useless to repeat that no theory is "correct" and none "incorrect." To apply the terms *right* and *wrong* to a chemical theory is to avow oneself destitute of the conception of the nature of scientific truth, yet how often do we find it said that, for example, Lavoisier showed that the old theory of combustion was "incorrect," and substituted for it the "correct" one! A theory may be adequate or inadequate to explain various sequences of phenomena, but it can never be said to be absolutely true; with absolute truth, in fact (if there be such a thing), science in its present embryonic stage of development has nothing whatever to do and, as far as we can see, may never have.

Dogma in chemistry, is a fatal handicap, as we all recognise unhesitatingly, except where our own favourite dogmas are concerned, but are we doing all we can to train the younger generations of chemists to a splendid irreverence for established chemical creeds? Or are we allowing the impressive grandeur of modern chemistry to hypnotise them into the belief that, in chemical theory, all is for the best in the best of all possible worlds? It is probably within the experience of the majority of us that the tendency lies very markedly in the second of these two directions, and it therefore behoves us to be up and doing, else we shall produce not chemists, but technicians.

What is needed is a different outlook and a better realisation of the essentially pragmatic nature of scientific truth, otherwise our theories, instead of being tools with which we hammer and carve and blast our way forward, will become superstitious creeds with which we mumble ourselves into a state of ecstasy. The best corrective of the attitude of slavish and blind adoration of the theories of the present is a study of the rise, development and subsequent fate of theories of the past. Perhaps a thorough training in the philosophy of science would serve the purpose equally well, but we cannot all be philosophers, and in many of us the very word "philosophy" arouses a vigorous inhibitive complex, due no doubt to our severely practical nature. In the same way, it is often impossible to get a man to react to theoretical ethics who will yet respond immediately to "The case of Hezekiah Smith: An Awful Warning to Sinners!" It is for this reason that we believe that the systematic study of the history of his subject should be made an integral part of the chemist's training. The time is past when the history of chemistry could be considered as a subject fit merely for the spare moments of the "practical" chemist—a pastime with which he might appropriately beguile his leisure. There is a real need now for men who will undertake historical research in chemistry as their main object in life, who will adopt the same critical attitude, employ the same acumen, and lavish the same unselfish care in rendering the development of the science plain and intelligible to the non-specialist, as are characteristic of the researches with glasses and test-tubes. That their work would be fruitful cannot be doubted: the arid regions of facts, with all their potential wealth, need to be fertilised with fecund ideas, and, while the man of genius must remain a mystery, yet the average mind can be trained to produce ideas with as great ease as the candidate for a doctorate produces new compounds. Let us show the new disciple that theories are not sacrosanct, by holding up to his gaze examples of the past; let us instil into his mind the continuity of chemical thought and its slow evolution throughout the ages, and let us encourage him to realise that chemistry is no cut and dried science in which all the main conceptions are impregnably established, so that the most we can hope to do is to add a brick here or to polish a rough surface there. All this and much more we could do by insisting that he should have an adequate knowledge of the growth of his science. The University of London has a lecturer on the History of Science: we trust it will not be long before every academic chemical department has its own lecturer on the History of Chemistry, whose services to the common cause will be recognised as of at least equal value with those of his colleagues in the laboratories.

* * *

Moving about the chemical world to-day one hears continual comment on the embarrasing growth of chemical science and the impossibility of keeping touch even with the main developments. The elders are bewildered by the pace and begin to consider what is going to happen to the thing they used to know for certain as solid chemistry. They feel rather as they do in a motor car when their nephew "lets her rip"—it is very wonderful, but after all there was something more restful in the less wonderful progress of a carriage and pair. The young man fresh from the University, on the other hand, more than ever feels how very old his elders are, how old-fashioned the foundation on which their structure of chemical knowledge was erected, how tremendously things must have changed since their young days.

Each of these extremes may be forgiven, they are indeed always with us and always will be. But between them we meet men in the fullness and maturity of vigour who are really much distracted by the flood of new knowledge. This is particularly the case among teachers. They will tell you two things in particular. One is that their lecture courses become unmanageable; the changes taking place, not only by the accretion of new knowledge but by far-reaching changes at the foundation, mean that a great deal of the old has simply to be jettisoned, not because it is unimportant, but because a place must be made for the new. There is now a much longer story that must be told of that part of chemistry which is not detail—a part where the experienced man is of most use as a guide. The other thing that you will be told is that young men coming to the staff from centres where the new knowledge is growing most rapidly are often amazingly ignorant of some of the older things which really are still indispensable for the right equipment of a chemist.

These facts suggest the enquiry—is it not time that we considered a re-ordering of the science which is now included under the word chemistry? Fifty years ago organic chemistry was still generally treated as an extra on chemistry proper, which included the general philosophy of the science and the systematic chemistry of all the elements. The increasing magnitude and importance of organic chemistry were clearly marked in this country when in 1874 Sir Henry Roscoe brought about the appointment of Carl Schorlemmer to the first British Chair of Organic Chemistry. The chief difficulty, however, has arisen from the rapid growth of chemistry on the physical side and the treatment of physical chemistry as a branch separable in the same way as organic chemistry from the main trunk of the science.

This has tended to make havoc of inorganic chemistry. It is absurd to talk of teaching inorganic chemistry apart from the general philosophy of the science. Certainly a stuffing process can be, and sometimes is, set up, reducing the subject to a sort of recited pharmacopœia. The only satisfactory solution would appear to lie in the inorganic chemist recovering a considerable fraction of what has been filched from him by the physical chemist, letting this be used as the life-blood of his teaching and leaving out a great deal of the detail of inorganic chemistry. There would still remain an ample field of the higher range of physical chemistry for the separate specialist teacher. It would seem to be a calamity if students are not to be given in the first instance a good measure of strictly unhyphenated chemistry by a first-class teacher.

THE BOHR ATOM AND COVALENCY

By N. V. SIDGWICK, D.Sc., F.R.S.

Dr. Main Smith's article on the Bohr atom (this vol., p. 1073) is chiefly devoted to a severe reprobation of my attempts to extend the Bohr theory to non-polar compounds.

He begins with a criticism of Prof. Bohr's theory, which may be summed up under three heads. The first is that though the theory accounts for the existence of positively charged ions, " no cognisance appears to be taken of the much more important fact that no atomic ions are capable of existence carrying more than one negative charge." The fact may, perhaps, be disputed on the ground of the existence of O^{--} and S^{--}; but apart from this question, any dynamical model which assumes the electrons to be held by the attraction of a positive nucleus gives a reason why negative ions should be less stable than positive. The firmness with which the outermost electron is held depends in the first instance on the positive charge on the rest of the atom. In an ion with a single negative charge, the positive charge is zero : in a divalent anion the charge on the rest of the atom is negative. This explains why triply charged anions are unknown, and doubly charged, if they exist at all, are rare. Singly charged negative ions can only be formed when their electronic arrangement is of unusual stability, and that is why they only occur when their effective atomic number is that of an inert gas.

The second point of attack is that if one of the valency electrons of aluminium occupies a 3_2 orbit, and the other two 3_1 orbits, aluminium should behave as a univalent element : from which he draws " many inferences " of an improbable character. But even if the three electrons were in orbits of the same type, in which case he would admit the trivalency, the work required for the successive steps of the ionisation would be in the ratio 1 : 4 : 9. This difference is not sufficient to prevent atoms from reverting to the inert gas type by the loss of two or three electrons ; and the fact that with aluminium one electron is in a 3_2 and the other two in 3_1 orbits will not affect the result, unless the ratio of energy levels of a 3_1 and a 3_2 orbit is large in comparison with these ratios, which Dr. Main Smith has not ventured to assert.

The third series of criticisms, that the Bohr theory does not account for the formation of complex ions, of carbon monoxide, of nitric oxide, for the absence of compounds of nitrogen and fluorine, and so forth, may be summed up by saying that it does not deal with non-polar linkages. This is admitted. It is precisely because the dynamics of orbits in which more than one nucleus is concerned is too complicated to be dealt with at present by physical methods, that I have made the attempt to approach the subject on the chemical side.

Dr. Main Smith then proceeds to deal with me. He begins by attacking the view, suggested seven years ago by Prof. G. N. Lewis, and now accepted by the majority of chemists interested in the subject, that a non-ionised link is due to the sharing of two electrons.* He says (p. 1075), " It might be supposed " from my accepting this theory " that the existence of covalencies was a proven fact. Actually there is no evidence to support it." A little later he says, " It is not suggested," *i.e.* by himself, " that the covalency postulate does not represent a reality." If it represents a reality, I should have thought that there must be some evidence for it. However, it seems that an inorganic covalency is formed by a single shared electron, but that when we enter " the realm of undoubted aliphatic and aromatic chemistry," two are required. The frontier of this realm is defined by the occurrence of " straight chains containing more than three carbon atoms."

This subordination of chemical laws to the requirements of text-books does not appeal to me. The great advantage of the application of electronic ideas to chemistry seems to me to lie in the fact that it enables us to regard all questions of structure, whether organic or inorganic, from a single point of view. Elsewhere (this vol., p. 848), Dr. Main Smith lays great stress on simplicity as a test of the truth of a chemical theory. This simplicity, it seems, is secured by proclaiming loudly that all valency is one, and then immediately dividing it into two, or, as it would now appear, into three kinds—polar valencies, one-electron covalencies for inorganic use, and two-electron covalencies for use in " undoubted " organic chemistry.

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* " One of the biggest advances yet made in the study of valency."—Andrade, *Structure of the Atom*, 1923, p. 244, note.

Dr. Main Smith argues that polar and non-polar valencies (though he provides a separate mechanism for them) are "practically undistinguishable," because solutions of some complex salts (such as K_2SiF_6) give reactions of the simple ions. He does not explain why other complex salts fail to give these reactions. The facts were accounted for by Werner by the very probable assumption that the complex dissociates in solution to a greater or less extent. Dr. Main Smith seems to have granted himself a dispensation from the edict which he promulgated against Prof. Lowry, forbidding anyone to tamper with the Werner theory. His whole treatment of the relation between ionisable and non-ionisable links is opposed to Werner's view (see, for example, *Neuere Anschauungen*, 1913, p. 72), and I notice that he has abandoned the use of the square bracket, by which Werner emphasised this fundamental distinction.

The conception that there are two kinds of valency, one due to a transferred electron, and the other to two shared electrons, is, of course, the basis of all my suggestions. If it is rejected, they fall to the ground at once. If it is accepted, the idea of effective atomic number follows of necessity, and is not, as Dr. Main Smith seems to think, a new assumption. If we know the structure of the molecule, we know the number of electrons surrounding any atom within it, and that is all that the effective atomic number means. Some of these electrons are "lone" electrons, the sole property of the atom: the rest are shared with other atoms. These two classes must obviously be distinguished from one another, though we need not make any assumption as to the orbits of the shared electrons, except that they are different from those of the unshared electrons. Since we know from Prof. Bohr's theory what are the stable arrangements of electrons in an isolated atom, it is natural to try to arrange the electrons in a combined atom in a similar way; and this is what I have done. Dr. Main Smith seems to think that it follows that an element which in a compound has a given effective atomic number must behave like an isolated atom of the same atomic number, regardless of the fact that some of its electrons are shared. But this is just the opposite of my view, as he would have seen if he had read my paper with any care. I have always considered the effective atomic numbers strictly in relation to the covalency number. To take his own example, in a compound $K[AlF_4]$ the aluminium has the effective atomic number 18. This is stable because the atom (like silicon in SiH_4) can have the arrangement (2) (4, 4) (*4*, *4*), differing from that of argon only in that eight of the electrons are shared. In $Na_3[AlF_6]$ the effective atomic number of the aluminium is 22 and the covalency 6 (as it is also in AlA_3,* and in the central atoms of $[SiA_3]Cl$, $K_2[SiF_6]$, SF_6, and possibly of $[Mg(NH_3)_6]Cl_2$. The number 22 occurs in combination with a covalency of 6, but not without it, in many stable compounds. It must, therefore, be possible to have a stable arrangement of 22 electrons when 12 of them are shared. I suggest that this may be expressed by writing the six pairs of shared electrons as two subgroups outside the unshared electrons: (2) (4, 4) (*6*, *6*). Dr. Main Smith says that the number 22 must indicate activity, because it is the atomic number of titanium. He entirely ignores the covalency, which is an essential part of my suggestion, and the fact that the activity of titanium is due to the structure (2) (4, 4) (4, 4, 2) (2), which is not possible for a 6-covalent atom, since it does not contain any group of 12 electrons. He says that the numbers in my groups "have no necessity beyond a desire to obtain an inert gas structure, or, failing that, any structure that looks symmetrical." The phrase "failing that" is misleading. It is essential that the number of the 6-covalent atom should be 22 rather than 18, which would lead to (2) (4) (*6*, *6*); this is not a stable grouping, and that is why the effective atomic number 18 does not occur with a covalency of 6. The total number has a "necessity" on the electronic theory, and if it can be shown that when the compound is stable this number can be expressed in a symmetrical way, that, I submit, is an advance of some importance. In titanium, as we know, the electrons are grouped in an unsymmetrical way, and that is why the element is active. Of course the word "symmetrical" requires to be defined more precisely. This can only be done by the further examination of effective atomic numbers; but I have tried to point out some of the conditions of symmetry or stability, founding my ideas of symmetry on those groupings which Prof. Bohr finds to be exceptionally stable in the isolated atom.

Now we come to the rule relating the covalency to the position of the atom in the periodic table. Here I must admit that in my paper in this *Journal* (p. 901), I was led by a desire for brevity to state the rule in a manner open to misconception; and this has enabled Dr. Main Smith to draw a number of absurd conclusions from it. In my paper in the *Transactions* of the Faraday Society (Oct., 1923), I stated it in the form that "the highest covalency number is that of the subgroup" (meaning of course the maximum size of subgroup), "next to the largest completed group in the atom." The maximum size of the successive quantum groups and subgroups according to Prof. Bohr is :—

1-quantum group : $1 \times 2 = 2$
2-quantum group : $2 \times 4 = 8$
3-quantum group : $3 \times 6 = 18$
4-quantum group : $4 \times 8 = 32$

If the principal quantum number is n, the maximum number of subgroups is n, and the maximum number of electrons in each sub-group is $2n$. I may point out to Dr. Main Smith that this is a conclusion of the Bohr theory, and is not my invention. The rule which I proposed is this. If the atom in the compound has enough unshared electrons completely to fill n quantum groups (the number required being 2 for 1, 10 for 2, 28 for 3, and 60 for 4) its maximum covalency is equal to the maximum number of electrons in a subgroup of the $(n+1)^{th}$ quantum group. Dr. Main Smith has overlooked the word maximum, which was stated with reference to the covalency, and clearly implied with reference to the subgroup number. Now we never find that an atom in a compound has more lone electrons than it had in the isolated state. It, therefore, follows that no atom before neon (10) can have a higher covalency than 4, and no atom before nickel (28) a higher covalency than 6. Dr. Main Smith quotes certain substances whose formulæ appear to contradict this rule, and these I will discuss later. The rule certainly accords with the behaviour of the great majority of substances. It is well illustrated by the acetyl-acetonates. It accounts for the fact that aluminium can form AlA_3, while boron, though it also is trivalent, cannot form BA_3, and so forms $[BA_2]X$ instead; and that zirconium can form ZrA_4, while titanium can only reach $[TiA_3]X$. The test case in this group of elements is germanium. This in my view is the lightest of the quadrivalent elements which can form a compound of the 8-covalent type: $GeA_4 : 32+12=44=(2)\ (4,\ 4)\ (6,\ 6,\ 6)\ (\mathit{8},\ \mathit{8})$. The germanium derivative of acetyl-acetone has, however, not yet been described. The reason I gave for this rule, which seems a natural one, is this. In the uncombined atom a subgroup cannot reach its maximum size until the groups of lower quantum number are complete. Thus in the 3-quantum group you cannot have a subgroup of 6 unless the two fours of the 2-quantum group are present. In general, you cannot have any subgroups of $2n$ unless they are supported, so to speak, by the full set of subgroups of $2n—2$, $2n—4$, etc. In the same way it would seem that in the combined atom you cannot have a covalency of $2n$ (which involves two subgroups, or something like subgroups, of $2n$ shared electrons each) until you have a full group of unshared electrons of the $(n—1)^{th}$ quantum number established. Thus of the following formulæ :—

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* For brevity I write A for the acetyl-acetonyl group.

(1) $BeA_2 \quad : \quad 4+6 = 10_4 = (2)\ (\mathit{4},\ \mathit{4})$
(2) $[BA_2]X : 5+6+1 = 10_4 = (2)\ (\mathit{4},\ \mathit{4})$
(3) $BA_3 \quad : \quad 5+9 = 14_4 = (2)\ (6,\ 6)$
(4) $AlA_3 \quad : \quad 13+9 = 22_6 = (2)\ (4,4)\ (6,6)$

(1), (2), and (4) comply with this rule, and represent actual compounds: (3) does not, since the sixes have no fours to support them, and accordingly no such compound as BA_3 exists. This rule is not proposed as an *a priori* principle of symmetry, but as a generalisation of the observed facts that certain of these compounds are formed, while others, which, apart from these ideas seem equally probable, are not. The rule takes the form to which Dr. Main Smith objects if we suppose that in these highly covalent compounds the lone electrons fill up completely as many of the lower groups as they can, and if we further assign to the covalency electrons a principal quantum number one more than that of the largest completely filled group. But as these assumptions are not obvious, and the last in particular (the assignment of a definite quantum number to the orbits of the shared electrons) is of doubtful validity, it is better to state the rule in the form which I have just explained.

If this form is adopted, it is obvious that it leads to none of the absurd conclusions which Dr. Main Smith deduces. But there still remains to be discussed the series of compounds which he quotes as indicating a higher covalency than the rule allows—compounds supposed to establish a covalency of 6 for boron, of 8 for titanium, of 12 for osmium, and even of 20 for aluminium and tantalum. Some of these do not seem at all to bear the interpretation which he puts on them if we take account of ionisation, or even of probable modifications of structure. Thus $[B(NH_3)_3]F_3$ would have a covalency of 3, and $[Ti(NH_3)_6]Cl_4$ of 6; H_3BF_6 may well be $B(F_2H)_3$, since F_2H is well established as a univalent ion. In the hexa-borotungstates $R_3B(W_2O_7)_6$ he would be a bold man who claimed to know the exact arrangement of the 55 atoms which form the complex. The rest of his selected compounds are open to an objection of a more general kind. Their formulæ express the composition of the solid phase, but no evidence is available, so far as I can discover, of the existence of such molecules in solution. Now in the case of hydrated salts it is generally admitted that there may be water molecules in the crystal which play no part in the molecular structure. Werner certainly took this view, and was often at pains to show that some of the water molecules entered into the constitution of the complex, while others did not. But if this is admitted for water it must certainly be admitted for ammonia likewise: and if for ammonia, why not for other molecules as well? We know from the X-ray results that the crystal unit may contain two or more molecules of the same substance. There is no sign that these are combined chemically: they are packed together in the crystal owing to the operation of crystalline forces, which are altogether subordinate to the forces connecting the atoms in a molecule. If the crystal structure is destroyed by fusion or solution, they separate again. Now if similar molecules can thus be joined crystallographically, why not dissimilar molecules? Why should not the substance $R_{15}TaF_{20}$, which Dr. Main Smith regards as evidence of a covalency of 20 in tantalum, really consist of, say, $R_3[TaF_8]+12\ RF$, forming separate molecules but one crystal unit? It may be said that this gives us great latitude in fixing the formulæ of complexes. The answer is that the composition and structure of a molecule must be determined by examining its properties in the liquid state before we can use it to establish or to overthrow any theories of valency. Werner was always careful to do this. By observing the number of ions formed from the compound in solution, by detecting its isomerism, and most conclusive of all, by producing instances of optical activity, he established a series of types of complex compounds about whose structure there was no doubt. Other methods of investigation can be employed. Non-polar compounds can be distinguished by their volatility, by their solubility in non-polar solvents, such as hydrocarbons,† and still better, if they dissolve in water without decomposition, by the non-conductance of the solution; their molecular weights can be measured in solution or in the vapour. The views I have expressed are founded on the behaviour of substances whose structures have been examined by methods of this kind.

Dr. Main Smith's remarks on hydrogen scarcely call for any reply. I agree with him that an electron cannot revolve in two different orbits at the same time; I also agree that 2-covalent hydrogen must have 4 electrons, only 2 of which can be in 1_1 orbits. If we are justified in giving the shared orbits any quantum numbers at all, the other two presumably occupy 2_1 orbits. But why should they not do so?

His remarks on the last page of his article as to the orbits of shared electrons are I am afraid beyond me. He says, "It is doubtful if the facts or the electrons are so simple or lie so close to the surface." However it may be with the facts, it is certain that the electrons (together with the protons) are the simplest things we know, and that the valency electrons are not only for most of the time near the surface, but constitute the surface, of the atoms. If the orbits of the two shared electrons encircle both nuclei, as he suggests, and as has been suggested before, it seems quite possible that one may be playing its part in the neighbourhood of one nucleus, while the other is doing the same for the other nucleus, and that in the course of a revolution each may change over from one nucleus to the other. The idea that a non-polar linkage is constituted of two electrons, which in some way count in the structure of both atoms is, as Prof. Lewis showed some years ago, a direct inference from the ordinary laws of valency and the conception of atomic number. No facts incompatible with it have yet been brought forward. If Dr. Main Smith can produce any, let him do so. If he claims that such linkages can equally well be formed of a single electron, let him show us, for a simple molecule, such as chlorine or methane, how this can be done. But he will need strong evidence to convince chemists of the truth of his distinction between organic and inorganic phenomena, or of his doctrine that new laws of valency come into being when we pass from propyl to butyl alcohol.

Dyson Perrins Laboratory,
Oxford
November 21, 1923

PERSONALIA

The U.S. National Research Council has appointed Mr. R. B. Sosman, of the Geophysical Laboratory, as American member on the Permanent Committee for the Standardisation of Physico-Chemical Symbols of the International Union of Pure and Applied Chemistry. The other members of the committee are Prof. E. Cohen, University of Utrecht, chairman; Prof. A. Findlay, University of Aberdeen; and Prof. Ch. Marie, the Sorbonne.

Monsieur Rivière has been appointed professor in charge of courses on the silicate industries and the gasification of fuels at the Central School of Arts and Manufactures, Paris. Monsieur Dufour has been appointed professor of general physics at the same school.

C. W. Parmelee, who has become Head of the Department of Ceramic Engineering at the University of Illinois, has been connected with the Institution since 1916 as professor of ceramic engineering, and during the past year has served as Acting Head.

* * *

The death is announced of Mr. H. Barrett, J.P., of the Phœnix Chemical Works.

The following deaths are announced from Germany: Prof. G. E. Emmerick, the founder of the Munich Photographic Institute, and of various photographic publications and associations; Dr. L. Grunmach, professor of experimental physics at the Berlin Technical *Hochschule*; D. H. Jordan-Mallinckrodt, founder and director of the Vereinigte-Glanzstoffabriken A.-G.; and Dr. A. Pfannenstiel.

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† It is on these grounds that I think the structure recently proposed for basic beryllium acetate by Sir W. Bragg and Prof. Morgan (*Proc. Roy. Soc.*, 104, A, p. 440) is untenable. This substance boils at 330°, giving a normal vapour density, and is soluble in chloroform. In fact these authors themselves admit that "there is no sign of ionic dissociation throughout this group of beryllium compounds." But according to their formula the molecule contains 17 "non-valent, but charged atoms" (4 berylliums and 13 oxygens). This can only mean that the atoms in question are ions. The six $CH_3{\cdot}C-$ groups must presumably also be ions, since none of the other atoms have any valencies to which they could be attached. The molecule of this compound which shows "no sign of ionic dissociation" therefore consists of 23 ions. The structure which I have suggested (*Nature*, vol. III, p. 808, 1923), in which the positions of the atomic centres are the same as in the formula of Sir W. Bragg and Prof. Morgan, but the distribution of the electrons is different, providing non-ionisable linkages for all the atoms in the molecule, seems much more in accordance with the properties of the substance.

FORTHCOMING EVENTS

Dec. 17. THE FARADAY SOCIETY, at The Rooms of the Chemical Society, Burlington House, Piccadilly, W. 1, at 8 p.m. Discussion on the Report on Atmospheric Corrosion, to be opened by W. H. Vernon.

Dec. 17. INSTITUTION OF THE RUBBER INDUSTRY. The Kelvin Room of the Engineers' Club, Coventry Street, Piccadilly, W. "The Position of the Rubber Tyre Industry," by Col. Sealy Clarke.

Dec. 17. INSTITUTION OF MECHANICAL ENGINEERS, *Graduates' Section*, Storey's Gate, S.W. 1, at 7 p.m. "The Management of a Sand and Flint Quarry," by F. E. A. Manning.

Dec. 17. INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, Victoria Embankment, London, W.C. 2. Discussion on "Students in Electricity Undertakings."

Dec. 17. THE TEXTILE INSTITUTE, *London Section*, at 38, Bloomsbury Square, W.C. 1, at 7.30 p.m. Discussion on "Comparative Methods of Testing Textiles."

Dec. 19. ROYAL MICROSCOPICAL SOCIETY, 20, Hanover Square, London, W. 1, at 7.30 p.m. "Melanin Formation and its Relation to the Nucleolus in a Melanotic Sarcoma," by Dr. R. J. Ludford, Ph.D.

Dec. 20 INSTITUTION OF MINING AND METALLURGY, Burlington House, W. 1, at 5.30 p.m.

Dec. 20. INSTITUTION OF MECHANICAL ENGINEERS, *Manchester Section*, at The Engineers' Club, Albert Square, Manchester. "Exhaust Valve and Cylinder Head Temperatures in High-Speed Petrol Engines," by Prof. A. H. Gibson, D.Sc., and H. Wright Baker, M.Sc.

Dec. 20. INSTITUTION OF MECHANICAL ENGINEERS. *Birmingham Section*, at the Medical Theatre, The University, Edmund Street, Birmingham. "Engineering Uses of Rubber," by H. C. Young.

Dec. 20. SOCIETY OF CHEMICAL INDUSTRY, *Glasgow Section*. The Ramsay Chemical Dinner, to be held at the Ca'doro Restaurant, Glasgow.

Dec. 20. THE CHEMICAL SOCIETY, Burlington House, Piccadilly, W. 1, at 8 p.m. (1) "The Relation between the Glow of Phosphorus and the Formation of Ozone," by W. E. Downey. (2) "The Origin of Mutarotation and the Mechanism of Isomeric Change," by T. M. Lowry. (3) "The Action of Inorganic Haloids on Organo-metallic Compounds," by F. Challenger and F. Pritchard. (4) "Organo-derivatives of Bismuth. Part VII. Iodo- and Nitro-derivatives of Triphenylbismuthine," by J. F. Wilkinson and F. Challenger.

Dec. 21. SOCIETY OF DYERS AND COLOURISTS, *Manchester Section*, 36, George Street, Manchester. "The Dyeing of Cellulose Acetate Silk," by L. G. Lawrie.

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

NOTICE TO MEMBERS AND SUBSCRIBERS

The Annual Suscription falls due on January 1 next, and Members and Subscribers are reminded that no issues of the Journal for 1924 will be despatched to them until their subscriptions have been received at the Society's offices.

The formal applications for subscriptions will shortly be despatched to Members and Subscribers.

EXTRA COPIES OF ABSTRACTS

Members and subscribers may find it advantageous to have extra copies of the Abstracts section of the Journal printed on one side of the paper only, for filing purposes. The Society is prepared to supply these for the year 1924 in complete sets at a charge of £1 per set. Members and Subscribers who desire to avail themselves of this offer are requested to communicate with the General Secretary as soon as possible.

CHEMICAL ABSTRACTS

The Bureau of Chemical Abstracts, formed on the basis of an agreement between the Chemical Society and the Society of Chemical Industry, is making arrangements for the issue of Abstracts in two sections, namely (*a*) Pure Chemistry, and (*b*) Applied Chemistry. So far as 1924 is concerned, these sections will be practically of the same form as the Abstracts at present issued by the Chemical Society and the Society of Chemical Industry, respectively.

Members of the Society of Chemical Industry can procure the Abstracts in Pure Chemistry for 1924 for the sum of £1 10s. An order form will be sent out in a few days, together with the application for the 1924 subscription to the Society. This form, when completed and signed by the member, should be sent at once with the appropriate remittance direct to *The Chemical Society*.

DEATHS.

Barker, Hugh S. (elected 1902), of 131, Brownlow Hill, Liverpool, Laboratory Furnisher. On October 20, 1923.

Stead, Dr. J. E., F.R.S. (Original Member), of 11, Queen's Terrace, Middlesbrough, Metallurgical Chemist. On October 31, 1923.

Wilkie, John M. (elected 1903), of 5, Balmoral Avenue, West Bridgford, Notts, Analytical Chemist. On November 29, 1923.

SHAWINIGAN FALLS SECTION

In the absence of the chairman, Mr. R. A. Witherspoon, Dr. F. W. Skirrow presided over the meeting, held in the Cascade Inn, on November 21. After the routine business was disposed of Mr. G. S. Shaw read a paper on "Industrial Hydrogen."

In this paper a review was made of the new uses of hydrogen, chiefly in hydrogenation and in the synthesis of ammonia. In the manufacture of synthetic ammonia the main cost item was that of preparing the pure hydrogen and nitrogen. The chief industrial processes in use to-day were described, special attention being paid to the steam-iron and electrolytic methods of producing hydrogen. This last method was the most interesting to the Shawinigan Falls industry, on account of the cheap power available there. The cost of power in Shawinigan was within the limit set by the cell manufacturers as necssary in order to complete with the costs of the other methods for the manufacture of pure hydrogen. A description was also given of small installations generating hydrogen for experimental purposes with small outlay of capital, although higher cost per unit of hydrogen.

Mr. H. S. Reid followed with a paper on "Automobile Motor Fuels," in which he discussed the growth of gasoline production in the United States from about a quarter of a billion gallons in 1904 to a billion and a half in 1914, nearly five billion in 1920, and finally about six and a quarter billion in 1922. This at first came entirely from straight distillation of crude petroleum, but later was augmented by the light oils compressed from natural gas, and still later by "cracking" the heavier oils of petroleum. Cracking processes were becoming more efficient, and at present about 20 per cent. of the gasoline supply came from this source. Of the present world's production of about 850 million barrels of petroleum, considerably over half originated in the United States, and yet 36 million had to be imported to supply the demand.

It is estimated that at the present rate of consumption there are reserves in sight to last a thousand years, but unfortunately these are not well distributed, and some of the principal consuming countries find it hard to get adequate supplies. If the shortage became severe enough greatly to elevate the price of gasoline, shale oil deposits could be worked which would greatly increase the supply.

Ethyl alcohol was an ideal motor fuel and is used as a substitute for gasoline in Europe, but could never come into very general use on account of the restricted supply. If the three main sources of cheap alcohol in the United States, viz., corn, molasses and wood waste, were thoroughly exploited, the resulting alcohol would run the motors of the country for only nine weeks. Benzol was also a satisfactory motor fuel, but the possible production also was inadequate. Mixtures of benzol and alcohol were used with success in Germany during the war, and were used to-day in such countries as Sweden, which are unfavourably located for gasoline supply. The quality of gasoline can be much improved by proper admixture with small amounts of other substances, such as ethyl lead, aniline and iodine, and considerable research work is being done in this field. The General Motors Corporation had lately put on the market a gasoline treated with "ethyl fluid," which is said largely to eliminate knocking and carbon deposits.

In discussing the papers, Dr. Skirrow suggested that in the future the two subjects, hydrogen and motor fuels, might not seem so remotely related, and recalled certain experiments in Germany where artificial coal, made by exposing wood fibres to immense pressures, had been further changed to a petroleum-like substance by treating it with hydrogen, also under pressure, thus possibly reproducing the way in which nature makes our oil deposits.

MANCHESTER SECTION

A joint meeting of the Manchester sections of the Institution of the Rubber Industry and the Society of Chemical Industry was held on December 7. Dr. H. Levinstein presided, and Mr. J. H. Mandleberg, M.A., chairman of the local section of the Institution of the Rubber Industry, was present. Dr. Levinstein said that at the inception of the Society the Manchester section had many members representing the rubber industry, and, although that industry had so developed that it required an institution of its own, the parent Society embraced all chemists and there was a very close connexion between the chemical and rubber industries. Rubber accelerators were first used at the Faber Fabrik at Leberkusen, where during the war some 3000 tons of synthetic rubber was produced.

A paper on "Methods to be Adopted in Comparing the Activity of Various Accelerators" was read by Mr. G. C. Martin (Superintendent, Rubber Investigations, Imperial Institute). The potency of an accelerator was affected by the purity of the rubber, and some investigators used the acceleration factor $k=\frac{S_a}{S_r}$ where k is the acceleration factor, S_a the rate of vulcanisation in the presence of the accelerator, and S_r the rate of vulcanisation of the same mixing in the absence of the accelerator. This factor depended upon the ratio of two values, both of which were affected by the raw rubber used and not always in the same direction. If the concentration of the accelerator was doubled the acceleration factor was less than $2k$, but recent work suggested that it might be possible to deduce an accelerator constant which was independent of the concentration. Different accelerators had specific effects, but the specific nature was not so important as potency, a factor which was affected by the sulphur content. Other factors affecting vulcanisation were the degree of fineness of the zinc oxide and the temperature. It could be seen that the acceleration factor was not entirely constant under simple alterations of conditions, but the variations in value were not sufficiently great to prevent the factor from being useful, especially for commercial description. The factor should be used for 1 per cent. concentration of the accelerator in the rubber, and the conditions under which it had been determined given. Physical methods of measuring the rate of cure gave larger values for the acceleration factor than the chemical method, but the two sets of values appeared to be inter-related.

A second paper, entitled "The Analysis of Organic Rubber Vulcanising Accelerators," by T. Callan, M.Sc., Ph.D., and N. Strafford, B.Sc., A.I.C., was read by Dr. Callan. Dr. Callan said that much work had been carried out on the comparative vulcanising powers of various accelerators, but very often only the trade-name of the accelerator used was stated, so that it was often difficult to co-ordinate the results of different workers, particularly as the same chemical substance might occur commercially under various proprietary names, and this had undoubtedly checked progress in the use of accelerators in the rubber industry. It is therefore desirable that there should be reliable methods available for the identification and estimation of the many widely different substances used as accelerators.

As there is little published information on the subject, the authors have put forward methods for the identification and quantitative determination of a number of the more widely used organic accelerators, including phenolic, nitroso, and amino compounds, the aryl guanidines such as diphenylguanidine and triphenylguanidine, the biguanides such as *o*-tolylbiguanide, thiocarbanilide and the substituted thiocarbanilides prepared from amines other than aniline, *e.g.*, toluidine, aldehyde ammonia, the derivatives of dithiocarbamic acid such as zinc diethyldithiocarbamate, diethylammonium diethyldithiocarbamate, piperidine piperidyl dithiocarbamate, and their oxidation products, the thiuram disulphides. Most of the methods put forward involve simple volumetric determinations, using ordinary standard solutions. The authors have also determined the physical constants of a number of purified compounds and their derivatives used as accelerators, such data being of considerable value in elucidating the composition of an accelerator requiring to be identified.

INSTITUTE OF CHEMISTRY

The annual dinner was held on December 10, in the Hotel Victoria, under the presidency of Mr. A. Chaston Chapman, F.R.S.

Viscount Haldane, in submitting the toast of "The Institute," said the science of the 'forties and 'fifties had very little relation to industry; consequently, manufacturers were able to get on very well without it, and they beat the world at production. Then a change began to set in, and the new discoveries of science began to be applied to industry. For a time we fell behind, but our methods had since changed. In this century the production of young men of science had gone on with extraordinary vigour, and while they might not produce as many here as were produced on the Continent, he was sure we produced more peaks and pinnacles than were produced there. The problem of the future is to see that more science is applied to industry, and that it is organised in the best way. We are quite capable of holding our own in the world, and the only question is how much we shall suffer through going too slowly.

Mr. A. Chaston Chapman, replying, recalled the purpose for which the Institute was founded in 1877, and said that since those early days its record was one of uninterrupted progress, and in the short space of the past thirty or forty years a great and powerful profession had been built up. Whether we regarded chemistry as essential to an understanding of the world in which we lived, as an agent which had done so much to transform the life of man, as one of the most powerful factors in the creation of material wealth, or, finally, as that department of knowledge on which our national prosperity and our national security so largely depended, its supreme importance was equally manifest. During the war he would not say that chemists were actually discovered, but for the first time the nature of their activities and their great usefulness were widely recognised. Notwithstanding this, could it be said that since the termination of the war the influence of chemists as a body had increased? He believed not, but rather the reverse. He hoped not only that the guests would take away with them recollections of a pleasant evening, but that they would do what they could to increase the general knowledge and better understanding of the services which chemistry was ever rendering to the community.

The toast of the "Houses of Parliament" was proposed by Prof. A. Smithells, F.R.S., and, Viscount Haldane, responding, said that nobody knew what the future would bring forth, but if the future brought forth any changes of a striking nature his impression was that the House of Lords would prove itself equal to the emergency. Mr. Robert C. Nesbitt, M.P., replied for the Lower House.

The toast of the "Forces" was submitted by Sir Robert Robertson, and, responding for the Royal Navy, Captain J. C. W. Henley, R.N., Director of Naval Ordnance, emphasised the extent to which naval efficiency depended upon the chemist. Lieut.-General Sir Noel Birch, Master-General of the Ordnance, replying for the Army, said that in the late war chemists saved us from defeat. In 1915, when the Germans made their gas attack, the chemists came to our assistance and beat the German at his own game. Air Vice-Marshal Sir W. G. H. Salmond also replied.

To the toast of "The Civil Service," proposed by Sir Herbert Jackson, Sir L. Amherst Selby-Bigge, Permanent Secretary, Board of Education, responded.

Viscount Burnham, in proposing the toast of "Science in Industry," observed that in the false security of the industrial life of the last century we allowed manufacture to be largely developed in Germany and America. Late, but not too late, we discovered our default, and we had been trying to think ahead of ourselves ever since. He was glad to say that the benefit of the trained mind, as well as the trained hand, was being recognised every day more and more by the employers of the country. There were no more convinced believers in technical education than the enlightened captains of our industries to-day. Most of the troubles of their industries had a chemical origin. No works could be called efficient or progressive without the works chemist. It was said in derision of a French statesman that he followed the policy of yesterday by the methods of to-morrow. That was what they all ought to do to regain the primacy of England in the trade of the world. That policy was the policy of the merchant adventurers who made the Empire. The methods were the methods of the wonder-makers of science, who put into facts and figures the discoveries and revelations of the master-minds of the world, and who were yoking the forces of nature to the service of man.

Sir John F. L. Brunner, replying, said that it used to be a reproach that science was not applied to industry. Formerly the head of a business hesitated to engage a highly trained chemist because he would not have known what to do with him. To-day the heads of businesses were better equipped and they knew what use to make of chemists. What the industrialist wanted mostly was knowledge which he could turn to pounds, shillings and pence. Science and industry must co-operate; science must help industry, and as an industrialist he would say that industry must help science. He hoped that companies able to do so would endow research, for the Universities to-day were in great need of money to carry on their research work.

To the health of the guests, submitted by Sir W. J. Pope, the Very Rev. W. R. Inge, Dean of St. Paul's, and Lord Justice Sargant replied.

SOCIETY OF PUBLIC ANALYSTS

A meeting was held in the Chemical Society's Rooms in Burlington House, on December 5, Mr. P. A. Ellis Richards presiding, and four papers were read.

Mr. H. Toms, M.Sc., presented an account of "The Crystalline Bromides of Linseed Oil." The "insoluble bromide" of linseed oil, first described by Hehner and Mitchell, appears to consist of mixtures in varying proportions of two crystalline bromides, viz., (1) a linolic-dilinolenic bromo-glyceride, and (2) the trilinolic bromo-glyceride of the oleic-linolic-linolenic bromo-glyceride. These two bromo-glycerides have been obtained in pure condition by crystallisation from ethyl acetate, and melt at 153° C. (corr.) and 117° C. (corr.), respectively. The solubility of the more insoluble bromide in ethyl acetate lies between 0·15 and 0·20 g. per 100 c.c. at 15° to 20° C. The methods of estimating the bromine in these compounds have been studied, and it is shown that theoretical results can be obtained by the method of Carius and by a modification of the method of Stephanow, but not by the lime method. Various methods of estimating the more insoluble crystalline bromides are described, the yields of the purest product from different oils varying from 9·39 to 11·6 per cent. The results obtained suggest that there is some relationship between the yield of this crystalline bromide and the iodine value of the original oil.

A "Plea for Standardisation," was put forward by Mr. M. S. Salamon, B.Sc., who emphasised the fact that in every field of analytical chemistry it was common to find different, although well-recognised methods of analysis yielding varying results. Particularly was this so with dried milks; in one instance a sample of dried milk was sent to four well-known analysts and a considerable divergence of figures resulted according to the methods used, particularly in the estimations of the fat and lactose. In the examination of essential oils, the need for standardisation was urgent, for in many cases minute modifications in detail cause quite substantial differences in results. This was true of inorganic materials of simpler composition, and the author sees a recognition of the difficulties in the details laid down for analyses under the Fertilisers and Feeding Stuffs Act. He strongly advocates the formation of a Committee to consider the whole question.

"A Note on the Estimation of Chromium" was read by Hubert T. S. Britton, M.Sc. The gravimetric methods of estimating chromium as oxide are discussed. Whatever precautions are taken to use only the purest reagents and salts, and platinum crucibles, the ignited oxide always contains some chromate. Hence, such methods give results that are too high. It has been found that chromium can be quickly and accurately estimated volumetrically, by adding to an approximately neutral solution of a chromium salt an excess of sodium peroxide (about 1 g.) and boiling for ten minutes to complete the oxidation to chromate and to decompose the unused peroxide. After acidification with either sulphuric or hydrochloric acid, excess of potassium iodide is added and the liberated iodine is then titrated in the usual way.

Mr. R. L. Andrew described "The Colorimetric Estimation of Lead in Cream of Tartar." During 1921-22 all imports of cream of tartar into New Zealand were examined for lead, and the following method was found to give similar results and to be less cumbersome than the B.P. method. One c.c. of 5 per cent. potassium cyanide solution, 1 c.c. of ammonia solution, and 40 c.c. of water are added to 2 grams of cream of tartar, and solution effected by warming and shaking. After cooling and filtering, any tint is matched in the standards by the addition of very dilute caramel. These standards are prepared in a similar way from 2 grams of lead-free cream of tartar, with the addition of requisite amounts of lead nitrate solution containing 0·01 per cent. of lead. A few drops of 10 per cent. sodium sulphide solution are added and the amount of lead estimated by comparison. If a standard water solution of lead is used a serious error is introduced as the colour is only about half the depth of that produced with a tartrate solution.

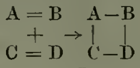
CHEMICAL SOCIETY

The President, Prof. W. P. Wynne, F.R.S., occupied the chair at an ordinary meeting held on Thursday, December 6, 1923, at 8 p.m.

The following considerations were put forward by the author :—

The additive formation of four-membered rings. Part III. A system of nomenclature for heterocyclic four-membered rings, and the formation and properties of some derivatives of β-methylene di-imineoxide. C. K. Ingold.

It has been found that the formation of a four-membered ring by the additive union of double bonds (I) is of considerable generality. This confirms the prediction (Part I), made from the analogy with the tautomeric change or internal addition reaction, shown in (II). The variety of new heterocyclic ring-types which have already been produced from the five types of double bond studied (C : C, C : N, C : O, N : N, N : O), is such as to call for a definite scheme for the nomenclature of these compounds. A proposal is made to meet this need. Part of the object of these investigations is to discover which types of four-membered heterocyclic ring are the most stable, in order to learn which of the aromatic heterocylic rings are most likely to possess stable bridged phases. The production of an unusually stable type of four-membered ring is of interest from this point of view. Now, it has been shown in Part II that azomethines of a certain type tend to pass into stable bimerides containing the ring (III). Moreover, there is evidence, confirmed by recent experiments, that many nitroso-compounds pass into stable bimerides containing the ring (IV). Hence, if an azomethine and a nitroso-compound of the types referred to be placed together, they should unite giving either the ring (V), or the ring (VI). Experiment shows that the ring obtained in this way has the structure (V) and not (VI), and that it is quite stable at ordinary temperatures. Its constitution has been established by alternative synthesis, and by a study of its decomposition at a higher temperature.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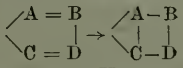
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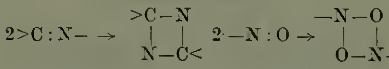
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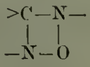
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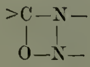

VI

Dr. H. J. S. Sand gave an account of

The dependence of polarisation-overvoltage on hydroxyl and hydrogen ion concentration. Part I. Polarisation-overvoltage of an antimony cathode in aqueous alkaline solution. H. J. S. Sand and E. J. Weeks.

The overvoltage, ω, of an antimony cathode in alkaline solution, determined by the commutator-method as previously described, has been found to obey to a very considerable degree of accuracy the empirical equation : $\omega = a - 2h$, in which h—briefly referred to as p_H voltage—is the potential difference between a standard (calomel) electrode and a hydrogen electrode in the solution examined, and a is a constant depending only on the temperature. This result, as well as the spontaneous formation of gas-bubbles, may be explained by the assumption that an ion $H(OH)_2''$ exists which has a definite supersolubility limit. When a sufficient number of these ions have assembled in the solid (or liquid) state to produce the energy necessary for the formation of a gas-bubble, they decompose simultaneously (explode). The conclusion has been drawn that the identical overvoltage-p_H voltage relation should be found with other metals which act as indifferent cathodes in alkaline solution.

A paper communicated by Dr. H. King is summarised as follows:—

Stereoisomerism and local anæsthetic action in the β-eucaine group. Resolution of β- and iso-β-eucaine. Harold King.

α- and β-vinyldiacetonalkamines on benzoylation yield O-benzoyl derivatives. Benzoyl α-vinyldiacetonalkamine is known commercially as the local anæsthetic β-eucaine, whilst for convenience it is proposed to call benzoyl β-vinyldiacetonalkamine, iso-β-eucaine. These two bases have been resolved by camphorsulphonic and bromocamphorsulphonic acid respectively. Each resolution presents some novel aspects, that of β-eucaine being effected within the transition interval where the partial racemate dl-β-eucaine d-camphorsulphonate is the most stable form, whilst in the case of iso-β-eucaine the salts being of approximate equal solubility separate alternately from the solution on fractional crystallisation. The circuit of reactions detailed in this investigation is summarised in the following diagram.

$$\begin{tikzcd}
& \text{Vinyldiacetonamine} \arrow[dl] \arrow[dr] & \\
\alpha\text{-Vinyldiacetonamine} \arrow[d] & & \beta\text{-Vinyldiacetonamine} \arrow[d] \\
\text{Benzoyl } \alpha\text{-Vinyldiacetonalkamine} \arrow[d] & & \text{Benzoyl } \beta\text{-Vinyldiacetonalkamine} \arrow[d] \\
\text{d-}\beta\text{-Eucaine} \arrow[d] & & \text{l-iso-}\beta\text{-Eucaine} \arrow[d] \\
\text{d-}\alpha\text{-Vinyldiacetonalkamine} & & \text{d-}\beta\text{-Vinyldiacetonalkamine.}
\end{tikzcd}$$

The relative local anæsthetic actions of β-eucaine, iso-β-eucaine, and the optically active forms are recorded.

In reply to Dr. G. W. Clough, Dr. King said that the physiological action is independent of the acid with which the base is combined, since hydrolysis takes place when the substance penetrates into the tissues.

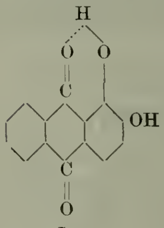
The following paper was read by the author:—

β-Alizarin. An isomeric form of alizarin. Albert Green.

When alizarin is boiled with thionyl chloride to complete solution, and the solvent is evaporated, a light brown solid (m.p. 164–170°) is formed. On immediate recrystallisation from glacial acetic acid and then from benzene or alcohol this yields golden yellow needles melting at 195–7° (uncorr.). The light brown solid fumes on standing in air, owing to decomposition of adhering thionyl chloride, and yields alizarin.

Analyses and molecular weight determinations of the yellow substance yield the formula $C_{14}H_8O_4$. This substance, termed β-alizarin by the author, appears to be stable under ordinary conditions, but is converted into alizarin by boiling with alcoholic solutions of hydrogen chloride, hydrogen bromide or hydroxylamine hydrochloride. The same result is obtained by pouring its solution in concentrated sulphuric acid into water or anhydrous ether, or by acidifying its solution in aqueous sodium hydroxide. On bromination it gives 3.bromo-1.2.-dihydroxy anthraquinone (as does alizarin). On boiling for six hours with acetic anhydride β-alizarin gives pure diacetyl alizarin. Alizarin gave an impure product after 16 hours boiling. β-alizarin is 15 times more soluble at 13° C. in benzene than alizarin. Attempts to isolate intermediate compounds of alizarin and thionyl chloride were fruitless. It is well known that I.hydroxy anthraquinones are alkylated only with much difficulty, while the ethers of 2.hydroxyanthraquinones are easily prepared. This fact has led to the suggestion that the former compounds may have an *o*-quinonoid structure. The easy formation of diacetyl alizarin from β-alizarin is suggested tentatively as evidence of different structures for the two forms, but no definite statement is advanced pending the completion of further work.

Dr. G. W. Clough said that all ten of the dihydroxy-derivatives of anthraquinone which were apparently theoretically possible were known, and their structures had been determined. He referred to the views of Pfeiffer, Dimroth (I), Georgievics (II) and Watson on the structure of alizarin and other hydroxyanthraquinones, and suggested that a comparison of the absorption spectrum of "β-alizarin" in alcoholic solution with the absorption spectra of other hydroxyanthraquinones in the same solvent might give some indication of the structure of the reported new compound. The theoretical and practical importance of Mr. Green's observations made it desirable to extend the investigation to similar compounds, especially to the two mono-hydroxyanthraquinones. He asked whether pure thionyl chloride was used, since the technical product sometimes contains tin, yielding a tin compound with alizarin.



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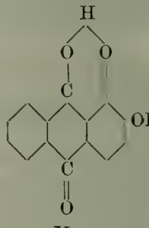
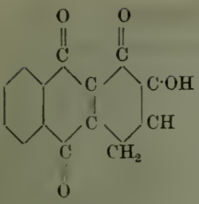
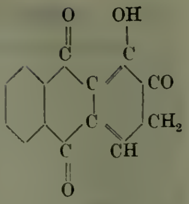


II

Dr. C. K. Ingold suggested, as a simpler working hypothesis than any previously mentioned, that one of the alizarins might be a ketonic individual, such as (III) or (IV). The two alizarins would then be tautomeric bodies,



III



IV

stable enough, however, to require a reagent for their interconversion, as is the case with anthranol and anthrone (the analogue of III).

Mr. Green replied that the thionyl chloride used was the "pure" quality, and was redistilled immediately before use. Isomeric forms of three further hydroxyanthraquinones had been obtained. The peroxide structure for the two carbonyl oxygens seemed to be indicated for the new isomers, for certain regularities had appeared in their properties.

Work on the oximes was described by Dr. O. L. Brady:—

The isomerism of the oximes. Part XV. The supposed fourth benzildioxime. O. L. Brady and F. P. Dunn.

The authors have repeated the work of Atack and Whinyates (*T.*, 1921, **119**, 1184), but have failed to obtain any evidence of the existence of a fourth benzildioxime. Some of the principal objections to a purely structural theory of the isomerism of the oximes as suggested by Atack (*ibid.*, 1175) are brought forward, particularly the existence of two O-ethers.

Taking a freshly-prepared solution of 1 gram of α-benzildioxime in 40 c.c. of $2N$-sodium hydroxide, and a similar solution which had been kept for three hours, the speaker demonstrated that on the addition of an equal volume of a 2·5 per cent. solution of nickel chloride and a little ammonia the colour of the precipitate was the same in each case. In the presence of alcohol both gave a much darker red precipitate. He pointed out that Atack and Whinyates had apparently used alcohol to "stabilise the α-form," and suggested that an explanation might be found in this fact, although the low melting-point remained unexplained.

The President, after complimenting the authors on having removed a compound from the voluminous literature of organic chemistry, said that unless Dr. Atack and Mr. Whinyates could substantiate their challenge, the authors' view of the matter would meet with acceptance.

Mr. W. E. Garner then gave an account of the following work:—

The alternation in the heats of crystallisation of the normal monobasic fatty acids. W. E. Garner and F. C. Randall.

Measurements of the heat of crystallisation of lauric, undecoic, capric, nonoic, and caprylic acids have been made and the following values obtained:—lauric, 43·73; undecoic, 32·20; capric, 38·86; nonoic, 30·54; caprylic, 35·44 cal/gm. The heat of crystallisation of an odd acid is lower than the mean for its neighbours in the series, and the heat of crystallisation curve resembles the melting point curve for these acids. The molar specific heats of the acids in the liquid state also show alternation, but this is very slight; the odd members possess the higher value. These results throw light on the causes of alternation in the physical properties of organic substances with long chains.

The odd acids, undecoic and nonoic, crystallise in two enantiotropic forms, α and β, and the heats of transition of these have been measured and found to be 9·89 and 8·39 cal/gm. respectively. The heats of crystallisation of the β-forms of the odd acids lie slightly above the curve for the even acids, thus giving an example of inverse alternation. The results are in agreement with the view that the even acids are more closely related to the β than to the α forms of the odd acids. The bearing of this on the work of Müller and Shearer on the length of the carbon chains in these acids is discussed, and it is concluded that the differences between the heats of crystallisation of the higher members of the odd and even acids may be ascribed to differences in the mode of attachment of the carboxyl groups in the crystal molecule.

Prof. F. G. Donnan, F.R.S., remarking on the laborious nature of the interesting research, agreed that the explanation given was the best.

Dr. R. H. Pickard, F.R.S., having questioned the legitimacy of a comparison of the curves with those derived from optical measurements in solution, Mr. Garner agreed, explaining that he had used the latter merely in the course of illustration of the views of Sir W. H. Bragg on the nature of the carbon chain.

BRITISH LEATHER MANUFACTURERS' RESEARCH ASSOCIATION

The fourth annual general meeting was held on November 29, under the presidency of Mr. J. A. Janson, Worshipful Master of the Leathersellers' Company. After the business meeting, a lecture was given in the Livery Hall of the Leathersellers' Company, by Dr. R. H. Pickard, F.R.S., director of research to the Association.

Dr. Pickard explained that the policy of attacking fundamental principles had been continued, and he felt confident that they could best assist the trade by devoting their attention to work of this kind. He then discussed the work which had occupied the staff during the past year. The difficulty experienced in soaking back dried, and more particularly sundried hides and skins had been shown to be due to the coagulation of their albumen constituents by the action of heat and light. Application for a patent had been filed provisionally protecting the use of certain salts, which when added to the soak liquors even in very small quantities, had the effect of dispersing these coagulated albumens. Experiments were shown illustrating the rapidity with which skins so treated could be soaked back. In the account of recent work on the formation of "spue" on chrome leather, Dr. Pickard said that the grease originally present in the skins did not seem to be the cause of this defect.

This part of the work was illustrated by a series of microscope slides projected on to the screen. The various fats and greases were stained by selective stains and their fate throughout the various stages of manufacture had thus been traced. On the much discussed subject of "acidity" or "free sulphuric acid" as a cause of deterioration of sole leather, bookbindings, etc., the present state of knowledge was very unsatisfactory. Existing tests such as the Proctor-Searle method and the indicator test recently put forward by the Boot and Shoe Research Association frequently gave misleading results. The subject was being examined thoroughly but the problem was not yet solved.

A series of lantern slides was exhibited, showing sections of defective leathers. This work was being done in order to interpret in scientific terms defects recognised in the trade under the names of tinniness, stretchyness, lack of tensile strength, etc., and to attempt to trace their causes. Many experiments on the formation of sludge in vegetable tan pits were in progress. The work had mostly been devoted to the possible methods of preventing the formation of this sludge by heating, various additions, and blending of materials. Work had also been commenced on the possibility of utilising sludge already formed, and on the effects of moulds and other micro-organisms and their products in the formation of sludge. In conclusion Dr. Pickard thanked those members of the Association who had supplied the staff with a large amount of information and material.

Mr. E. D. Evans, President of the United Tanners' Federation, in proposing a vote of thanks, expressed his appreciation of the lecture and emphasised the utility and great promise of the work of the Association.

On the occasion of its opening meeting, the University of Paris conferred the diploma of Doctor *honoris causa* on Prof. J. J. Thomson, F.R.S., Svante Arrhénius, Señor Torres y Quevedo (Spain), Prof. Golgi (Italy), and Prof. Keen (Philadelphia, U.S.A.).

CORRESPONDENCE

THE THEORY OF CATALYSIS

Sir,—In a paper on "Heterogeneous Gas Reactions" in the November number of the *Journal of the Chemical Society*, Messrs. Hinshelwood and Pritchard develop a theory of catalysis in which the action of a surface in promoting the decomposition of a molecule A B adsorbed on it is attributed to the fixation of the part A, say, on the surface, leaving the part B in a situation in which it can be drawn away from A, the latter being incapable of following B in its course. I have always understood that some such idea was implied in Mercer's theory of catalysis, put forward in 1842, although the explanation (which seems very similar to the one above) given on p. 225 of my "Text-book of Inorganic Chemistry" may be a slight modification of Mercer's theory. I have usually pointed out, as an analogy, that it is difficult for either one of two dogs to divide a rat which he is holding between his teeth, but that the two dogs together can do it easily. This is hardly even "a mechanical picture," but it may please those to whom the "passage of an electron to an orbit of higher quantum number," to quote the two authors mentioned, may not seem very closely related to the phenomena of catalysis.—I am, Sir, etc.,

J. R. Partington

East London College,
University of London

SOURCES OF OIL CAKES

Sir,—I should be very much obliged if any of the readers of the *Journal* could indicate to me a probable source for obtaining some of the undermentioned cakes or meals, which I require for some important research work :—

Beechmast cake
Candlenut ,,
Madia ,,
Safflower ,,
Sunflower ,,
Camelina cake
Hempseed ,,
Olive ,,
Sesame ,,
Poppyseed ,,

Preferably both decorticated and undecorticated.—I am, Sir, etc.,

W. Leslie Carter

Birmingham
December 7, 1923

BRITISH DYESTUFFS INDUSTRY

Sir,—The letter from the Clayton Aniline Company in your issue of December 7 shows that they still labour under the misapprehension that I was responsible for the price of 12s. 3d. for Sky Blue F.F., mentioned in my letter in your issue of September 21.

The price of 12s. 3d. was quoted by Prof. Morgan on page 872 of your issue of September 14, and the Clayton Aniline Company are in error in attributing that price to me and treating it, as if it was the current market price at the date of my letter.

May I therefore briefly state the following:
(1) I said the price of 12s. 3d. for Sky Blue F.F. is 12 times its pre-war price. This is true.

(2) I said that the Sky Blue, marketed by the Clayton Aniline Company was weaker than Chlorazol Sky Blue F.F., and therefore its price must necessarily be a lower one. This statement is true.

(3) In neither of my letters did I question the quality of the Sky Blue made by the Clayton Aniline Company. The best assurance that I can give them on this point, is the fact that I use their product in my dye-house, the supply being obtained through one of their associated firms.—I am, Sir, etc., C. M. Whittaker

Cheadle Hulme, Cheshire
December 8, 1923

THE DECAY OF BUILDING STONE

Sir,—The short report (*Chemistry and Industry*, page 1185) of the communication on "Decay of Building Stones" made by Mr. Harrison and myself to the London Section of the Society is not quite correct in one or two particulars.

The statement attributed to us that nitrifying organisms could not resist "sulphur" in the air is rather startling, since we have no information of value on this subject. The point we endeavoured to make was that any action due to nitric acid in the air, or to nitrifying organisms present in stone, is of altogether secondary importance in towns, particularly London.

We did not condemn all stone preservatives as ineffective, nor are we in a position to make a sweeping statement of this character. In the absence of large scale tests, or of data collected over a long period from exposure tests, it is not possible to pass such a judgment on preservatives generally. All that can safely be said at present is that some stone preservatives may prove an advantage when used carefully for small structures. The application of preservatives to large and elaborate structures which are difficult of access is not, in our view, likely to be of great value in the long run, partly because of the difficulty of renewing treatment.—I am, Sir, etc.,

London J. J. Fox
December 11, 1923

THE DIFFICULT ENGLISH

M. the Editor,—I like you so very much that you have study the examination questions: I have suffer so badly from them. Will you not say us, however: "Is the letters-man not as bad as the chemistry-man, when he ask questions of the poor schools boy?"

Also I like what the Reviewer say of the "molality" and other beautiful* nonsense words in the Thermodynamics of the MM. Lewis and Randall. Truly, I think, they write not the English "in the ordinary sense of the term." Perhaps now he have built the Sky Scrapaire, the—as I have call him—cacologophilic† American will be in a hurry to make him fast ready for a Tower of Babel of the Sciences, which shall be the much biggest thing in the New World—so as to put in all the bad English, whom you shall emigrate. What a beautiful land you then will have—one where the English is once again the spoken. This shall be, I think, the end of your difficulty of the unemployment and the over-population and the cause of the return of the Dr. Marie Stopes to the coal and the stones animals.

The Mr. Reviewer disappoint me a little, I must say me, in his words. Should he not himself be more careful, when he write his so clever notices of the books, and live him up to the Oxford where he was a student, I suppose me? Perhaps, he even have browse with the Prof. Gardner, and wish to show him how much he have profit from the classics. He say: "The phraseology employed by the authors occasionally pulls the reader up with a jerk." I have a friend who draws the picture to laugh. I ask him to do me one of "a phraseology pulling up a reader," which I can send you. You will perhaps have pictures like *The Times*—but, please, no Brides or of the Sport. As the Mr. Smithells so truly say, "such language is positively dangerous." "Phraseology employed" belong to the Gibbs' Rule of Phrases, I suppose. When you instead say the short English "words used," it seem to me so nicer. The English small words are much so nicer and also so saving of the space and of the tongue—and of the temper of the reader, who read him with care.

I have speak before of Anatole France. He say it cost him twenty years' work to write the Jeanne D'Arc. It is tell us:—

"He multiplied the corrections, interpolated phrases, arranged fresh transitions, cut up his sheets until they resembled a puzzle, put at the beginning what was at the end, at the top what was at the bottom and fixed the whole together with the gum brush."

"He suspected that the work, written without leaning towards one point of view or another, with sole respect for the truth, would satisfy but few readers."

Is it not so? This is the way to write of the science! A critic say him, he show deep scientific knowledge of Astronomy and ask him the sources of it. He say, he consulted only a book for the little child, but he add:—

"The important thing is not, perhaps, my scientific baggage, which is light, but rather the reaction of modern discoveries upon a sensibility formed by long commerce with the gentle, subtle and human authors of our country."

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* Perhaps I say better "activated" nonsense, of the kind of the nitrogen or out-blown charcoal.

† I see the English call the compound of the M. Bunsen cacodyl, not kakodyl.

Pointing to his library, he then say :—

"There are my sources. You will find there nothing save great or charming writers who spoke good French—that is to say, who thought clearly. For one cannot exist without the other."

Is not this a beautiful thought—and true ? Also—to remember ? How can the young man learn well, when he have so bad examples before him to read ? You shall help him much.

Like the Mr. Gosse, of *the Times Sunday*, I am tired and now take me a holiday for the travel. I have not the good enough adjectives for you, so shall sign me only, this last time,

December 10 Parisian

A QUERY

Sir,—In an out-of-the-way place like this one finds it very difficult to obtain information that would need only a few seconds' reference to some up-to-date chemical dictionary. There are two very ordinary substances that are repeatedly referred to in articles and advertisements, but no one ever dreams of assisting unfortunate people like myself by explaining what they are: I mean "lithopone" and "blue water gas." If you or any kind reader would kindly devote a minute or two to a brief explanation I should be greatly obliged.—I am, Sir, etc., E. G. Bryant

Priska, South Africa,
November 19, 1923

[Lithopone is a pigment consisting of a mixture of zinc oxide, zinc carbonate, zinc sulphide and barium sulphate, and is made by heating the mixture of zinc sulphide and barium sulphate obtained by mixing solutions of barium sulphide and zinc sulphate. Blue water gas is the term applied to the unenriched mixture of hydrogen and oxides of carbon formed when steam is passed through incandescent carbon.]

NEWS AND NOTES

FRANCE

Pasteur Day and the Laboratories

It is announced that the sum collected for the benefit of French scientific laboratories on "Pasteur Day" amounted to 13 million francs, or over £160,000.

CANADA

Crude Petroleum in 1922

The production of crude petroleum in Canada in 1922 amounted to 179,068 barrels having a sales value of $520,073, plus Government bounties on these sales amounting to $91,103. In 1921 the production was 187,541 barrels, having a total value of $641,533. The average market value per barrel in 1922 was $2·90 compared with $2·92 in 1921.

Cobalt

Canadian production of cobalt in 1922 was 569,960 lb. valued at $1,852,370, the price per lb. being $3·25. For the last 20 years the major portion of the world's supply of cobalt has been derived from the silver-cobalt-nickel arsenides of the Cobalt district.

Altogether 3719 tons of cobalt ores and residues were treated, the content of metallic cobalt being (by assay) 536,400 lb. The following is a summary of the statistics for 1922 :—

	Output of smelters		Marketed	
	Total lb.	Cobalt contained lb.	Quantity lb.	Value reported by smelters $
Metallic cobalt	106,274	106,274	109,067	282,602
Cobalt oxide . .	360,495	252,347	398,697	798,271
Mixed oxide . .	86,730	39,023	123,605	99,687
Residues exported . .	†	172,311	1,036,000	*156,402
Quantity		569,960	—	1,336,962

* Estimated. † Not given.

BRITISH INDIA

First Groundnut Forecast, 1923-24

A memorandum based on reports received from the three provinces of Madras, Burma and Bombay, which comprise 99 per cent. of the entire groundnut area of British India, states that the total area sown in the present season in these provinces is estimated at 1,687,000 acres, as against 1,855,000 acres (revised) at this time last year, or a decrease of 9 per cent. In Madras the crop has generally been benefited by the September rains, and sowings are proceeding briskly, and in both Burma and Bombay the present prospects are satisfactory.—(*Ind. Tr. J., Oct.* 25, 1923.)

GENERAL

Mauritius in 1922

According to the Annual Report of the Department of Agriculture the sugar crop for the 1922–23 season is estimated at 233,500 metric tons (197,420 t., in 1921–22), about 6 per cent. below the normal output. Approximately 97 per cent. of the crop will consist of Vesou sugar; there will be very little first syrup, and 3 per cent. of low syrup. At present 52 sugar factories are at work, and 174,000 acres are under the crop. The production of alcohol in 1921–22 decreased to 1,749,994 litres, and a further decrease is expected, owing to the new licensing law. A large distillery has been erected for the production of power alcohol of the "Natalite" type. Nothing new is reported of the subsidiary agricultural industries, viz., aloe fibre, coconuts, and vanilla, but experimental work on crops and livestock is being actively continued by the Department.

REVIEWS

TREATISE ON GENERAL AND INDUSTRIAL ORGANIC CHEMISTRY. *By* DR. ETTORE MOLINARI. *Translated from the third (enlarged and revised) Italian edition by* T. H. POPE, B.Sc. *Part II. Pp. viii*+457-897. *London: J. and A. Churchill*, 1923. *Price* 30*s. net.*

The translation of this well-known work has been done in an excellent manner. The division of the organic section into two parts is convenient. In certain parts there are considerable additions to the descriptions of technical operations which appeared in the first English edition. The statistics have been brought up to 1913, and in a few cases only to 1920. The numerous illustrations are mostly of machines made in Germany, and naturally the technical operations described are those in continental practice. The revision of the second Italian edition was probably undertaken too soon after the war for a full description of the great development of many industrial processes which then occurred to find a place.

The work as a whole, and the section of it now under review in particular, seems to be suitable for the student of pure chemistry requiring some information on industrial applications, and for the industrialist who requires a short description of substances allied in properties to those he is using. This section of the work, however, does not appear suitable for the systematic study of that part of organic chemistry to which it deals, either on the pure or applied side.

ROBERT H. PICKARD

ORGANIC CHEMISTRY FOR ADVANCED STUDENTS. PART III. SYNTHESIS. *By* JULIUS B. COHEN, B.Sc., Ph.D., F.R.S. *Fourth Edition. Pp. vi*+412. *London: Edward Arnold and Co.*, 1923. *Price* 18*s.*

The third volume has appeared with commendable rapidity after the first and the second, and is in every way up to the standard set by its predecessors. Amongst the new matter will be found references to the recent work of Ruzička on the terpenes and allied substances, and although in this section the author brings out the more salient facts and gives a fair and concise description of the views held by Meerwein and others, yet in certain cases he exercises a kind of diffidence which does not seem altogether to be warranted by the experimental data. For example, he says (page 242): "Carene . . . is said to occur in Indian Turpentine . . . and has probably the formula . . . " Surely there can be no question that Simonsen isolated Carene from *Pinus longifolia* and that its formula is beyond doubt? The relationship between Pinene and Carene and their connexion with what ought, in the *para* series, to be camphene, but is not, afford a wonderful natural picture which the author has somehow failed to paint effectively. The recent work of Pyman on the glyoxalines and of W. H. Perkin, Robinson and others on the alkaloids is given in detail, the accounts of the work on cryptopine, strychnine and brucine being especially clear and concise. In fact, the whole of the section on the alkaloids is written in a manner which will render it capable of being readily understood by the student. In connexion with the synthesis of camphoric acid (p. 262) it is perhaps desirable to point out that the reference to the 1906 paper of Perkin and Thorpe is misleading. This paper merely confirmed the work described in a previous communication published in 1904, the abstract of which was published in the *Proceedings* of the Chemical Society in 1903, actually prior to the appearance of Komppa's paper in the *Berichte*. It is perhaps unfortunate that the author has refrained from giving any account of the colouring matter of flowers, but refers the student to the well-known monograph by A. G. Perkin and Everest. A brief description would give the reader some idea of these important substances and would lead him to make further enquiries elsewhere. In conclusion it is suggested that in future editions the name index should contain references to each individual author, with cross-references where joint work is concerned. It is not always the author whose name appears first who is primarily responsible for the work.

JOCELYN THORPE

THE MANUFACTURE OF NITRIC ACID AND NITRATES. *By* ALLIN COTTRELL, M. Sc. VOL. VI. THE MANUFACTURE OF ACIDS AND ALKALIS. *By* DR. G. LUNGE, PH.D. *Completely revised and re-written under the editorship of A. C. Cumming, O.B.E. Pp. xv*+454. *London: Gurney & Jackson*, 1923. *Price* 36*s.*

In this volume the author has succeeded in compiling a valuable and instructive account of the pot process for the manufacture of nitric acid. The matter is arranged systematically and the facts stated with a commendable brevity, which makes the book particularly useful to the technical chemist, a great mass of information being condensed into a relatively small space, whilst clarity is maintained by very numerous sub-headings.

The title of the volume is not, perhaps, very well chosen, since only the pot process receives detailed consideration. The section on nitrates is, for the same reason, quite inadequate from the point of view of technical information.

So far as the general arrangement of the book is concerned, only praise can be offered, with the single exception of the sections on analytical methods, which might with advantage be collected into one chapter.

The sections on denitration and the concentration of dilute nitric acid are rather disappointing and stand in great contrast to the other sections of the book. Such an important question as the technical utilisation of dilute nitric acid, for example, is hardly discussed, and the chemical engineering problems connected with this and other phases of the process are not dealt with at all.

The author has added considerably to the value of the book by quoting verbatim original descriptions, reports, etc., but in some cases the change from the ordinary text to the special headings of a factory research report is apt to be confusing unless there is some preliminary description of the size, type and operating conditions of the plant with which the report deals.

The experience gained of large-scale practice during the recent European war rightly occupies an important place throughout the book, but its value would have been enhanced if accompanied by a fuller discussion of the theoretical principles underlying the use of a particular type of plant or modification of a process.

The misprints in the text are exceptionally few and the illustrations admirable. A few cases of undesirable repetition occur, however, but these are minor details which do not detract from the general value of the book.

There is rather an obvious misstatement concerning the Bowman and Scott method for nitric-acid estimation. The author states quite rightly that the method gives only the real nitric acid, but then goes on to say that the results are hence identical with those obtained by the nitrometer method, which, of course, is incorrect. Other minor errors concern the oxidation of nitrous acid in the Pohle air lift, and the titanium sulphate method for the nitrogen acids in nitre cake. These, however, are small errors almost inevitable in a work covering so much ground.

The book should not only maintain, but very much increase, the popularity enjoyed by the earlier editions of Lunge's treatise, and the author must certainly be congratulated on the able manner in which he has created a new and up-to-date account of the process, whilst maintaining the valuable and practical view-point of the former work. H. W. Webb

The Cultivation of the Sugar Cane in Java. An elementary treatise on the agriculture of the sugar cane in Java and more especially on its cultivation on the Krian Sugar Estate. *By* R. A. Quintus. *Pp. xi*+164. *London: Norman Rodger*, 1923. *Price* 12*s*.

In the former of the two parts comprising this book the author treats of the chemistry, physics and bacteriology of the soil with special reference to the conditions that obtain in Java, and then describes the morphology and physiology of the sugar-cane plant and the various diseases to which the plant is liable. The second part of the book is chiefly devoted to the conditions and methods of cultivation of the cane in Java.

The author's style is frequently marred by a carelessness in phraseology which sometimes obscures his meaning, there is needless repetition in some places, and words are occasionally used in a wrong sense. On p. 18 it is stated that "Ammonia is the most powerful base," and the reader is left to infer from the context that what is meant is that ammonia is more readily adsorbed than other bases by colloids. Expressions such as "not too brief a moment," "decrease of growth," and "a short time longer," though not misleading are certainly irritating. Chemical equations are referred to as formulæ, the words "adsorb" and "absorb" are used to describe one and the same phenomenon, and "maximum water-capacity" is used (p. 27) where "maximum water-content" is intended. These are but a few instances of many.

The subject of colloids and their bearing on the texture and fertility of soils is especially important in Java, where rice forms one of the crops in rotation with cane; this subject is dealt with in some detail and useful practical information on the treatment of Javanese soils is given. With regard to the bacterial flora of soils, the author adheres to Russell and Hutchinson's hypothesis of the inimical effect of soil protozoa on the bacteria; he makes the surprising statement, however, that the spores of bacteria are not destroyed in this way (p. 29), thus wrongly ascribing to the protozoa the selective action that partial sterilisation by heat or antiseptics is believed to effect. Cane diseases and their remedies are described adequately and well, though the author makes a curious double slip in connexion with *sereh* disease (p. 69). After stating that the disease is hereditary, so that selection is of no use. he observes in the next sentence that this (*i.e.*, selection) is the only means of combating the disease, and in the next paragraph he gives another method of combating the disease by crossing improved varieties with others that are immune from *sereh*.

Apart from the faulty phraseology previously referred to, the second part of the book is very good and should prove a useful guide, especially to the Javan planter. The author is obviously thoroughly conversant with the practical details of cane cultivation in Java; he gives an excellent account of the complicated system of irrigation and drainage and of the treatment of the soil before and during the growth of the crop. and has supplemented the textual description with nearly forty excellent plates besides other illustrations. The book concludes with some useful statistics concerning the Javan sugar industry.

Lewis Eynon

REPORT

Report on the Industrial and Economic Situation of China in June, 1923. *By* H. J. Brett, *Commercial Secretary, Shanghai. Together with a Report on the Trade of Chinese Turkestan, by* C. P. Skrine, *H.M. Consul-General, Kashgar. Department of Overseas Trade. Pp.* 52. *H.M. Stationery Office,* 1923. *Price* 1s. 6*d.*

The conditions of lawlessness and brigandage previously recorded (*cf. Chem. and Ind.*, 1923, 107) still continue, with adverse effects on trade.

The industrial development of the country progresses in spite of adverse conditions, and there are now few industries not represented in China. Many concerns run without foreign aid are, however, feeling ill-effects from under-capitalisation, absence of reserves, and inefficient management. Few mining developments have taken place recently. Coal output remains at about 20,000,000 t. per annum, the export in 1922 being 1,886,398 t.

The net value of trade in 1922 was a record, amounting to 1600 million taels (the value of the tael was about 3s. 9d. during 1922). Imports were valued at tls. 945 mill. and exports at tls. 655 mill. Imports of dyestuffs, colours, and paints were valued at tls. 24·8 mill. Germany is making progress in the recovery of her pre-war trade. There has been a slight increase in China's total trade with Britain, though actually imports into China have decreased. Traders of all nationalities have had to face great difficulties lately, but it is satisfactory to note that Great Britain's share is being maintained.

COMPANY NEWS

CASSEL CYANIDE CO., LTD.

The net profit for the year ended September 30, 1923, including the balance from last year, amounts to £67,388, and deducting the interim dividend of 3d. per share paid in June, £49,763 remains for distribution. A final dividend of 6d. per share, totalling £35,250, is to be paid, and £14,513 carried forward. The issued capital of the company is £352,500, in 5s. shares.

BRIMSDOWN LEAD CO., LTD.

The annual general meeting will be held at the Great Eastern Hotel, E.C. 2, on December 21, at 2.30. In the circular announcing the meeting it is stated that the negotiations for amalgamation with other important firms carrying on similar business have recently made further progress, and that the directors consider it would be inadvisable that there should be a public discussion of the company's affairs until they are in a position to submit a definite proposition for the shareholders' consideration.

BRITISH OXYGEN CO., LTD.

An interim dividend of 9d. per share, tax free, has been declared.

SCOTTISH OILS, LTD.

Owing to the depression in the oil trade, and pending the result of the full year's working, the directors announce they are unable to recommend payment of the dividend in January on the 7 per cent. non-cumulative participating preference shares.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Dec.* 6)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Australia ..	Aluminium, chemicals, oils, colours, tanners' supplies ..	600
,, ..	Skins, casein ..	601, 602
Chile ..	Earthenware ..	627
Italy ..	Pig tin	613
Japan ..	Drugs, chemicals ..	11490/85/F.E./C.C./2
Netherlands	Rubber	617
Norway ..	Lead sheets and tubes	618
Smyrna ..	Paper, photographic apparatus	624
South Africa	Iron piping (tender)	12696/E.D./E.C./2
Switzerland	Iron, brass, copper and bronze wire, rubber tubing ..	21192/F.W./E.C./2
United States	Leather	21158/F.W./M.C./2

TARIFF CUSTOMS EXCISE

Federated Malay States.—A certificate of registration is required on all sales of rubber.

Italy.—Picric powders and other explosive products have been exempted from the manufacturing tax when destined solely for public works, or industrial and agricultural purposes.

Nigeria.—The export duties have been revised on ground nuts, oils, skins and hides.

Poland.—An increased excise duty is payable on acetic acid.

Sierra Leone.—Exports of palm oil are no longer dutiable.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The heavy chemical market maintains a steady tone, both home trade and export continuing to take tolerably satisfactory quantities. Prices are firm.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry.
Acid Hydrochloric	3s. 9d.—6s. per carboy d/d., according to purity, strength and locality.
Acid Nitric 80° Tw.	£21 10s.—£27 per ton makers' works, according to district and quality.
Acid Sulphuric	Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 65s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
Ammonia Alkali	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d.
Potash Caustic	£30—£33 per ton.
Potass. Bichromate	5¾d.—6d. per lb.
Potass. Chlorate	3d.—3½d. per lb.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£27 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Prices in this section are unchanged.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

With the exception of acetates of lime and lead the demand for wood distillation products keeps below normal. German charcoal is again being offered.

Acetate of Lime—	
Brown	£14—£14 10s. per ton d/d. Demand active.
Grey	£22 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£9 per ton, according to grade and locality. Market quiet.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. „ „ 24° Tw.
Red Liquor	10d.-1s. „ „ 14/15° Tw.
Wood Creosote	2s. 7d. „ „ Unrefined.
Wood Naphtha—	
Miscible	5s. 6d. per gall. 60% O.P. Competition being met with.
Solvent	6s. per gall. 40% O.P. Fair demand.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead	£42—£43 per ton. Demand more active.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. per lb. Weaker, with limited demand.
Crude 60's	2s. 9d.—3s. per gall. Limited business for spot delivery. No market for forward delivery.
Acid Cresylic, 97/99	2s.—2s. 1d. per gall. Firm, with good demand.
Pale 95%	1s. 10d.—2s. per gall.
Dark	1s. 7d.—1s. 10d. per gall. A little inquiry for forward delivery.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.

Anthracene Oil—	
Strained	9d.—10d. per gall. Better demand. Little material available.
Unstrained	8d.—9d. per gall. Quiet.
Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Benzole, Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 3d.—1s. 4d. per gall.
Pure	1s. 9d.—1s. 10d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8½d.—9½d. per gall. according to grade and district. Market very firm.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 1d.—1s. 2d. per gall. Market weak.
Solvent 90/190	1s. 1d.—1s. 3d. per gall. Business quiet.
Naphthalene Crude—	
Drained Creosote Salts	£5—£8 per ton. Demand increasing. Market scarce.
Whizzed or hot pressed	£9—£11 per ton. Quiet.
Naphthalene—	
Crystals	£19 per ton.
Flaked	£19 per ton.
Pitch, medium soft	110s. per ton. Little business. Market difficult. Little inquiry forward.
Pyridine—90/140	22s.—23s. per gall. Demand good. Supplies short.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

The slight improvement in dyestuffs business has been maintained, but orders are still only for small quantities.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 8d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Much better demand.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—9½d. per lb. naked at works.
Aniline Salts	9½d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 8d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Demand quiet.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dimethylaniline	2s. 7d. per lb. d/d. Drums extra.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£83 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 7d. per lb. d/d.
Nitrobenzene	5¾d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	11¾d. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 6d. per lb. d/d.
p-Phenylene Diamine	12s. lb. 100% basis d/d.
R. Salt	2s. 7½d. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8½d. lb. 100% basis d/d.
o-Toluidine	7d.—8d. per lb.
p-Toluidine	4s. per lb. d/d.
m-Toluylene Diamine	5s. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

English makers are steadily gaining ground in the manufacture of pharmaceutical chemicals with the aid of the Safeguarding of Industries Act, and whilst the present position in Germany continues supplies of chemicals manufactured abroad on a low exchange basis will gradually disappear from the market.

Acid, Acetic 80% B.P.	£48 10s. per ton.
Acid, Acetyl Salicylic	3s. 7d.—3s. 9d. per lb. Very firm. Makers fully occupied. Demand exceeds supply.
Acid, Benzoic	B.P. quality almost unobtainable. Commercial quality offered forward at 2s. 3d. per lb. for cwt. lots.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Camphoric	17s.—19s. per lb.
Acid, Citric	1s. 5½d. per lb., less 5%, for ton lots. Dearer.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst	6s. per lb. for 28 lb. lots.
Acid, Salicylic	2s. 6d.—2s. 7d. per lb. Very firm market. Expected to advance if demand continues.
Acid, Tannic	3s. 3d. per lb. for B.P. quality. Very firm.
Acid, Tartaric	1s. 1½d. per lb. less 5 %. Firmer.
Amidol	9s. per lb. d/d.
Acetanilide	Advanced to 3s. 3d. per lb. on a short market. No supplies from Continent.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	4s. 3d.—5s. per lb. for English make.

Ammon. Carbonate B.P.	£27 15s. per ton.
Atropine Sulphate	12s. 6d. per oz. for English make. Continental prices much higher.
Barbitone	18s. per lb. Slightly higher and in shorter supply.
Benzonaphthol	4s. 9d. per lb.
Bismuth Salts	A steady market. Prices according to quantity:
Bismuth Carbonate	12s. 9d.—14s. 9d. per lb.
,, Citrate	11s. 4d.—13s. 4d. ,,
,, Salicylate	10s. 2d.—12s. 2d. ,,
,, Subnitrate	10s. 9d.—12s. 9d. ,,
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.

Bromides—	Per lb.	
Potassium	9d.—10d.	Remain very firm. Continental prices advancing.
Sodium	9½d.—10d.	
Ammonium	10d.—11d.	

Calcium Lactate	2s. 9d. per lb. for best English make. Inferior Continental supplies have almost ceased.
Chloral Hydrate	4s. 3d. per lb. Position very firm and active.
Chloroform	2s. per lb. for cwt. lots. More active.
Creosote Carbonate	6s. 6d. per lb. Little demand.
Guaiacol Carbonate	Spot supplies very scarce. Present value 14s. per lb.
Hexamine	4s. 6d. per lb. for foreign makes. Manufacture in England has been discontinued since formaldehyde was removed from the dutiable list.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate	1s. 11d.—2s. 3d. per lb., according to quantity.
Magnesium Carbonate—Light Commercial	£36 per ton net.
Magnesium Oxide—Light Commercial	£72 10s. per ton, less 2½%. Reduced by £5 per ton.
Heavy Commercial	£27 per ton, less 2½%.
Heavy Pure	1s. 6d.—2s. per lb., according to quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 62s. 6d. per lb.
Mercurials	Firm and likely to advance.
Red oxide	4s. 11d.—5s. 1d. per lb.
Corrosive sublimate	3s. 8d.—3s. 10d. ,,
White precip.	4s. 6d.—4s. 8d. ,,
Calomel	4s. 1d.—4s. 3d. ,,
Methyl Salicylate	2s. 11d. per lb. for carboys. Brisk market. Higher values expected.
Methyl Sulphonal	22s. per lb.
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 6d.—1s. 7d. per lb. In shorter supply.
Phenacetin	7s. 6d. per lb. Steady market. English makers fully employed. Foreign supplies shorter.
Phenazone	8s. 9d. per lb. In short supply.
Phenolphthalein	8s. per lb. Very firm.
Potass. Bitartrate—99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Market firmer.
Potass. Citrate	1s. 8d.—2s. per lb.
Potass. Ferricyanide	3s. per lb.
Potass. Iodide	16s. 8d.—17s. 5d. per lb., according to quantity. Demand continues.
Potass. Permanganate	9d. per lb. for B.P. crystal. Shortage of foreign supplies has enabled English makers to regain lost ground.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Salol	4s. per lb.
Silver proteinate	10s. 6d. per lb. Quiet.
Sod. Benzoate	3s. 6d. per lb. Very scarce.
Sod. Citrate, B.P.C., 1923	1s. 5d.—1s. 9d. per lb., according to quantity. Very firm, in common with other citrates.
Sod. Hyposulphite—Photographic	£14—£15 per ton, according to quantity, d/d. consignee's station in 1-cwt. kegs.
Sod. Nitroprusside	16s. per lb. Less for quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 11d. per lb., and Crystal at 3s. per lb. Firm and very active.
Sod. Sulphide—Pure recryst.	10d.—1s. 2d. per lb., according to quantity.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	17s. 6d. per lb.
Thymol	13s. 6d.—14s. 6d. per lb. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 9d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine	3s. 3d. ,, ,,
Benzaldehyde free from Chlorine	3s. 3d. ,, ,,
Benzyl Benzoate	4s. ,, ,,
Cinnamic Aldehyde Natural	22s. 6d. ,, ,,
Coumarin	20s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	10s. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	37s. 6d. ,, ,,
Geraniol	6s. to 13s. 6d. per lb.
Heliotropine	8s. 6d. per lb.
Iso Eugenol	15s. 9d. per lb.

Linalol ex Bois de Rose	20s. ,, ,,
Linalyl Acetate	20s. ,, ,,
Methyl Anthranilate	8s. 6d. ,, ,,
Methyl Benzoate	6s. ,, ,,
Musk Ketone	47s. 6d. ,, ,,
Musk Xylol	13s. 6d. ,, ,,
Nerolin	4s. ,, ,,
Phenyl Ethyl Acetate	10s. ,, ,,
Phenyl Ethyl Alcohol	16s. ,, ,,
Rhodinol	60s. ,, ,,
Safrol	1s. 10d. ,, ,,
Terpineol	3s. ,, ,,
Vanillin	25s. 3d.—26s. 6d. per lb. Firm with steady demand. Raw materials dearer.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	14s. 6d. per lb.
Anise Oil	1s. 11d. ,, ,,
Bergamot Oil	13s. 3d. ,, ,, spot.
Bourbon Geranium Oil	37s. ,, ,,
Camphor Oil	75s. per cwt.
Cananga Oil, Java	9s. 6d. per lb.
Cinnamon Oil, Leaf	5¾d. per oz.
Cassia Oil 80/85%	11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	4s. 9d. ,, ,,
Ceylon	Very little on offer.
Clove Oil	10s. 6d. per lb.
Eucalyptus Oil 70/75%	2s. 6d. per lb.
Lavender Oil—	
French 38/40% Esters	24s. 6d. per lb.
Lemon Oil	2s. 10d. per lb. Higher prices expected.
Lemongrass Oil	2¾d. per oz.
Orange Oil, Sweet	11s. 9d. per lb.
Otto of Rose Oil—	
Bulgarian	34s. per oz.
Anatolian	26s. per oz.
Palma Rosa Oil	24s. 6d. per lb.
Peppermint Oil—	
English	70s. per lb. Market very unsteady.
Wayne County	15s. 6d. per lb. Market very unsteady.
Japanese	12s. 6d. per lb. Market very unsteady.
Petitgrain Oil	9s. 6d. per lb. Dearer.

TRADE NOTES

World Trade in Sulphur and Copper Sulphate

According to information in the International Year Book of Agricultural Statistics, 1922, published by the International Institute of Agriculture, Rome (price 8s.), and quoted in the *Board of Trade Journal* of November 8, Italian sulphur production in 1922 fell to 172,000 metric tons, as compared with 274,000 t. in 1921 and 385,000 t. in 1913; exports, however, increased considerably as compared with 1921, a year of intense crisis in the sulphur trade of Sicily. The United States, in 1922, maintained its sulphur out-turn (1,860,000 metric t.) at almost the highest level, which was attained in 1921, and exceeded the 1913 yield by about 1350 m.t. The exports from the United States in 1922 amounted to 496,000 m.t., a figure never previously reached.

During 1922, Germany, France, the United Kingdom, Sweden and Canada notably increased their imports of sulphur as compared with 1921 and 1913. Prices of sulphur, both in Italy and in the United States, were in 1922 fixed at a much lower level than in 1921. In the United States the monthly quotations were even below those obtaining before the war.

Production of sulphate of copper was for 1922 higher than for 1921 in France and the United Kingdom; but, whereas the French production showed a notable increase on the pre-war outturn, the yield of the United Kingdom showed a great decrease. Figures for the output in the United States in 1922 are not available, but those for 1921 indicated a great diminution in production, especially in comparison with 1913. Figures of the Italian yield in 1922 are also not available, but it may be stated that the recent growth of manufacturing plant now gives Italy the lead in capacity for producing copper sulphate.

Foreign Patents

The following table has been compiled in order to show the cost of taking out a patent in various countries:—

Country	Taxes $	Average Working Charges $	Average Total Cost $
Argentina	120	125	450
Australia	32	350	560
Austria	940	385	1,500
Belgium	480	390	950
Brazil	662	420	1,280
Canada	40	—	175
Chile	—	270	640
Cuba	—	40	180
Denmark	627	360	1,270
England	654	—	870
France	403	180	710
Germany	1,327	—	1,510
Holland	635	480	1,520
India	305	300	730
Italy	351	180	660
Japan	163	120	490
Mexico	—	—	135
New Zealand	51	300	490
Norway	337	—	510
Panama	—	45	340
Peru	—	150	410
Philippines	—	—	75
Porto Rico	—	—	75
Portugal	125	210	440
Spain	493	425	1,050
Sweden	259	—	440
Switzerland	312	385	820

These figures, it is stated, are not to be compared with the $500 estimated as the cost of a United States patent, because these figures for foreign patents pre-suppose that the application has already been taken out in the United States, which means that a large amount of hard work has been done, and the filing in a foreign country means little new thought or consideration.—(*Chem. & Met. Eng., Oct.* 15, 1923.)

Import Licences for Dyestuffs

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during November, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee :—

The total number of applications received during the month was 612, of which 485 were from merchants or importers. To these should be added 8 cases outstanding on November 1, making a total for the month of 620. These were dealt with as follows :—

Granted—433 (of which 413 were dealt with within seven days of receipt).

Referred to British makers of similar products—119 (of which 105 were dealt with within seven days of receipt).

Referred to Reparation supplies available—40 (all dealt with within two days of receipt).

Outstanding on November 30, 1923—28.

Of the total of 620 applications received, 558, or 90 per cent., were dealt with within seven days of receipt.

Foreign Company News

Switzerland.—It is reported that a company with a capital of 2 million (Swiss ?) francs has been registered under the title "Borvisk" at Zurich, for the manufacture of artificial silk by a new process due to Mr. Borzykowski.

Foreign Patent Rights in France

In 1922 the number of patents taken out in France was 18,300, of which 10,879 were due to French, and 7421 to foreign patentees. Of the foreign patentees, 1875 belonged to the United States, 1504 to England, and 1480 to Germany. Figures showing the number of chemical patents taken out in 1922 are not available, but in 1921, out of 955 chemical patents 236 or 25 per cent. were taken out by Germans, who were also the holders of 12 per cent. of all the patents of all kinds taken out in that year.—(*Chem. Ind., Dec.* 1, 1923.)

French Company News

By the end of 1924 the "Société des Produits Azotes" will possess works representing a total of 12,000—14,000 k.w., and it is hoped to produce 12,000—15,000 metric tons of calcium carbide. At present the output of calcium cyanamide lies between 40,000 to 50,000 t.

A group comprising over twenty Belgian, English and French petroleum companies has been formed in Paris, under the title of the "Comité interallié des compagnies petrolifères en Russie," to defend their rights in Russia, on the lines laid down by the assembly of the "Groupement international des Sociétés naphtifères en Russie" in September (*cf. Chem. & Ind.*, p. 1020).

Two new companies are being founded by French mining and chemical enterprises for the recovery of the by-products of coal. The first company, including the following companies :—Mines de Lens, Dourges—Nœux, Houillères de Sarre et Moselle, Cie. d'Alais et Camargue, is to utilise the Casale process to produce synthetic ammonia, a plant being erected at each battery of coke ovens belonging to the group. The second company, including most of the companies previously mentioned, is to extract and treat coal tar, in a factory to be erected at Pont à Vendin.

It is evident that there is a general tendency to similar joint action throughout the heavy chemical industry in France. Thus the amalgamation has recently been announced of the Compagnie Nationale des Matières Colorantes and the Etablissements Kuhlmann, thus leading to the formation of the sole French company with an output covering the whole realm of organic and inorganic products. The new company will be known as the Cie. Nationale de Matières Colorantes et Manufactures du Nord Réunies. Etablissements Kuhlmann. The capital of the Etablissements Kuhlmann is to be raised to 150 million fr. by the emission of 50 million shares of 10 fr. each, which will be exchanged for shares in the Cie. Nationale. In future the work will be distributed between the two companies to avoid any duplication of effort.

PUBLICATIONS RECEIVED

The Chemistry and Physics of Clays and other Ceramic Materials. *By* A. B. Searle. *Pp. xiii*+695. *London: E. Benn, Ltd.*, 1924. *Price* 55*s. net.*

Keramik. *By* E. P. Bauer. Fortschritte der Chem. Technologie in Einzeldarstellungen. *Edited by* Prof. B. Rassow. *Part I. Pp. xi*+143. *Dresden and Leipzig: T. Steinkopff*, 1923. *Price* 4*s.*

Felix Cornu, Blätter Liebenden Gedenkens und Verstehens, ein Familienbuch für den Freundeskreis; mit Widmungen Namhafter Zeitgenossen, naher Freunde, und einer Lebensskizze von seiner Mutter. *Pp.* 148. *Dresden and Leipzig: Theodor Steinkopff*, 1923. *Price* 4*s.*

Publications of the Department of the Interior, *United States Geological Survey. Washington: Government Printing Office*, 1923:—

Ilsemannite at Ouray, Utah. *By* F. L. Hess. *Contributions to Economic Geology*, 1923. *Part I. Pp.* 1—16. *Bulletin* 750a.

Peat in 1922. *By* K. W. Cottrell. *Mineral Resources of the United States*, 1922. *Part II. Pp.* 5—6. *No.* II:2.

Annual Report on the Department of Agriculture for the year 1922. *Colony of Mauritius. Pp.* 18. *Port Louis: F. S. Passingham*, 1923.

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EDITORIAL

WE have received a most interesting book on Technical Writing, by Mr. T. A. Rickard, a lecturer at the University of Harvard and some other universities. Mr. Rickard quotes a statement of Sir James Barrie that "the man of science appears to be the only man who has something to say just now—and the only man who does not know how to say it." He furnishes us with abundant instances of inaccurate, slovenly, and ungrammatical writing, of vague and high-flown phrases, and he points out to us how these can be corrected or improved. He has an excellent chapter on jargon, that prevalent infirmity which shrinks from the simple and direct, and loves the indefinite, wordy phrases, unduly crammed with meaningless prepositions. Many writers prefer the long words of Latin or Greek origin to the shorter English words; they are afraid to use the simple words and forget that the long ones are commonly so hackneyed as to be unwelcome. The style of many of the articles in our newspapers and scientific journals is deplorable, but these articles are full of stock phrases which sink into the memory and easily slip into our conversation and into any hurried writing. During our year of editorial work we regret to find we have acquired many such, and we think the surest way to spoil the lucidity of an author is to read much scientific writing. Mr. Rickard's book will not teach an author how to write well, but it will point out to him a number of common faults which can easily be avoided. Here and there are statements with which we do not agree; every now and then he quotes with dissatisfaction sentences that appear to us to be tolerable. But these are points of taste where some individuality is allowed. There is no reason why we should all adopt the same rules when we are considering minute variations of style. With nine-tenths of the examples in the book we cordially agree, and we hope that this book will be read in every university and technical college in this country.

* * *

The English language has only one reliable standard, the usage of the best writers. These do not all adopt, in trivial matters, the same practice; each author is entitled to the enjoyment of a few fads, provided that in the main he adheres to the principles accepted by the great masters of literary English. The phrases of the Authorised Version of the Bible, of Macaulay's History, of the Essays of Addison, de Quincey, Hume, Lamb and Huxley, will be a safe guide. Taste and grammar have varied a little during the last three hundred years, and some allowance should be made for these changes, but the books we have mentioned and the writings of Ruskin, De Foe, Lyell, Mark Pattison and a score of others furnish us with a good standard, adequate for our needs. Mr. Rickard has what we consider a justifiable fad in preferring, in many cases, the word "that" to "which." The rules he gives are doubtless convincing, but a rule which does not permit the phrase, "Our Father, which art in Heaven," must not be too rigidly applied. We hastily read a few pages of the Vicar of Wakefield, of Francis Bacon, Cowley, Swift, de Quincey, John Addington Symonds, Henry Mackenzie, Hazlitt, Lamb, Lyell and Giekie, and satisfied ourselves that their practice is not uniform. We confess to a few fads of our own; perhaps we are unduly annoyed by an attempt to fit together the singular and the plural; we dislike "the Company are," "the Board of Trade have," "the Chemical Society say," "the agenda provides," "optimum conditions," "those kind of things," and "none are." Among our chemists are some notable instances of writers who think clearly and write good English, but there are many who take no pride in their writing and show no signs that the perusal of transactions and abstracts has been supplemented by the reading of our standard authors. To all these Mr. Rickard's book will be amusing and valuable.

* * *

Thus with the year, seasons return; for those who have young children this is a season for school reports and school bills, for fancy dress and other parties, for cakes and ices, for late hours and indigestion. For all of us it is a time when we change our occupation, the men cut a large slice out of a working day and devote the time to hurried and concentrated shopping. We are all actors, as even more gifted authors remarked before chemistry became a science, and many of us are compelled to put aside the learned look, which is so appropriate to a lecturer or a participant in the sacred rite of titration, and to become for a brief space a Father Christmas, a Malvolio, or a Touchstone. It is refreshing to see a Fellow of the Royal Society with a false nose, or a University Professor with a burnt-cork moustache, romping with a younger generation. Those who can describe themselves as "directors of a public company" relax their eyes severe and forget their wise saws and modern instances and easily shift into the garb of a lean and slippered pantaloon. Perhaps the most agreeable change for many of us is that we shall be free for a few days from committees. Of all methods of earning an honest livelihood, talking is the most remunerative. Compare it with writing, for instance: and of the many varieties of talking, not lecturing, nor preaching, nor advocating, is so likely to lead to that combination of affluence and rheumatism which denote success, as talking at a board meeting or a committee meeting. This is a penalty of our complex civilisation; were the heroes of Homer with us now, we predict that Nestor would alone be the proprietor of a Rolls-Royce, Hector and Achilles would be glad of temporary employment in Bavaria or the Balkans, and the god-like Odysseus would find that his cunning, his fertile imagination and his disregard of the highest forms of accuracy would have involved him in monotonous and ill-paid labour on Dartmoor. But in chemical matters do we not rather overdo our committees? We probably have not too many committees in existence, but they are too large; committees which meet regularly and do useful work can act only after overcoming the inertia of the slowest members; the larger the committee, the more leisurely it operates.

MILK

By H. R. WHITEHEAD, M.Sc.

Milk is one of our most important foodstuffs, since it contains all the substances necessary for the maintenance of life: protein substances which supply tissue-building material; sugar and fat, which provide energy for both muscular work and heating; and, lastly, various enzymes, vitamins and inorganic salts, the action of which is still obscure, but which are known to be of prime importance to life. Since milk is the principal food of children and invalids, it is of the utmost importance that every care should be taken to maintain its quality and to protect it from contamination.

There are two aspects of the subject of milk production. The farmer has to look at the matter from a commercial point of view, and thus has gathered a large amount of practical knowledge concerning the breeding of cows, their feeding, and the milk production of different types. From the academic point of view, great interest attaches to the value of milk in nutrition, to its chemical constituents, and to the effect of bacterial contamination. The co-operation of both sides is necessary to solve the problem of providing the country with a supply of clean milk. In this paper, however, the matter will be considered from a theoretical standpoint, and more especially from the point of view of bacteriology.

Milk Proteins

The principal protein of milk, occurring to the extent of 3 per cent., is casein. It belongs to a class of substances of very high molecular weight, and it is moreover one of the most complex of this class. Casein is weakly acid and probably occurs in milk in pseudo-solution as the calcium salt. When diluted milk is acidified the casein is precipitated, entrapping the fat globules and leaving a clear whey. This is substantially what happens in ordinary souring. The clot of casein obtained in this manner is not the same as that formed by the action of rennet, which hydrolyses the casein into a protein, paracasein, of half the molecular weight of the original protein, and as the calcium salt of paracasein is insoluble, this separates out.

On treatment with acids, alkalis and enzymes, casein, like all proteins, is hydrolysed into simpler nitrogenous bodies and finally into amino acids. This is what happens in the body. The enzymes in the stomach and intestine, pepsin and trypsin, break down the casein molecule into soluble peptones and amino acids, which can pass into the blood stream, there to be rebuilt, so to speak, into the proteins of animal tissue.

These hydrolytic reactions are also made use of in bacteriology for the preparation of culture media, since micro-organisms require amino acids or similar bodies for their nutrition.

For example, when trypsin, the enzyme of the pancreas, is allowed to act upon casein at 37° C. for ten days, a clear brown fluid results which forms an excellent medium for the growth of many bacteria.

Milk also contains about 0·4 per cent. of other proteins which differ from casein in that they are coagulated by heating to about 70° C. These proteins are known as lactalbumin and lactoglobulin, and, together with a certain amount of fat, constitute the skin which forms on the surface of boiled milk.

MILK SUGAR

The sugar, which constitutes 3·74 per cent. of cow's milk, is lactose, a disaccharide like cane sugar, but less soluble and much less sweet to the taste. On hydrolysis it breaks down into galactose and glucose, sugars which can be assimilated by the animal body. Many micro-organisms can ferment lactose, forming lactic acid as a main end-product. When this happens in milk we get the familiar souring with precipitation of casein.

MILK FAT

Milk fat consists of a mixture of the glycerides of at least nine fatty acids, and is found in the shape of small globules, varying in size from 0·01 mm. to 0·0016 mm. Owing to their high refractivity the globules can readily be seen under the microscope, the smaller drops showing Brownian movement. On standing, the droplets slowly coalesce and rise to the surface of the milk as cream. The determination of the fat content is one of the necessary tests of milk under Government regulations, 3 per cent. being the lower limit allowed.

OTHER CONSTITUENTS OF MILK

Besides the proteins, fat and sugar, milk contains about 0·75 per cent. of mineral salts (mainly chlorides and phosphates), traces of urea, hypoxanthine and other nitrogenous bases and colouring substances. Several enzymes and some vitamins give evidence of their presence, but their chemical nature is so far entirely unknown.

The Government regulations require that the percentage of total solids not fat in milk shall not fall below 8·5 per cent., so that in addition to the fat, the total milk solids must be estimated by evaporating a definite quantity of milk to constant weight on a water bath. The object of this test is to detect any adulteration. It might be thought that a determination of the specific gravity would suffice, but as the removal of fat would raise the density, and since adding water would lower it, a skimmed milk adulterated with water might well have the same density as a genuine milk.

PRESERVATION OF MILK

The problem of keeping milk at a fairly constant chemical composition is comparatively simple when compared with that of preventing changes taking place during distribution. Milk is an ideal medium for bacterial growth, and its temperature at the time of milking is especially favourable for the growth of micro-organisms. Thus it is practically impossible to keep the milk in the sterile condition in which it leaves a healthy cow's udder, much less so when the conditions of milking and distribution are not of the cleanest. Bacteria from the coat of the cow, from the air of the byre, from the person of the milker, and from the vessels used, all gain access to the milk. Many of these organisms are harmless, both as regards their effect on human beings and their power of producing changes in the milk, but the total number of organisms present in any sample affords a good indication of the degree of contamination. The only method of ensuring that disease-producing organisms shall not be present, is to prevent the introduction of any organism whatever, *i.e.*, the milk must be kept sterile.

It is important to point out the fallacy that exists in the "dirt test" sometimes applied to milk as a criterion of cleanliness. Many bacteria gain access to the milk in company with particulate matter, such as hay, straw and manure, but since filtration through muslin or cloth will remove much of the dirt without affecting the bacterial content in the slightest, it will be clear that the sediment test determines the efficiency of the straining rather than the bacterial contamination, which is much the more important point. In other words, a well strained but contaminated milk may appear much cleaner by the sediment test than one produced with more care but less efficiently strained. As Savage says, "Take care of the bacteria and the sediment can take care of itself."

BACTERIA IN MILK

The bacteria found in milk may be classified as :—

(A) Non-pathogenic organisms
(B) Pathogenic organisms

The most important of the first class of organisms from the dairyman's point of view are the lactic acid bacilli. These are rod-shaped organisms which ferment lactose, lactic acid being the main, but not the only, substance formed. Traces of the following substances have been detected in sour milk: acetic, butyric and succinic acids, carbon dioxide, hydrogen and alcohol. This group of bacilli may be subdivided into :—

(i) Bacilli which form acid and gas.
(ii) Bacilli which form acid alone.

The main organisms comprising the first subdivision are *B. coli* and *B. lactis aerogenes.*

These are particularly important from the point of view of public health, as they are almost invariably derived from the excreta of the cow, and their presence in milk indicates the degree of pollution. The test for the presence of these organisms is part of the routine of bacteriological examination of milk.

The other bacilli in the second subdivision, such as *B. acidi lactici* and *B. bulgaricus,* are useful rather than harmful, because the reactions they bring about tend to inhibit the growth of pathogenic organisms, and further, by producing changes in the milk (souring and clotting) they prevent the sale of stale milk laden with other possibly harmful bacteria, which give no such indication of their presence.

Next in importance among the non-pathogenic bacteria found in milk are the streptococci, round organisms which grow in chains, varying in length according to the type of organism and the conditions of growth. They are sometimes derived from the cow's udder if this is affected with inflammation, or mastitis, and as cow dung contains on the average 10–100 million streptococci per g. they may gain access to the milk in the same way as *B. coli*, through faulty milking. Many streptococci ferment lactose, producing acid, and some observers have isolated a lactic acid streptococcus, bringing about the same changes as *B. acidi lactici.* Although the streptococci are included among the non-pathogenic organisms, their presence in milk is regarded with suspicion, some observers claiming that they are the cause of gastro-intestinal catarrh, infantile diarrhœa, and sore throat in human beings. But the identification of streptococci is still not satisfactorily worked out, so that the issue is obscure.

Another coccus present almost invariably in milk is *Staphylococcus,* an organism similar in shape to *Streptococcus,* but growing in clusters instead of chains. There are many varieties of the organism, but as their effect on milk is not to be compared with that of the lactic acid organisms, and as they have no harmful effect on human beings in the general way, no great interest attaches to their presence.

The next group of organisms is that of the spore bearers, of which there are both aerobic and anaerobic varieties. These are rod-shaped organisms which have the power, when in surroundings uncongenial to their growth, of changing into a round or oval form very resistant to destruction by drying, heat or antiseptics, and remaining in a quiescent condition until they find themselves once more in a suitable medium, when they resume their vegetative form and reproduce in the usual way. These organisms became prominent during the war as being the invading agent in cases of gas gangrene. Some of the spore-bearing bacilli will grow only in the absence of oxygen, and of these *B. Welchii,* derived from cow dung, is sometimes present in milk. It does not grow in the milk, being an anaerobe, and is non-pathogenic to man, except in special conditions, such as lacerated wounds, but its presence affords evidence of manurial contamination. Milk containing the spores of the organism and incubated (after being heated to 80° C. for 30 mins. to destroy other organisms) under anaerobic conditions, soon exhibits well-marked changes : the casein separates as a clot, and there is abundant gas formation.

The aerobic spore-bearing bacilli found in milk are derived mainly from hay and straw, and are non-pathogenic, but decompose the milk proteins. Since all the sporing organisms are very resistant to heat, they constitute one of the greatest difficulties to be overcome in the sterilisation of milk.

The organisms enumerated constitute the majority of those found in milk, but since milk is such an excellent medium for bacterial growth and is exposed in so many ways to infection, there is really no end to the varieties of organisms which may be found. There are organisms which cause various colour changes, blue, red and yellow, and almost invariably yeasts and moulds are present. The only other organisms which require mention are those pathogenic to man.

PATHOGENIC ORGANISMS

Milk has been shown to be the carrier of the infecting agent in epidemics of cholera, typhoid fever, scarlet fever, diphtheria, malta fever and sore throat. The infection of the milk by the specific organism of a disease is generally brought about by some person who is suffering or recovering from the disease, or who is a "carrier" of that particular organism, *i.e.,* he exhibits no symptoms of the disease although he harbours the organism and spreads infection. Typhoid fever may also gain access to milk through polluted water used to wash out the milk vessels. Most of the pathogenic organisms occuring in milk cause no obvious changes such as souring and clotting, and their presence is generally only discovered after they have caused illness in human beings.

TUBERCULOSIS

By far the most common pathogenic organism found in milk is *B. tuberculosis,* which occurs in the milk of cows suffering from the disease not only when localised in the udder but in any part of the body. For many years there was doubt whether tubercle bacilli of bovine origin could cause tuberculosis in human beings, but it is now established that many cases of tuberculosis are caused by infection from tuberculous milk. It has been found that 86·6% of the infections of children up to 5 years old suffering from tuberculosis of the cervical glands are bovine in origin. In 1068 cases of various tubercular lesions the following percentages proved to be of bovine type.

Age	Per cent
0—5	37·5
5—10	29·45
10—16	14·66
Over 16	6·25

B. tuberculosis does not multiply to any extent in milk, and the surest method of detecting its presence is to inject the milk into the peritoneum of a guinea pig. If tubercle bacilli are present, the animal develops the disease, and at the end of about six weeks a post-mortem examination will reveal specific lesions. This examination is continually being carried out with samples of milk offered for sale, and where milk is found to be tuberculous the infected animal is traced, if possible, and removed from the herd.

Another method of detecting tuberculosis in cows is by applying the tuberculin test. Tuberculin is a fluid prepared by growing tubercle bacilli in glycerin veal broth, sterilising in an autoclave, concentrating *in vacuo* and filtering. If an appropriate dose be injected into an animal suffering from the disease, a well marked reaction indicated by a rise in temperature takes place, whereas in most healthy animals no reaction occurs; 0·4% of normal bovine animals do, however, give a reaction. In this way tuberculous animals can be eliminated with a fair degree of certainty from any herd.

STANDARD MILK

Milk is usually sold without any restriction as to its bacterial content; it merely has to satisfy the chemical standards. The Government is, however, proceeding along the right lines in introducing standards to which milk dealers can voluntarily conform. Ultimately it is to be hoped that all milk sold will satisfy these standards. There are, under the recently introduced regulations, three grades of milk apart from ordinary ungraded milk :—

I. Grade A certified milk.

II. Grade A milk (which may also be tuberculin tested).

III. Pasteurised milk.

This grading deals purely with the bacterial content, since all milk must perforce conform with the chemical standards. The significance of the grades is as follows :—

Grade A certified milk must be produced from tuberculin-tested cows and must not contain more than 30,000 organisms per c.c. as delivered to the consumer. The test for *B. coli* must be negative in 3 tests of 0·1 c.c.

Grade A milk must contain less than 200,000 organisms per c.c. as delivered, and the *B. coli* test must be negative in 3 tests of 0·01 c.c. There is no absolute guarantee that the milk is not tuberculous, unless it is specifically stated to be from tuberculin-tested animals.

Pasteurised milk must have undergone an approved method of heat treatment, and must not contain more than 50,000 organisms per c.c.

When milk is sold under any of these three labels it is tested periodically in the bacteriological laboratory. An inspector collects a bottle of the milk during delivery, puts it into a special ice box and delivers it at the laboratory. The testing of the milk is then carried out as follows. The bacteriologist has before him three bottles each containing 90 c.c. of water, plugged with cotton wool and sterilised. With a sterile 10 c.c. pipette he measures 10 c.c. of milk into the first bottle, inserts a sterile rubber stopper and shakes the bottle thoroughly. With a second sterile pipette he measures 10 c.c. from the first bottle into the second, inserts a stopper and shakes. Similarly 10 c.c. are transferred from the second to the third bottle. Thus three dilutions, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, of the milk are obtained. Next 1 c.c. of each dilution is pipetted off with a sterile pipette, mixed with 15 c.c. of melted medium in a tube and the tubes poured into sterile glass Petri dishes. The medium is made from commercial peptone, Lemco meat extract, and agar, a solidifying agent. It is prepared according to standards laid down by the Ministry of Health so that constant results are obtained throughout the country. The plates of medium are then allowed to set.

The *B. coli* test is carried out by pipetting 1 c.c. from the appropriate dilution bottle into a tube containing McConkey's broth. This broth contains peptone, lactose, litmus as an indicator and bile salt or sodium taurocholate which favours the growth of *B. coli* and tends to inhibit other organisms. In the tube, a smaller test tube is inverted in the broth. If *B. coli* is present in the milk it forms acid and gas from the lactose; the acid is indicated by the reddening of the litmus and some of the gas is trapped in the small tube. The presence of *B. coli* is only taken as proven when both acid and gas are producedi because other organisms such as the streptococc, produce acid only from lactose.

When the agar has set, the plates are incubated, together with the McConkey tubes, in an incubator at 37° C. The first reading of results is made after 48 hours, when the McConkey tubes are examined and the colonies on the three plates counted. The plate prepared from the 1 in 10 dilution contains the organisms from 0·1 c.c. of the original milk and the other two contain those from 0·01 and 0·001 c.c. respectively. Each colony is assumed to have originated from one organism in the milk. From the counts of the three plates the number of bacteria in 1 c.c. of the original milk is calculated by averaging. The McConkey tubes after having been read are incubated for a further 24 hours before the final reading is made, when they are marked as positive or negative.

It is of little use to introduce bacteriological standards unless all those who have to deal with milk learn how to avoid bacterial contamination. In milking, all that is required is extreme cleanliness; the cow's udder and flanks should be washed; the byre should be kept clean and as free as possible from dust; the milker should wash his hands immediately before milking and should wear a clean overall; the milk vessels should be sterilised by scalding before use and they should be kept covered when containing milk.

Most of the organisms found in milk grow best at the temperature of the human body, 37° C. As the milk leaves the cow it is roughly at this temperature and the organisms which do gain access to it, however great the care of the milker, begin to multiply rapidly unless checked. The further the milk has to travel the greater the bacterial content when it reaches the consumer.

There are three main ways of keeping down the number of bacteria, viz., by (1) efficient cooling, (2) pasteurisation or sterilisation, and (3) the addition of antiseptics.

The first method is the only really satisfactory one at the present time. In milk kept at freezing point the bacteria will not multiply to any extent for several days, whereas there may be a 14-fold increase in 24 hours in milk kept at 15° C. Of course the cooling will not eliminate disease germs if these have entered the milk already. It should be emphasised that cooling to temperatures far below 0° C. does not kill bacteria.

The second method consists in heating the milk above the thermal death point of the organisms present and thus rendering it sterile. The disadvantage of the method lies in the fact that a temperature sufficient to destroy with certainty all the organisms including spores will bring about chemical changes in the milk, altering its taste, and perhaps destroying vitamines and enzymes valuable in nutrition. Any temperature above 60° C. will almost certainly bring about chemical changes and since spores can only be destroyed at temperatures over 100° C. or by heating to boiling point several times in succession it will be seen that it is almost impossible to obtain unaltered sterile milk by any method of heat treatment. According to the latest results *B. tuberculosis*, the most resistant of the vegetative bacteria, is killed in milk by heating to 60° C. for 20 minutes.

The third method is bad since a substance capable of destroying bacteria in milk, generally has a harmful effect on human beings and especially on children. Substances commonly added to milk are boric acid, formaldehyde, sodium carbonate, and salicylic acid. Their use merely stifles the bacteria, disguises the true condition of a contaminated milk and puts a premium on uncleanly dairying. Consequently the use of antiseptics and preservatives is prohibited by law.

The soundest method therefore of keeping down the bacterial content of milk is by clean milking and by maintaining the milk at a low temperature during delivery. The practice of delivering milk in sealed bottles is infinitely preferable to delivery in bulk and the subsequent measuring out of smaller quantities in a dusty street. Finally the milk must be produced from healthy cows and no one concerned in its production or distribution must be a disease carrier.

In conclusion I would quote a rather humorous paragraph from Savage's *Milk and Public Health*, referring to the present methods of delivering milk.

"The dairy shops scattered about the towns are usually scrupulously clean, the milk vessels are equally clean and the attendant neat and tidy. Indeed for those who know the average conditions under which milk is produced and the gross contamination to which the milk sold in such dairies has probably been subjected, there is keen irony in the beautiful surroundings which envisage the milk as soon as it comes within the purview of the consumer and a whited sepulchre comparison is felt to be not unwarranted."

RESINS IN THE FAR EAST

Copal, dragon's blood, gamboge, gurjunbalsam, elemi and rosin are the principal resins produced in Eastern Asia. In 1920, 1,019,834 kg. of copal was exported to India, Great Britain, United States, Belgium, France, Spain, Japan, China and Australia, and in 1921 the total shipments were 542,700 kg. Large quantities of dragon's blood (obtained from *Calamus draco*, which grows in the Dutch East Indies, Straits Settlements and the Federated Malay States) is shipped to India, China and Europe from Singapore and Batavia, the two chief export centres. Several trees produce gamboge, the chief variety coming from *Garcinia morella*, which flourishes in Siam, the islands on the east coast of the Gulf of Siam, various parts of India and the southern areas of Cochin China. The chief export centres are Bangkok, Saigon and Singapore. Gurjunbalsam, which is exported chiefly from Singapore, is an oleo-resin obtained from several species of *Dipterocarpus*, of which *D. turbinatus* is found in the Straits Settlements and French Indo-China and *D. trinervis* in Java and the Philippines. The trade in gurjun is mostly carried on between various Eastern countries, and some is also shipped to America and Europe. Kwangtung and Kwangsi, provinces of China, are the chief sources of supply of rosin in Eastern Asia, shipments being exported from Kowloon, Canton, Swatow and Wuchow. Hongkong imports practically all the Chinese output of rosin, Japan being the next largest purchaser. Elemi is produced in the Philippines, Great Britain and the United States being the largest importers.—(*Ch. Comm. J., Oct.* 5, 1923.)

FORTHCOMING EVENTS

Dec. 29 to Jan. 9. Scientific Novelties Exhibition, King's College, Strand, W.C. 2. Demonstrations and Experiments, 2—5 p.m., and 6—9 p.m.

Jan. 2. Institution of Electrical Engineers, *Wireless Section*, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "Some Experiments on the Screening of Radio Receiving Apparatus," by R. H. Barfield, M.Sc.

Jan. 3. Society of Chemical Industry, *Bristol Section*, Chemical Department, The University, Bristol, at 7.30 p.m. "The Chemical Technology of Canned Foods," by O. Jones.

Jan. 7. Institution of Electrical Engineers, Savoy Street, Victoria Embankment, W.C. 2, at 6 p.m. "Troubles with Domestic Electrical Appliances." Discussion opened by J. W. Beauchamp.

Jan. 7. Society of Chemical Industry, *London Section*, in the Rooms of the Chemical Society, Burlington House, W. 1, at 8 p.m. "The Estimation of Butyric Acid in Presence of Acetic Acid," by Dr. E. Fyleman; "The Estimation of Cadmium in Spelter and Zinc Ores," by C. E. Barrs.

Jan. 7. Institution of Rubber Industry, *London Section*, The Engineers' Club, Coventry Street, W. 1, at 8 p.m. "Consistency of Rubber and Rubber Compounds," by Dr. S. S. Pickles.

Jan. 8. Institution of Mechanical Engineers, *Swansea Section*, at Chamber of Commerce, Swansea, at 6 p.m. "Modern Developments in Steam Raising," by Sir J. H. R. Kemnal, F.R.S.

Jan. 8. Institute of Metals, *Birmingham Section*, Chamber of Commerce, New Street, Birmingham, at 7 p.m. "Nickel Brasses," by O. Smalley.

Jan. 8. Institute of Metals, *North-East Coast Section*, Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. "The Action of Molten Brass on Nickel-Steel," by H. M. Duncan, B.Sc.

Jan. 10. Institute of Metals, *London Section*, Institute of Marine Engineers, 85—88, The Minories, Tower Hill, E. 1, at 8 p.m. "X-Rays and Metallurgy," by W. T. Griffiths, M.Sc.

Jan. 10. Institution of Mechanical Engineers, *Glasgow Section*, Royal Technical College, Glasgow, at 7.30 p.m. "Radiation and Atomic Structure," by Prof. J. Muir, D.Sc.

Jan. 11. Institute of Metals, *Sheffield Section*, The University, St. George's Square, Sheffield, at 7.30 p.m. "Influence of Casting Temperature on the Physical Properties of Metals," by F. H. Hurren. (Conjoint Meeting with the Institute of British Foundrymen).

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

EDITORIAL NOTICES

The Society as a body is not responsible for statements and opinions appearing in the Journal.

Members of the Society, and others, are invited to submit original articles, news, notes and other relevant information to the Editor of *Chemistry & Industry*. Such contributions should be clearly written (preferably typewritten with double spacing), and be accompanied by a stamped and addressed envelope. They will be paid for if inserted. Sources of information should always be given, not necessarily for publication.

Hon. Secretaries of Local Sections and of other Societies are asked to forward notices and reports of meetings as early as possible, and publishers to send books for review, direct to :—The Editor, *Chemistry & Industry*, Society of Chemical Industry, Central House, Finsbury Square, E.C. 2. [Telephone: Clerkenwell No. 2429.]

Hon. Secretaries of Local Sections and of other Societies are asked to note that announcements of forthcoming events cannot be inserted in the next issue of the Journal *unless they are received not later than Tuesday in any week.*

Matters relating to the Transactions and Abstracts, including Papers intended for insertion as Communications, should be addressed to The Editor of Transactions, at the same address.

CHEMICAL SOCIETY'S LIBRARY

The Library of the Chemical Society will be closed for the Christmas Holidays from Monday, December 24, to Thursday, December 27, inclusive.

LIST OF MEMBERS ELECTED

December 14, 1923

Bishop, Wilfrid B. S., Department of Chemistry, The University, Sydney, N.S.W., Australia. Demonstrator.

Boan, R. Farquharson, Borthwicks Pty., Ltd., Elizabeth Street, Waterloo, N.S.W., Australia, Chief Chemist.

Briggs, Chas. V., 126, Glenville Avenue, Allston 34, Boston, Mass., U.S.A. Chemist.

Campbell, George I., 63, Palace Road, Tulse Hill Park, London, S.W. 2. Wax and Oil Merchant.

Cocks, Leslie V., 38, Egerton Park, Rock Ferry, Cheshire. Research Chemist.

Coutinho, Dr. Constancio, Municipal Offices, Victoria Terminus, Bombay. Municipal Analyst.

Eadie, Robt. G. W., 22, Whitevale Street, Dennistoun, Glasgow. Chemist.

List of Members Elected (*cont.*).

Garrod-Thomas, R. Noel, 166, Piccadilly, London, W. 1. Barrister-at-Law.

Heaton, John S., C.P.A. Central Laboratory, Rhodes, near Manchester. Research Chemist.

Hetherington, Arthur C., St. Kitts, Slateford, Midlothian. Research Student.

Hill, J. Bennett, The Barrett Co., Frankford, Philadelphia, Pa., U.S.A. Chemist.

Hirst, Joseph F., 3, Wolseley Gardens, Gunnersbury, London, W. 4. Chemist.

Hoffert, Wilfred H., Dept. of Coal Gas and Fuel Industries, The University, Leeds. Research Chemist.

Holmyard, Eric J., The Brow, Clevedon, Somerset. Schoolmaster.

Honey, Harry E. E., Incorporated Oil Seed Association, Exchange Chambers, 24, St. Mary Axe, London, E.C. 3. Analytical Chemist.

Hopkins, David G., Physical Chemistry Dept., The University, Bristol. Research Chemist.

Hotton, Donovan H., c/o Messrs. Bristowes Tarvia, Ltd., St. Stephen's House, Victoria Embankment, London, S.W. 1. Technical Chemist.

Louden, Chas. R., 4, South View, Dalmuir, Dumbartonshire. Chemist.

McLeod, William G., The Harris Abattoir Co., Ltd., Toronto, Ont., Canada. Chemist.

Malcolm, George, 12, Miller Street, Shawlands, Glasgow. Chemist.

Mann, William, 2, Albin Street, Morley, near Leeds. Textile Chemist.

Mieras, Adrian P., Keith Lodge, Beaverhall Road, Edinburgh. Analytical Chemist.

Miller, Stuart P., The Barrett Co., Margaret and Bermuda Streets, Frankford, Philadelphia, Pa., U.S.A. Chemist-Superintendent.

Morrison, Robert E., c/o Blanchard, 9, Antigua Street, Edinburgh. Chemist.

Munro, Reginald J., "Dunmore," Eccles Road, Hunters Quay, N.B. Chemist.

Read, Harold R., 62, Dale Street, Liverpool. Analyst.

Reid, John H., Westgarth, Formby, Lancs. Chemist and Manager.

Scholes, George R., Oxo Factory, Southwark Bridge, London, S.E. 1. Technical Chemist.

Schorman, William A. P., 51, Douglas Drive, Toronto, Ont., Canada. Consulting Engineer.

Slater, Albert V., 20, Clifford Street, Hornsea, E. Yorks. Chemist.

Tait, John B., 32, Ryehill Terrace, Leith. Works Chemist.

Walker, George, "Aldersyde," North Street, Stanmore, Sydney, N.S.W., Australia. Demonstrator in Chemistry.

Whytlaw-Gray, Robert W., The Chemistry Dept., The University, Leeds. Professor of Chemistry.

Williams, Edward T., 49, Grasville Road, Higher Tranmere, Birkenhead, Cheshire. Research Chemist.

Wood, Benjamin, 10, Mansard Close, Jeffcock Road, Wolverhampton. Analyst.

Wright, Ethel C., c/o Leach Neal and Co., Ltd., Spondon, near Derby. Industrial Chemist.

LIVERPOOL SECTION

A meeting was held in the Rooms of the Over-Seas League, on November 30, Mr. Edwin Thompson, the Chairman of the Section, presiding. The principal business of the meeting was a discussion on "The Society of Chemical Industry and what it stands for," which was opened by the President, Dr. E. F. Armstrong, F.R.S.

The Chairman, before calling upon Dr. Armstrong, said that it was hoped to make the Section as useful to everyone as possible and to induce members to attend the meetings because they found them interesting, and not merely as a matter of duty. The Sections should be a real help to the Society, and he hoped that the President would go back convinced that the Liverpool Section was doing its share.

The President said that a Society such as the Society of Chemical Industry had two main purposes. The one was to be of assistance to the academic chemist; the other to represent those engaged in industrial chemistry. The Society was really complementary to the Chemical Society, because papers were read before its Sections dealing with the industrial side of the science. Their past records contained many very important papers, and their abstracts had been an achievement of which they were justly proud. The Institute of Chemistry represented, in the main, professional chemists, and could not cater altogether for that large class which was engaged in chemical industry. Our Universities were turning out hundreds of highly trained men, and they were naturally asking if the Society could not do something for them. He (the President) thought that there was great scope for assisting these chemists, and nothing fitted a man better for his career than a scientific training, although he need not necessarily become a chemist. In after life, though he might go in for finance, commerce or some other branch of business, he would be none the worse for a preliminary training in science. Every year the world was becoming more scientific; educated men were expected to understand technical matters of which their fathers knew nothing, and they found this scientific knowledge of use to them. What they required was some chemical body to keep these men in touch with science, and he would like to see such persons members of our Society, attracted to it by its activities, by its Journal and by its club life. He had felt a certain sense of shame that a body of the importance of the Society of Chemical Industry had no meeting place of its own, and this aim might be realised if all these people on the fringe of the profession, but who were not actually chemists, would join with them. He did not know what could be done to make the meetings more attractive, but he felt that they must endeavour to interest people outside the profession, and by so doing they would provide better opportunities for chemists.

Prof. I. M. Heilbron agreed that it was necessary to obtain the active support of some of those on the border line of chemistry, and get them to attach themselves to the Society. He asked if it would not be possible to associate with other bodies in Liverpool, so that the aims and objects of the Society should be more widely known, and thus the position of chemistry strengthened. He foresaw the difficulty as the years went on of maintaining sectional meetings, owing to lack of appropriate material for papers. He suggested that the experiment might be tried of inviting members of the Institute of Chemistry to attend the meetings and thus ensure closer co-operation. Similarly, meetings with other local societies might be arranged. The Chairman mentioned that it was proposed to hold a joint meeting with the Liverpool and North-Western Section of the Institute of Chemistry on January 18. Mr. W. Mansbridge pointed out that there was co-operation between the learned societies of the district; last year a delightful soirée was held in the Liverpool Museums, and among other activities of the Committee of Learned Societies, the proposal to obtain a common meeting place was under consideration.

Mr. A. A. Robertson observed he was glad that there was a desire to instil life into the Section. He thought that a closer connexion between the University and industry in Liverpool would be a great advantage, and that the Section could provide a suitable meeting-ground. Students of chemistry should be invited to attend. Dr. C. H. Clarke said that by working together and getting the support of the heads of the profession they would be able to interest others in influential quarters. People looked to the Society to keep chemists together, and he thought that they would get larger attendances if popular subjects were chosen rather than technical ones. Mr. A. T. Smith strongly endorsed the President's suggestion that a training in chemistry would serve a man well in after life. It would be useful in giving him an appreciation of the value of exactitude. Their Society was one which diffused knowledge of chemistry, and he thought it would do a great deal of good if they could get some of the older members to come among them and talk things over. If they could infuse more life into the Society it would be a very good thing.

Mr. E. H. Shepherd pointed out that the Society was working on much the same lines as the Institute of Chemistry, and that what was required was to co-ordinate the work of the two. What was needed was the right "emulsifying agent." Mr. J. C. Cunningham pleaded for the junior members, and suggested that they might be specially invited to speak at the meetings. Mr. T. W. Stuart, speaking as a member of the Society since the commencement, thought that they had not much to complain of. They had papers of general interest, and he had found that the meetings enabled them to get to know one another and to revive old friendships. He regarded the social side as of importance, and he thought they should try to induce the seniors to attend more frequently; it would be to the benefit of the younger members. Prof. W. H. Roberts agreed with Mr. Stuart that the older members should attend the meetings as much as possible, as the younger men did not get much opportunity of meeting them. If they intermingled more it would be better for both.

Prof. Baly fully concurred in the view expressed by the president that an education in chemistry was an admirable one. The value of this education lay in the fact that students, after graduation, gained great advantage by undertaking research work, during which they learned to think for themselves and to apply the knowledge they had obtained as undergraduates since they were breaking new ground. He felt that a University education in chemistry, including agricultural chemistry, would be an excellent one for all owners of land. It might be thought worth while to discuss the proposal with the Council of the University. As regards the suggestions made for the sectional meetings, he rather deprecated the advertisement of the work done by chemists. The proposal to approach the citizens of Liverpool, possibly through the Rotary Club, with the view of interesting them in the many activities of chemists appealed to him. Too many papers on pure and applied chemistry of the ordinary type should not be read, as in his opinion members felt more interest in matters outside their ordinary day's work. He appealed for more papers of the type of the chairman's address and as an instance suggested a paper and discussion on the chemistry of photography.

On December 12 a Joint Meeting with the Chemical Engineering Group was held at the Over-Seas Club, Mr. Edwin Thompson in the chair.

A paper was read by Mr. J. T. Brewis on "The Extraction of Oil from Seeds, Nuts and Kernels." The author dealt firstly with the variable nature of the raw materials handled and with the methods adopted for cleaning, and described separators, seed and lint cleaners, and the arrangement of plant for cleaning seed and lint. The linting and defibrating process was discussed and illustrated, and a comparison drawn between the English method of pressing cottonseed and the American process, which involves previous decortication. Decorticating plant was described and also types of magnetic separators through which all seeds should pass before milling. The subsequent operations of reducing, milling, cooking and pressing were described in detail and types of open and closed presses shown. The author then proceeded to describe the extraction of oil by means of solvents, the relative merits of various solvents being discussed. Illustrations were given of plant for washing and for the separation of oil and solvents.

A discussion followed in which Mr. Reavell, chairman of the Chemical Engineering Group, Prof. J. W. Hinchley, and Messrs. Austin, Briggs, Savage and Sibbald took part.

Previous to the meeting a party was conducted through the African Oil Mills (Co-operative Wholesale Society, Ltd.), by the courtesy of the Directors, and at the close of the proceedings the officers and committee of the Chemical Engineering Group and the Lecturer were entertained to dinner at the University Club.

NOTTINGHAM SECTION

At the meeting, held on December 12, Prof. A. R. Ling gave a lecture entitled "Some Points in the History of Fermentation, particularly as Applied to the Brewing Industry."

Prof. Ling introduced his subject by defining fermentation as a phenomenon, directly or indirectly connected with life, producing a simplification of chemical substances (catabolic changes), accompanied by evolution of heat. The reactions attending the processes of respiration, digestion, assimilation, excretion and putrefaction all came under the heading of fermentation.

The lecturer then outlined the historical development of fermentation processes, the first recorded being the making of wine from rice and bread from wheat in 1998 B.C. by Ching-Nouang in China. The Egyptians made beer from barley as early as the Fourth Dynasty.

During the period of alchemy (350-1525 A.D.) many theories to explain fermentation were put forward, but it was not until 1648 that Van Helmont came near to the discovery of the living nature of yeast by observing that during fermentation something passes from the ferment into the fermenting liquid, and it is the growth of this something which actually causes the fermentation. In modern times the theory of alcoholic fermentation could be traced through three distinct epochs—chemical, biological and biochemical. Stahl considered that a ferment was a body in a state of active motion which it could communicate to another body, and later Lavoisier showed that when sugar was fermented the weights of alcohol and carbon dioxide produced were together equal to the weight of sugar. Latour and Schwann independently and almost simultaneously asserted that yeast was a living organism—a theory ridiculed by Wöhler and Liebig.

The second epoch (biological) opened with the work of Pasteur, who stated that "alcoholic fermentation is a phenomenon correlated with the life, and not with the death of yeast." The researches of Pasteur forced Liebig to admit the living nature of yeast, although he still maintained that the life of yeast was a thing apart from fermentation.

In the third epoch (biochemical) the views of Pasteur and Liebig were linked up in 1897 by Buchner, who discovered that the yeast cell contained an enzyme (zymase) which could convert sugar into alcohol.

Prof. Ling then described the processes of malting and brewing, mentioning the pioneer work of H. T. Brown and O'Sullivan, and the value of the chemical training which had enabled them to improve the industry so successfully. Finished malt contained very little maltose, but chiefly starch with a little saccharose. After discussing the fermentation of wort, the different races of yeast were described and the curious intraconvertibility of different yeasts, such as top and bottom yeasts, pointed out.

Prof. Kipping asked what was the explanation of the formation of saccharose during germination, and why one yeast could take on other functions (after a time). Mr. Pentecost referred to the use of thin starch in stiffening textiles and asked if it could be determined when the thinning (say with diastase) had gone far enough; also if boiling the starch solutions would completely destroy all enzymes.

Prof. Ling, in reply, said that the production of saccharose during fermentation had yet to receive a proper explanation; it was similar to the conversion of the starch of green apples into varying amounts of invert sugar and saccharose during ripening. With regard to the intraconvertibility of yeasts any yeast was a product of its environment. Thus in the four systems of wort fermentation, each system had its own yeast, and at first a different yeast will spoil the brew. After a time, however, such a yeast will change its characteristics and be capable of performing different functions—gradually becoming accustomed to the altered conditions. It should not be difficult to regulate the action of diatase on starch, and the polarimeter, and Fehling's and the iodine reactions could be used to follow the change. All enzymes in the starch solution would be destroyed by boiling, but this should be done rapidly; alkali (10 per cent.) would also destroy enzymes in starch solution.

NEWCASTLE SECTION

At the meeting held on November 28, Mr. Arthur Trobridge in the chair, a vote of sympathy was extended to the relatives of the late Dr. J. E. Stead. Subject to the approval of the Council, it was decided to admit Associate Members. It was announced that the Saville Shaw Memorial Medal had been awarded to Mr. Stanley Peat for his special work on the analysis of the old Chinese alloy, "Tutaneg."

A paper was read by Mr. W. S. Coates on the "Utilisation of Low Grade and Waste Fuels in Power Production." The paper dealt with the methods adopted by The Newcastle-on-Tyne Electric Supply Co., Ltd., to produce electrical energy at a very low cost. The company produces the highest amount of power per pound of coal burnt, the fuel used being largely low-grade coal containing a high ash content (up to 30 per cent.) and of relatively low calorific power. This fuel is, as a rule, of very small size, about 40 to 50 per cent. passing through ¼-in. mesh sieve. The paper was illustrated by slides, which depicted the various boilers, grates and automatic pulverisers utilised.

SOCIÉTÉ DE CHIMIE INDUSTRIELLE

On November 30, the Economic Group met, under the presidency of M. Duchemin to hear an address by Prof. H. Hauser, on "American Industry."

Prof. Hauser, who has recently been "exchange professor" at Harvard University, said that the dominant character of American production is the attempt to obtain the maximum yield with the minimum of effort. The rhythm of industrial life in America is accelerated, and everything is organised to maintain that acceleration by speeding up methods of working. After describing means of transport, Prof. Hauser indicated the importance given to technical education in the universities, to which are attached veritable works with admirable equipment. Another impression remaining from a stay in the United States was the immensity of that country's resources, whether in minerals or crops. The use of electricity was a common feature of daily life, and this favoured the installation of enormous electric generating stations, some of which even now were not charging prices more than those of 1913. However, as everything is directed towards maximum output without care of rational utilisation, there is an immense wastage of raw materials. Coal is extracted by defective processes, the intensive manufacture of wood pulp is carried out without care to conserve the forests, and the production of petrol is insufficient in comparison with the development of the engineering and motor car trades. In contrast to the wastage of raw materials the greatest care was taken to economise labour, to maintain the productive capacity of each workman at its best and to close the country to immigrants unsuited to industrial life. A consequence of this economy of labour is the extraordinary development of machinery to reduce the human factor as far as possible, *e.g.*, in the Taylor system. Great importance is attached to social work, and workers' representatives play an important part when questions were discussed, not only relating to wages, but also to the management of the works.

The general impression gained by Prof. Hauser was that the prosperity of the United States depended on the vast absorption capacity of the interior markets, so that the question of exportation was of secondary importance. But the acceleration of production could surpass this capacity of absorption, which has, so far, not been affected by the increases in wages. If the appreciation of the dollar continues to limit exportation, a renewed interest by the United States in European economic interests might not be impossible in the future.

ACADÉMIE DES SCIENCES

M. Friedel read a paper on November 26, on certain black inclusions in diamonds, the inclusions being shown to be lamellæ of graphite. At the end of the meeting, Prof. Aimé Cotton was elected a member of the physical section, in place of the late Prof. Violle.

On December 4, M. Jentil communicated a note by M. Lazareff, on magnetic anomalies in Russia, shown over two bands, 200 km. long and 50 km. apart, and due to the presence of iron. Iron ore has actually been discovered at a depth of 500 ft., the mineral containing 40 per cent. of iron, the percentage increasing in depth. The author claimed that this deposit was the largest yet found, as it was calculated to contain 16 times the total mass of iron of the rest of the world.

The Abbé Senderens described some researches on the catalytic dehydration of hydroaromatic alcohols, by means of which he has obtained little-known aromatic compounds.

M. d'Arsonval announced that the Cie. Générale d'Electro-ceramique had constructed a high-tension laboratory for research on currents of 1,000,000 volts.

On December 10, Monsieur Bigourdan communicated a paper by M. Henry, describing a self-registering thermo-electric actinometer, similar in principle to that of Arago, in which the difference in temperature between two black spheres placed in a vacuum is measured by means of a thermo-couple of great sensitivity.

Dr. Roux communicated a paper by MM. Girond and Durand of the Pasteur Institute, Tunis, on certain streptococci which produce colour when cultivated anærobically in the presence of starch.

Prof. Le Chatelier described work by Prof. Matignon, indicating that mono-sodium aluminate, zirconium silicate and aluminium nitride are worthy of consideration as refractory materials.

At the conclusion of the meeting, Monsieur Bigourdan was elected president, Monsieur L. Bouvier, vice-president for 1924, and MM. E. Picard and A. Lacroix were elected as perpetual secretaries.

From the Lontreuil Bequest 10,000 francs was awarded to the Central Electrical Laboratory of Paris for researches on the standard international ohm; 10,000 frs. to the international committee of tables of constants, and 5000 frs. to the Office Central de Chauffe Rationale, for work on the industrial measurement of high temperatures.

BIRMINGHAM UNIVERSITY CHEMICAL SOCIETY

A lecture entitled "From Test-tube to Tank Wagon in Three Years" was delivered by M. A. Appleyard, M.Sc., of Bristol University Fruit Research Station, at the meeting on December 3, Prof. G. T. Morgan, F.R.S., presiding.

After a summary account of the production of higher alcohols by fermentation, Mr. Appleyard discussed the cultural characteristics of the acetone organism with which he had carried out the Weizmann process in England and in India. The method of sub-culturing the organism, and the best way to secure a virile culture, were described. The mechanism of the reactions which take place when carbohydrate is fermented with the acetone organism was considered, and emphasis was laid on the necessity for further work on the question of the nitrogen nutrition of this bacillus.

The reasons for failures to ferment wort successfully in the early stages were attributed to the fact that sufficient protein was often absent from the wort. The importance of Dr. Thaysen's discovery of *Bacillus volutans* was commented upon, and a tribute was paid to the work of Dr. H. B. Hutchinson, Dr. A. C. Thaysen, Mr. F. Hirst, and Mr. A. Gill, B.Sc., who did a great deal to make the Weizmann process a success on a large scale. Experience indicates that the types of infection against which it is imperative to guard are those found on the grain itself, and success with the process is measured by the extent to which such infections can be destroyed or suppressed.

A description was given of the types of cookers, vats, stills most suitable for the process, and slides were shown illustrating various acetone plants in England, Canada and India. Owing to recent developments in America by the Commercial Solvents Corporation of New York, it was more appropriate now to refer to this process as the butyl alcohol process. A large number of butyl derivatives which are being used to a large extent in the United States were exhibited. The large development of the nitro-cellulose industry in the United States was referred to in some detail, and the steps taken by the Commercial Solvents Corporation of New York—the assignees of the Weizmann patents—to meet the needs of this industry were described. The United States can consume annually for known uses no less than 6000 tons of high boiling solvents; Germany consumes from 600 to 800 t.; whilst Great Britain requires about 400 to 500 t. a year. Probably about 80 per cent. of the butyl alcohol produced is converted into and used as butyl acetate, which is a satisfactory substitute for amyl acetate as a solvent of nitro-cellulose. Other uses are constantly being suggested, and there is little doubt that in a short time many butyl derivatives recently made available in large quantity will be found useful in industry.

INSTITUTION OF ELECTRICAL ENGINEERS

On December 13 a paper on "Pulverised Fuel and Efficient Steam Generation" was read by Mr. D. Brownlie, B.Sc., M.I.Chem.E.

The first mention of pulverised fuel dates as far back as 1820, and remarkable work was carried out by T. R. Crampton, of London, in 1868, but pulverised fuel was first used on a large scale in the cement industry, especially in the United States, shortly after 1890, and to-day about 90 per cent. of the cement of the world is made with pulverised coal. The present total consumption of pulverised coal for all purposes in the United States and Canada, but particularly in the cement, iron and steel, and glass industries, is now over 30 million t. per annum. Little progress was made in application to steam generation in the United States until 1913, the real development commencing in 1920 with the Lakeside plant at Milwaukee. The general principles of the process consist in crushing the coal, passing it over a magnetic separator to remove iron, drying down to 1–2 per cent. moisture, and pulverising in ball mills so that 90 per cent. will pass through a 100-mesh screen (100 holes per linear in.) and 65 per cent. through a 200-mesh screen. The pulverised coal is conveyed to bunkers, and then to "feeders," which mix the coal with 10 per cent. of the air required for combustion and deliver it to the burners, in which 90 per cent. of the air, preheated to a high temperature, is then added. The result is an intensely hot flame of over 2000° F. with complete combustion, 17–18 per cent. carbon dioxide and entire absence of smoke.

The "Lopulco" system of pulverised fuel embodies many improvements, the chief being the water screen (a series of water-cooled 4-in. steel tubes in the bottom of the furnace), which prevents the ash becoming molten. Further, cold air circulating through the hollow brickwork becomes heated to 300-700° F., and is used to supply the 90 per cent. of secondary air to the burners. The average efficiency with which 90 million t. of coal is burnt per annum in the steam boilers of Great Britain is less than 60 per cent., representing an avoidable loss to the country of 20 million t. of coal per annum. In Great Britain, apart from three small installations, only one large boiler plant, that of the Hammersmith Electricity Station, uses pulverised coal.

The advantages of pulverised coal include:—Higher boiler-plant efficiency; complete combustion of the ash; the fuel is free from moisture; convenient of transport in the boiler house; flexibility of the steam output of the boiler, permitting overloads of 100 per cent. for long periods; reduced stand-by and banking losses; greater ease of scientific control; and reduced labour costs. The various disadvantages, such as excessive power consumption, wear and tear and risk of breakdowns; danger of explosion and spontaneous combustion; troubles with the ash; and higher capital cost as compared with mechanical stoking, are now proved, as the result of experience, to be almost entirely avoidable.

Extraordinary efficiencies are obtained with pulverised coal. Lakeside is running regularly at 85–86 per cent. boiler plant efficiency, and 89 per cent. has been obtained on ordinary short tests. The loss of heat in the chimney base is only 8 per cent. Labour costs with pulverised coal are approximately 20 per cent. less than with mechanical stoking; and the unburnt material in the ash of pulverised coal is 0·40–0·75 per cent. carbon, whereas the best stoker figures are 2 per cent. with 3–5 per cent. for a large number of stations.

The quality of the coal that can be burnt varies enormously, so that differences in the heating value do not affect the efficiency of the plant, on the contrary, to mechanical stoking. It is difficult to obtain authentic figures for the capital cost, but roughly there is not much difference between pulverised coal and mechanical stoking.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

The monthly meeting of the Council was held at the Offices of the Association on December 13, 1923, Sir Max Muspratt presiding.

The Council extended its congratulations to Sir William Alexander, Sir John Brunner and Dr. G. C. Clayton on their election as Members of Parliament.

Dr. A. Ree presented a report of a conference which had been arranged by the Trade Marks, Patent and Designs Federation to consider the International Industrial Property Convention of 1883, which regulates international relations in industrial property matters and which is due to be revised in the near future. It appears that at the conference certain resolutions were passed including one recommending the abolition of revocation of patent rights either for non-working or for abuse of monopoly rights, but permitting each country at its discretion to grant compulsory licences in such cases. Another resolution was opposed to a proposal as to the desirability that the laws of the Convention Countries should contain an uniform clause providing that no patent be granted in respect of:—(*a*) Products resulting from the combination of defined chemical elements; (*b*) pharmaceutical products; or (*c*) patent medicines of all kinds. The Council was strongly opposed to these recommendations and the General Manager was instructed to convey this decision to the Trade Marks, Patents and Designs Federation.

In connexion with the British Empire Exhibition the General Manager reported that a contract had been entered into with Messrs. Gaze & Sons, Ltd., for the erection of the shell stands in the Chemical Section.

A report from the Transport Manager indicated that the conditions of carriage of merchandise by merchandise train at owners' risk had been approved by the Railway Rates Tribunal after being agreed between the railways and the traders' representatives. The question of the retention of exceptional rates in accordance with Section 36 of the Railways Act, 1921, has also been the subject of negotiation with the railway companies and it is hoped to be able to announce a definite settlement of a scheme to deal with the matter at the end of the present week.

CORRESPONDENCE

COLOUR EFFECTS

Sir,—Referring to the extremely interesting article by Mr. Rex Furness in your issue of November 23, it seems to me that he overworks the words "disperse" and "dispersion" in connexion with colour effects. Why disregard the old doctrine of interference, as, for instance, in the case of "Newton's rings," and the colours of the peacock and of selective absorption as in the case of atmospheric effects?

Spectrally, a blue sky is simply a minus yellow. The spectrum gives every colour in the rainbow, but a comparative dimness in the yellow. In other words, not the normal amount of yellow light. Now, in a transparent or partially transparent medium like the air, it is inevitable that the same medium that reflects one colour from white light should show the complement of that colour to an observer looking at the course of the light through the medium. For instance, in the evening, the prevailing colour on the side away from the sun is bluish and on the side toward the sun yellowish or reddish. Nevertheless, these tints are modified by the actual absorption of a certain amount of light, but generally speaking, white light is analytically divided: part of it is reflected and part transmitted.

In connexion with the subject of camouflage and in particular of concealed insignia at the time of the world war, I made some study of pigments and dyes and found three things:—

First, natural colours are never monochromatic.

Second, pigments are never monochromatic although some, as for instance ultramarine, are quite nearly so. By ultramarine I mean the artificial lapis lazuli.

Third, synthetic dyes are more nearly monochromatic than natural colours. They show practically a total absence of certain parts of the spectrum and by a very careful study and selection of dyes and of colour screens, determined by actual spectrum analysis of both, very interesting and extraordinary effects can be obtained.

I was shown in the laboratory of Mr. Pevear, the colour expert who arranged the colour effects in the great celebration of the Massachusetts Institute of Technology in the year 1917, three yellows indistinguishable by the naked eye, of which one was simply a minus violet, showing every colour in the spectrum excepting violet ; another was a monochromatic yellow; and the other contained no yellow, but was simply a mixture of blue and green. I was shown at the Bureau of Standards in Washington a brilliant canary yellow shade of paper on which, to the naked eye, there was not the slightest trace of any marking of any kind or sort, and on looking at it through a yellow colour screen writing appeared as black as ebony.—I am, Sir, etc.,

Godfrey L. Cabot

Boston, Massachusetts
Dec. 7, 1923

TURKEY RED OIL

Sir,—I should be obliged if any of your readers would give me any information regarding "Turkey Red Oil," its price and where it is obtainable.—I am, Sir, etc.,

R. J. C.

Dec., 16, 1923

PERSONALIA

Monsieur Mailag has been appointed professor of industrial chemistry, and Monsieur Calerns, professor of agricultural chemistry in the University of Toulouse.

The Royal Academy has formed a committee of artists and scientists to investigate the qualities of artists' materials and the various methods of cleaning old pictures. The committee includes the following scientific members : Prof. A. P. Laurie, Sir H. Jackson, F.R.S., Sir A. Schuster, F.R.S., Dr. A. Scott, F.R.S., Mr. C. F. Cross, F.R.S., Dr. R. S. Morrell and Mr. N. Heaton.

* * *

We regret to announce the death, on December 18, of Prof. F. Clowes, at the age of eighty-five. Prof. Clowes occupied the chair of chemistry at University College, Nottingham, from 1881 to 1897, when he became chemical adviser to the London County Council, and since 1913 he had been expert adviser on gas supply to the Corporation of London. He was President of the Society of Chemical Industry in 1897–1898, a vice-president of the Institute of Chemistry, and an active member of other scientific bodies. He was the author of standard textbooks on analytical chemistry, and published a number of investigations bearing on analysis, the bacterial treatment of sewage, and the estimation of gases in the air.

NEWS AND NOTES

BRITISH INDIA

Second Forecast of the Sesamum Crop, 1923-24

According to reports received from provinces which contain an average of 99·6 per cent. of the total area under sesamum, the area so far reported under the crop is 3,016,000 acres, as compared with 3,432,000 acres at this time last year, a decrease of 12 per cent. The present condition and prospects of the crop are, on the whole, reported to be fair.—(*Ind. Tr. J., Oct.* 25, 1923.)

Second Forecast of the Sugar-cane Crop, 1923-24

The area planted to sugar-cane in provinces which contain on an average 99 per cent. of the total area under sugar-cane, is estimated at 2,787,000 acres, as compared with 2,460,000 acres at this time last year, an increase of 13 per cent. The weather has not been unfavourable to the crop, and present prospects, on the whole, are satisfactory.—(*Ind. Tr. J., Oct.* 25, 1923.)

CANADA

Pulp and Paper Industry

There were 104 pulp and paper mills in operation in Canada in 1922, the total net value of the production being $155,785,388, according to a preliminary report issued by the Dominion Bureau of Statistics. The amount of capital invested in the industry increased from $379,812,751 in 1921 to $381,006,324 in 1922. The number of employees in the pulp and paper industry in 1922 was 25,830, whilst wages and salaries amounted to $32,918,955. More than 50 per cent. of the exports of pulp. wood was supplied by the Province of Quebec.

UNITED STATES

The Use of Glue in Coating Paper

The Bureau of Standards is carrying out some experiments dealing with the use of glue in coating paper. Nine runs have been made on the experimental coating machine, using two makes of bone glue for eight of the runs and a French casein glue for one. A good grade of English coating clay (Lee Moor) was used for all runs, and the results indicate that the water resistance of glue-bound coating containing chrome alum, compares favourably with that of casein-bound paper containing no formaldehyde. It is believed that the degree of waterproofness will prove sufficient for most of the papers used in half-tone printing. Difficulties have been experienced in obtaining a uniform coating, because of variation of the fluidity of the coating mixture, and mechanical defects in the machine, so that additional work will be necessary before paper suitable for printing tests can be produced.—(*Chem. & Met. Eng., Oct.* 22, 1923.)

REVIEWS

Motor Fuels, their Production and Technology. *By* E. H. Leslie, Ph.D. *Pp.* 681. *New York: Chemical Catalog Co., Inc.*, 1923. *Price* $7.

To the many books dealing with petroleum, published during the last few years, particularly in the United States, that under review is certainly an important addition.

The author, Dr. Leslie, fully explains his aim and objects in an excellent preface. A study of the book will demonstrate how well these have been achieved. Perhaps the most striking feature of the book is the critical attitude adopted by the author. Realising that "the tendency of the human mind is to travel in ruts" and that "too often much ingenuity is extended in trying to perfect an apparatus which is inherently incorrect," he points out the necessity for an accurate knowledge of the underlying principles of physics, thermodynamics and chemistry. In the chapters dealing with plant construction and operation, he points out the application of these principles, exemplifying this by the critical study of actual plants.

The book opens with an introductory chapter in which the development of the petroleum industry and the problem of future supplies of motor fuel are briefly discussed. This is followed by a chapter on the composition of petroleum, which, however, deals practically only with the crudes of the Western hemisphere, many interesting types of crudes of the Old World receiving no mention.

Chapter III gives a short summary of the working-up of crude oils in the refinery, which is quite sufficient for the purposes of the book.

Chapters IV to VII deal with the manufacture of motor fuels, the principles of the theory of fractional distillation and their applications being fully discussed. The application of the laws of fluid flow and heat transfer to the refining plant is also well treated, the difficulty of the subject being fully recognised.

The chapter on refinery equipment is very good, the modern types of plants are described, and important practical details dealt with. His condemnation, "Distillation equipment now in general use in the petroleum industry can hardly be said to be better than crude," is too often well merited.

An interesting chapter on the thermal reaction of hydrocarbons leads up to a description of the chief cracking processes which have actually been in use.

The question of the chemical refining of gasoline is fully discussed and the modern methods of refining, such as the Edeleanu, silica gel and hypochlorite processes are described.

A chapter on the natural gas industry concludes the portion of the book which deals specifically with petroleum products.

In a short chapter the production and manufacture of alcohol and its possibilities as a motor fuel are discussed. This is followed by a short chapter on the more interesting of the composite motor fuels, such as Natalite and Alcogas.

The latter quarter of the book deals with specifications, methods of analysis, with tables of useful data, constants, etc.

As specifications are liable to change from time to time and as these and the methods of analysis are so readily accessible in the publications of the "United States Bureau of Mines," of the American Society for Testing Materials, etc., the chapters dealing with these form the least valuable portion of the book. As many of the data given in Chapter XVII, however, are not readily available elsewhere, this chapter is one of considerable value.

On the whole the book confines itself rather to American practice and American oils. It is up to date and includes most modern work of interest. It is a pity that a section was not devoted to the use of motor fuels and the behaviour of the various types of hydrocarbons and other fuels in the automobile engine. No mention is made of the important work of H. Ricardo in this connexion published in the *Automobile Engineer* in 1921. The book is well printed and the copious references to the literature of the subject should prove very useful. It is certainly one of the most useful books that the reviewer has come across, and the author is to be congratulated on the mass of useful information contained therein, and on the way in which the subject is handled.

J. Kewley

Coke and Its Uses, in Relation to Smoke Prevention and Fuel Economy. *By* E. W. L. Nicol. *Pp. xii*+132. *London : E. Benn Bros., Ltd.*, 1923. *Price* 19*s*. 6*d*.

This is a somewhat short treatise in non-technical language, dealing with the use of coke, particularly from the point of view of steam and power generation (other than gas producers), being essentially a plea for the use of coke instead of raw coal. Mr. Nicol, who, as is well known, is the engineer and fuel expert to the London Coke Committee, is naturally an enthusiast on the subject, but in view of his long and specialised experience very few people indeed are better qualified to write a book of this character.

For steam generation, coke, provided the moisture content is not over, say, 7-8 per cent., is a most excellent fuel, and Mr. Nicol states the general advantages concisely and without exaggeration. In fact, more might be made of this aspect ; thus, for example, coke as a rule gives a granular ash which consequently is easy to clean out. Some of the prejudices that still exist against the use of coke, such as that it corrodes boilers, and "has had all the nature taken out of it," are dealt with trenchantly

In this connexion Mr. Nicol states that prior to 1913 the use of gas coke as fuel for steam raising was practically unknown outside the gas industries, which is rather a neat, and presumably unconscious, commentary on the characteristic lack of enterprise and imagination displayed by the gas industry in the matter. During the past century millions of tons of coke breeze have been simply thrown away, and apparently millions of tons of gas coke sold at a price much below their true value, for want of organisations such as the London Coke Committee, which was only founded ten years ago. A considerable space is, quite rightly, devoted to the "sandwich" system for burning coke and coal, and although this is generally applied to chain-grate stokers, it is interesting to learn the same principle will work with the "Underfeed Type E" stoker. Unquestionably we shall have to devote more attention to the efficient burning of refuse fuels in these hard times, and mounds of coke breeze are one of the best arguments for a more progressive policy on the part of the steam user in general.

Mr. Nicol does not discuss the most serious objection to coke, the varying moisture content, and as far as can be made out all his comparisons with coal are based on coke of 12,000 B.Th.U., and 5 per cent. moisture. To anyone who has had much practical experience of coke this seems hardly fair, and whilst for example with dry coke 9½ lbs. of water can be evaporated per lb. of coke, the consumption being 20 lbs. per square foot of grate area per hour, most commercial coke will not do this. The book is extremely well printed on excellent paper, and the illustrations are adequate, but it somehow gives the impression of being "skimpy," and the index could be improved.

David Brownlie

COMPANY NEWS

THE BRITISH CYANIDES CO., LTD.

The directors take advantage of the opportunity afforded by the payment of the preference dividend to give shareholders a brief account of the company's progress. At the annual general meeting in July last, the chairman stated that an interim dividend on the ordinary shares would be considered before the end of the year, subject to the proviso that the conditions of trade did not depart from the normal to any great extent. Unfortunately, conditions have been by no means normal since then, and the directors, therefore, do not feel justified in declaring a dividend. The plant for the manufacture of permanganate of potash was started up last August and is earning revenue. The first unit plant for the fixation of atmospheric nitrogen, mentioned at the annual meeting, has been installed and was started up in November. The process is producing and promises well, and further units are being installed.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for Dec.* 13)

OPENINGS FOR BRITISH TRADE

The Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1) has received the following inquiries from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Aden ..	Photographic accessories	630
Australia ..	Hardware, crockery ..	631
,, ..	Tinplate, crockery, hardware, glassware, building materials	631 *
,, ..	Engineering supplies, builders' requisites	412/7/1/1/189
Belgium ..	China, crystal glass, earthenware	**
Canada ..	Liquid chlorine ..	12639/E.D./E.C./2
Egypt ..	Paint, oil (tender) ..	11944/F.E./C.C.
,, ..	Drugs, chemicals (tender)	11945/F.E./G.C.
France ..	Rubber goods.. ..	639
Japan ..	Galvanised sheets ..	11490/74/F.E./E.C./2
Netherlands	Heavy chemicals ..	640, 641
New Zealand	Ironmongery, hardware	634
,,	Wrapping paper (tender)	12746/E.D.
South Africa	Paper, leather, electrical material	635, 636, 637
Tripoli ..	Sugar	654
United States	Steel	656
Uruguay	Tiles, paint, varnish, paper	9061/F.L./M.C./2

* Mr. A. W. Robinson, 46a, Market Street, Sydney, N.S.W., Australia.

** The Belgian Chamber of Commerce, 24, St. Dunstan's Buildings, St. Dunstan's Hill, E.C. 3.

TARIFF CUSTOMS EXCISE

Australia.—The application of the duty on metal cordage, paper, and iron and steel has been further postponed.

Bulgaria.—Imports of artificial fertilisers are allowed duty-free.

Italy-Spain.—Reduced duties are prescribed for Spanish citric and tartaric acid and rubber imported into Italy, and for Italian fish oil and skins imported into Spain.

Poland.—A list is given in the current issue of reduced duties on certain articles imported from the United Kingdom.

Rumania.—The import duty on rubber goods is increased.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The heavy chemical market maintains a steady tone, both home trade and export continuing to take tolerably satisfactory quantities. Prices are firm.

Acetic Acid. 40% tech. ..	£24 per ton. Fair inquiry.
Acid Hydrochloric ..	3s. 9d.—6s. per carboy d/d., according to purity, strength and locality.
Acid Nitric 80° Tw. ..	£21 10s.—£27 per ton makers' works, according to district and quality.
Acid Sulphuric	Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 65s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
Ammonia Alkali ..	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder ..	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime ..	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride ..	£5 17s. 6d. per ton d/d.
Potash Caustic	£30—£33 per ton.
Potass. Bichromate ..	5¾d.—6d. per lb.
Potass. Chlorate ..	3d.—3½d. per lb.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76% ..	£17–£19 10s. per ton, according to quality.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98% ..	£24 per ton.
Sod. Bicarbonate ..	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96% ..	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£27 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Prices in this section are unchanged.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide ..	4s. 9d. per lb.
Carbon Bisulphide ..	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide ..	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark ..	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite ..	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

With the exception of acetates of lime and lead the demand for wood distillation products keeps below normal. Naphthas are an unsettled market.

Acetate of Lime—	
Brown	£14—£14 10s. per ton d/d. Demand active.
Grey	£22 per ton.
Liquor..	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£9 per ton, according to grade and locality. Market quiet.
Iron Liquor	1s. 7d. per gall. 32° Tw. 1s. 2d. ,, ,, 24° Tw.
Red Liquor	10d.-1s. ,, ,, 14/15° Tw.
Wood Creosote	2s. 7d. ,, ,, Unrefined.
Wood Naphtha—	
Miscible	5s. 6d. per gall. 60% O.P. Competition being met with.
Solvent	6s. per gall. 40% O.P. Fair demand.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead ..	£42—£43 per ton. Demand more active.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. per lb. Weaker, with limited demand.
Crude 60's	2s. 9d.—3s per gall. Little business passing.
Acid Cresylic, 97/99 ..	2s.—2s. 1d. per gall. Firm, with good demand.
Pale 95%	1s. 10d.—2s. per gall.
Dark	1s. 7d.—1s. 10d. per gall. A little inquiry for forward delivery.
Anthracene Paste 40%..	4d. per unit per cwt. Nominal price. No business.

Anthracene Oil—	
Strained	9d.—10d. per gall. Better demand. Little material available.
Unstrained	8d.—9d. per gall. Quiet.
Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Benzole, Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 3d.—1s. 4d. per gall.
Pure	1s. 9d.—1s. 10d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil	8½d.—9½d. per gall. according to grade and district. Market very firm.
Heavy	
Standard Specification	
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 1d.—1s. 2d. per gall. Market weak.
Solvent 90/190	1s. 1d.—1s. 3d. per gall. Business quiet.
Naphthalene Crude—	
Drained Creosote Salts	£5—£8 per ton. Demand increasing. Market scarce.
Whizzed or hot pressed	£9—£11 per ton. Quiet.
Naphthalene—	
Crystals	£19 per ton.
Flaked	£19 per ton.
Pitch, medium soft	100s.—105s. per ton. Rather more inquiry, but little business passing.
Pyridine—90/140	22s.—23s. per gall. Demand easier.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

The slight improvement in dyestuffs business has been maintained, but orders are still only for small quantities.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 7d. lb. 100% basis d/d.
Acid Naphthionic	2s. 6d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Much better demand.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—10d. per lb. naked at works.
Aniline Salts	9½d.—10d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 7d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Demand quiet.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dimethylaniline	2s. 6d. per lb. d/d. Drums extra.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£83 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
α-Naphthylamine	1s. 6d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 6d. per lb. d/d.
Nitrobenzene	5¾d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	11¾d. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 6d. per lb. d/d.
p-Phenylene Diamine	10s. 6d. lb. 100% basis d/d.
R. Salt	3s. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8d. lb. 100% basis d/d.
o-Toluidine	7d.—8d. per lb.
p-Toluidine	4s.—4s. 6d. per lb. d/d.
m-Toluylene Diamine	4s. 6d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The demand is falling off as the end of the year approaches, but further appreciation in prices may be expected after the holiday period.

Acid, Acetic 80% B.P.	£48 10s. per ton.
Acid, Acetyl Salicylic	3s. 7d.—3s. 9d. per lb. Price hardening. Some makers asking 4s. In very steady demand.
Acid, Benzoic	B.P. quality almost unobtainable. Commercial quality offered forward at 2s. 3d. per lb. for cwt. lots. Makers fully sold ahead.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Camphoric	17s.—19s. per lb.
Acid, Citric	1s. 5½d. per lb., less 5%, for ton lots. Dearer.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	6s. per lb. for 28 lb. lots.
Acid, Salicylic	2s. 6d.—2s. 7d. per lb. Very firm market. Makers hard pressed to meet demand.
Acid, Tannic	3s. 3d. per lb. for B.P. quality. Very firm.
Acid, Tartaric	1s. 1½d. per lb. less 5%. Firmer. More inquiry for forward delivery.
Amidol	9s. per lb. d/d.
Acetanilide	Advanced to 3s. 6d. per lb. on a short market.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	4s. 3d.—5s. per lb. for English make. Cheaper than other benzoates.
Ammon. Carbonate B.P.	£27 15s. per ton.

Atropine Sulphate	12s. 6d. per oz. for English make. Dull market.
Barbitone	18s. per lb. Without much inquiry.
Benzonaphthol	6s. per lb. Very much firmer.
Bismuth Salts	A steady market. Prices according to quantity:
Bismuth Carbonate	12s. 9d.—14s. 9d. per lb.
,, Citrate	11s. 4d.—13s. 4d. ,,
,, Salicylate	10s. 2d.—12s. 2d. ,,
,, Subnitrate	10s. 9d.—12s. 9d. ,,
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	Per lb.
Potassium	9d.—10d. Remain very firm. Continental prices advancing.
Sodium	9½d.—10d.
Ammonium	10d.—11d.
Calcium Lactate	2s. 9d. per lb. for best English make. A better market.
Chloral Hydrate	4s. 3d. per lb. Position very firm and active.
Chloroform	2s. per lb. for cwt. lots. More active.
Creosote Carbonate	6s. 6d. per lb. Little demand.
Guaiacol Carbonate	Spot supplies very scarce. Present value 14s. per lb.
Hexamine	4s. 6d. per lb. for foreign makes. Manufacture in England has been discontinued since formaldehyde was removed from the dutiable list.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate, B.P.	1s. 11d.—2s. 3d. per lb., according to quantity.
Magnesium Carbonate—	
Light Commercial	£36 per ton net.
Magnesium Oxide—	
Light Commercial	£72 10s. per ton, less 2½%.
Heavy Commercial	£27 per ton, less 2½%.
Heavy Pure	1s. 6d.—2s. per lb., according to quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 62s. 6d. per lb.
Mercurials	Firm and likely to advance.
Red oxide	4s. 11d.—5s. 1d. per lb.
Corrosive sublimate	3s. 8d.—3s. 10d. ,,
White precip.	4s. 6d.—4s. 8d. ,,
Calomel	4s. 1d.—4s. 3d. ,,
Methyl Salicylate	3s. per lb. for carboys. Brisk market. Slightly advanced.
Methyl Sulphonal	22s. per lb.
Methylene di-tannin	7s. 6d. per lb. In good demand.
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 7d. per lb.
Phenacetin	7s. 6d. per lb. Steady market. English makers fully employed. Foreign supplies shorter.
Phenazone	8s. 9d. per lb. In short supply.
Phenolphthalein	8s. 6d. per lb. Very firm.
Potass. Bitartrate—99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Market firmer.
Potass. Citrate	1s. 8d.—2s. per lb.
Potass. Ferricyanide	3s. per lb.
Potass. Iodide	16s. 8d.—17s. 5d. per lb., according to quantity. Demand continues.
Potass. Permanganate	9d. per lb. for B.P. crystal English make. In good demand.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	5s. 6d.—5s. 9d. per lb. Neglected.
Salol	4s. per lb. In more plentiful supply.
Silver proteinate	10s. 6d. per lb. Quiet.
Sod. Benzoate	3s. 6d. per lb. Scarce.
Sod. Citrate, B.P.C., 1923	1s. 5d.—1s. 9d. per lb., according to quantity. Very firm, in common with other citrates.
Sod. Hyposulphite— Photographic	£14—£15 per ton, according to quantity, d/d. consignee's station in 1-cwt. kegs.
Sod. Nitroprusside	16s. per lb. Less for quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 11d. per lb., and Crystal at 3s. per lb. Firm and very active. Supplies still scarce.
Sod. Sulphide— Pure recryst.	10d.—1s. 2d. per lb., according to quantity.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	17s. 6d. per lb.
Thymol	13s. 6d.—14s. 6d. per lb. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 9d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine	3s. 3d. ,, ,,
Benzaldehyde free from Chlorine	3s. 3d. ,, ,,
Benzyl Benzoate	4s. ,, ,,
Cinnamic Aldehyde Natural	22s. 6d. ,, ,,
Coumarin	20s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	10s. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	37s. 6d. ,, ,,
Geraniol	6s to 13s. 6d. per lb.
Heliotropine	8s. 6d. per lb.
Iso Eugenol	15s. 9d. per lb.
Linalol ex Bois de Rose	20s. ,, ,,

Linalyl Acetate ..	.. 20s. ,, ,,
Methyl Anthranilate	.. 8s. 6d. ,, ,,
Methyl Benzoate	.. 6s. ,, ,,
Musk Ketone ..	.. 52s. 6d. ,, ,,
Musk Xylol ..	.. 19s. ,, ,,
Nerolin	.. 4s. ,, ,,
Phenyl Ethyl Acetate	.. 10s. ,, ,,
Phenyl Ethyl Alcohol	.. 16s. ,, ,,
Rhodinol.. ..	.. 60s. ,, ,,
Safrol	.. 1s. 10d. ,, ,,
Terpineol ..	.. 3s. ,, ,,
Vanillin	.. 25s. 3d.—26s. 6d. per lb. Firm with steady demand. Raw materials dearer.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A.	.. 14s. 6d. per lb.
Anise Oil.. ..	.. 1s. 11d. ,, ,,
Bergamot Oil ..	.. 13s. 3d. ,, ,, spot.
Bourbon Geranium Oil	.. 37s. ,, ,,
Camphor Oil ..	.. 75s. per cwt.
Cananga Oil, Java	.. 9s. 6d. per lb.
Cinnamon Oil, Leaf	.. 5¾d. per oz.
Cassia Oil 80/85%	.. 11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	.. 4s. 9d. ,, ,,
Ceylon.. ..	.. Very little on offer.
Clove Oil.. ..	.. 10s. 6d. per lb.
Eucalyptus Oil 70/75%	.. 2s. 6d. per lb.
Lavender Oil—	
French 38/40% Esters	24s. 6d. per lb.
Lemon Oil ..	.. 2s. 10d. per lb. Higher prices expected.
Lemongrass Oil ..	.. 2¾d. per oz.
Orange Oil, Sweet	.. 11s. 9d. per lb.
Otto of Rose Oil—	
Bulgarian ..	.. 34s. per oz.
Anatolian ..	.. 26s. per oz.
Palma Rosa Oil	.. 24s. 6d. per lb.
Peppermint Oil—	
English ..	.. 70s. per lb. Market very unsteady.
Wayne County	.. 15s. 6d. per lb. Market very unsteady.
Japanese ..	.. 12s. 6d. per lb. Market very unsteady.
Petitgrain Oil ..	.. 9s. 6d. per lb. Dearer.

TRADE NOTES

Exhibition of Educational Materials in Argentina

The Department of Overseas Trade is informed by the British Legation at Buenos Aires that the American Academy of History is organising an International Congress of History and Geography of America and exhibition of educational materials to be held in Buenos Aires in 1924.

The Academy invites all scientific and geographical institutions to participate, as well as manufacturers of and dealers in materials concerned in the supply of educational institutions, libraries, science laboratories, etc. Particulars of the scheme may be obtained from the Secretary of the Academy, Dr. A. E. de la Guardia, Academia Americana de la Historia, Buenos Aires.

Market News from Belgium

Prices of iron and steel products have a downward tendency, but the situation is uncertain. There are no signs of a fall in the price of coal, as there are no stocks at the mines, and importation is hindered by the appreciation of sterling. Coke is in very short supply. The situation in the plate-glass industry is excellent, and all the works are in full production. Window glass is in good demand, and orders have even been refused. Prices for bottles are very firm. There is a good demand for cement.

The British Fertiliser Industry

The report of the British Sulphate of Ammonia Federation for the year ending May 31, 1923, states that production increased by 50 per cent., exports by 58 per cent., and home deliveries by 3 per cent., as compared with the previous year. Exports were satisfactory during the last six months, although prices have declined. Many of the Canadian producers have joined the Federation.

The superphosphate industry continues to suffer from Continental competition, and several large factories have been closed for some months. Competition is felt chiefly from French, Belgian and Dutch makers.—(*Bull. F. B. I., Dec.* 4, 1923.)

PUBLICATIONS RECEIVED

Report on the Economic Conditions in South Africa. *By* W. G. Wickham. *Department of Overseas Trade. Pp.* 56. *H.M. Stationery Office*, 1923. *Price* 1*s.* 6*d.*

Arsenic, Calcium Arsenate and the Boll Weevil. *Articles and Addresses. By* H. W. Ambruster. *Pp. vi*+42. *New York: Barr-Erhardt Press, Inc.*, 1923. *Price* 50 *cents.*

Technical Writing. *By* T. A. Rickard. *Second edition, rewritten and enlarged. Pp. ix*+337. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.*, 1923. *Price* 10*s.*

Chemisch-Technische Vorschriften. *Part III. Harze, Ole, Fette. By* Dr. Otto Lange. *Third edition, revised and enlarged. Pp. xix*+796. *Leipzig: Otto Spamer*, 1923. *Price, paper* 50 *goldmarks, bound* 75 *goldmarks.*

Sands and Crushed Rocks. *Vol. I. Nature, Properties and Treatment. Pp. xiv*+475. *Vol. II. Uses in Industry. Pp. ix*+281. *By* A. B. Searle. *London: H. Frowde, and Hodder and Stoughton*, 1923. *Price* 52*s.* 6*d.*

Fifth Report on Colloid Chemistry, and its General and Industrial Applications, *Department of Scientific and Industrial Research. British Association for the Advancement of Science. Pp.* 130. *London: H.M. Stationery Office*, 1923. *Price* 2*s.* 6*d.*

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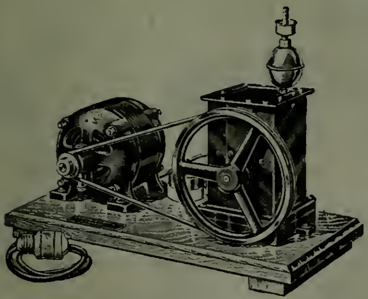
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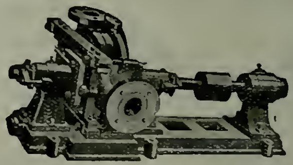

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JOURNAL *of* THE SOCIETY OF CHEMICAL INDUSTRY

CHEMISTRY & INDUSTRY

Official Organ of the Federal Council for Pure and Applied Chemistry

Vol. 42 NEW SERIES London, December 28, 1923 No. 52

EDITORIAL

FARADAY discovered benzene in the year 1825, and the number of derivatives prepared from benzene is infinite. Ought we not to celebrate in some worthy manner the hundredth anniversary of this discovery? The occasion is noteworthy, and Faraday himself was a great man; this was not the greatest of his discoveries, he made many of supreme importance, but this one is the most significant in the domain of pure chemistry and can be identified with one particular date. The Faraday Society keeps his name before us and plays an important part in promoting knowledge of the frontiers of chemistry and physics, but we think some additional prominence should be given to the achievement of Faraday as a chemist, and that chemists might profitably consider in their leisure moments the most fitting means of celebrating the anniversary. Will our readers give the chemical world the benefit of their suggestions? It is not too early to consider the matter; if the thing is to be done, and done well, a good deal of organisation and publicity will be necessary.

* * *

It has been borne upon us of late that the pessimism regarding the status of chemistry in the public esteem is, perhaps, rather exaggerated. Before the war it was reasonably true to say that our wasted oil unprofitably burns, like hidden lamps in old sepulchral urns, but now we are inclined to think that the effect of this long-continued combustion is beginning to be perceptible—dimly, it may be, but still perceptible. Our readers will already have seen a headline in their favourite daily paper announcing the election of a new President of the Swiss Federation. But in the gloom and cold of these winter mornings such an announcement would hardly earn anything more than a casual glance. Yet it indicates a unique event, for it is the first time that a chemist has attained such a position of dignity. Monsieur Ernest Chuard, the new President, was professor of industrial chemistry at Lausanne when he was elected Federal Councillor in 1914, and since then he has been the head of the Finance Department. As far as we remember, one or two scientists have occupied high public positions; and we all know how journalists are favoured candidates for the Presidency across the Atlantic; but the news that a chemist has been chosen as the highest official in a modern and important State cannot fail to rejoice our hearts. We will not pause to consider how significant it is that the new President is, or was, concerned with industrial and not academic chemistry, as there should be no need of the distinction. We can safely point out that the Swiss are practical people, of great administrative ability, so that their choice of a chemist as their President implies that they, at least, do not consider that a knowledge of chemistry unfits a candidate for the highest office.

* * *

Hard upon the announcement recorded above come other cuttings from the daily Press that are of interest. At the Distribution Day dinner of the Salters' Company, Lord Askwith pointed out how industry was crying out for the help of science, but that science could do little unless industry also came to its help. He then showed how the Salters' Company was trying to bring science and industry together, and said that from the Salters' Institute great things would be expected. This is a spirit which should be far more common than it is. Memories of past inactivity, of neglected opportunities of applying science are far too abundant. We recorded in a previous issue the statement that somewhere in the '60's the Government of the day rejected experiments on the preservation of building stone because an expenditure of £150 would have been necessary; but the lack of permanence of certain artists' materials has been obvious, not only in Turner's pictures, but ever since the days of Leonardo da Vinci, whose experiments have, unfortunately, deprived us of more than one masterpiece owing to the lack of durability of his materials. Possibly it was necessary to wait for the present state of knowledge of oils, varnish and pigments before the question could be examined scientifically, but we are glad that, at last, the Royal Academy has appointed a committee, including both scientists and artists, to investigate the qualities of artists' materials and the various methods of cleaning old pictures. The composition of the committee warrants the hope that definite knowledge will be forthcoming to replace the empiricism that hitherto has characterised the choice of materials which serve to preserve the fleeting moment for the delight and instruction of future generations.

* * *

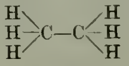
The Press, it will be realised, is now paying rather more attention to the doings of chemists, and it is all to the good that the public should be told that, for instance, the services of Dr. Alexander Scott and of Mr. A. Lucas are considered necessary to ensure the preservation of the objects found in the tomb of Tutankhamen. Dr. Scott has already done valuable work on the restoration and preservation of objects in the British Museum, and Mr. Lucas has, we understand, had similar experience during his directorate of the Egyptian Government Laboratory, Cairo; so it is to be hoped that as the "new" knowledge—too often "new" only in the sense of lacking application—spreads, we may be spared the sight of melancholy ruins displayed to our dismay in museum cases. Some attempts to record scientific events in the daily Press have been far from happy, however. A little time ago we were shown an illustration depicting a laboratory in which a chemist, supposed to be testing rubber, was pouring a fluid on a complete motor tyre, which he held easily at arm's length, and, more recently, the Press reports of one of our own Sectional meetings were not quite satisfactory. Prof. Ling recently gave a valuable review of the history of fermentation, particularly as applied to the brewing industry, at a meeting of the Nottingham Section. There was no lack of interesting points that could have been utilised in preparing a short account for public consumption, but apparently appreciation of these points was lacking, for a great London evening newspaper headed its note "Brewing in 1998 B.C.," which was repeated by a provincial paper, with the sub-heading, "What Ching-Young taught the Chinese." Our newspaper magnates are supposed to know exactly what the public wants, but we are indeed surprised to find that the history of science is so much appreciated. Yet we must be thankful for so much as this, for it is a beginning, and, for the present, that must suffice. It is well, however, to note that there is a slight period of three thousand odd years which remains to be bridged.

THE ACTIVATION OF HYDROGEN IN ORGANIC COMPOUNDS*

By EDITH HILDA USHERWOOD, Ph.D.

As a result of recent work on heavily substituted derivatives of ethane, everyone is now familiar with the idea that the strength of the carbon-carbon bond can be so diminished, that there is a progressive tendency towards dissociation in solution into two radicles, on passing, for instance, from ethane, through hexaphenylethane, which exists partly as triphenylmethyl in solution, to still more heavily substituted ethanes, for example tetraphenyldi-α-naphthylethane, which exists almost entirely as diphenyl-α-naphthylmethyl in solution (Gomberg and Schoepfle, *J. Amer. Chem. Soc.*, 1919, **41**, 1655. Gomberg, *Ber.*, 1904, **37**, 2049. Schmidlin, *Ber.*, 1908, **41**, 2471. Wieland, *Ber.*, 1909, **42**, 3029; and others).

A similar phenomenon can also be noticed in the case of carbon-halogen bonds. Thus while this bond in methyl iodide is comparatively stable, it has been found by Walden (*Ber.*, 1902, **35**, 2029, 2031) that tertiary butyl iodide is ionised in sulphur dioxide solution:—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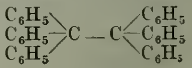
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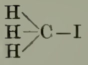
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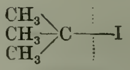
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There is no doubt that a similar variation exists in the strength of the carbon-hydrogen bond, and although the weakening of the bond only proceeds in rare instances to such a degree that electrolytic dissociation occurs in solution, nevertheless the writer hopes to show that such variability as undoubtedly does occur is one of the main factors which govern the occurrence and reversibility of a great variety of apparently unrelated organic reactions, and, furthermore, is consequent upon certain well defined structural conditions. Before discussing the effect of structure, however, it is necessary to show that the presence of activated hydrogen in an organic molecule is indicated by a number of definite but independent criteria, which, however, point to an identical conclusion.

In the first place we may consider the group of criteria which arise from the relationship of this activation of hydrogen to dyad and triad tautomerism. The extensive researches which have centred around the class of phenomena which usually reveals itself in the fact that certain compounds afford ambiguous evidence of their structure have rendered it clear that the majority of such compounds contain the so-called triad system of the type :—

---

* Paper read before Section B (Chemistry) of the British Association on September 14, 1923.

$$(H)\ X-Y=Z \rightleftarrows X=Y-Z\ (H).$$

Since in the course of this reversible interchange the hydrogen atom, (H), must at some stage become detached from the terminal atoms, X and Z, of the system, it seems reasonable to suppose that tautomeric mobility of this kind will always necessarily be associated with the occurrence of hydrogen in that loosened or activated condition which is responsible for the wide range of organic reactions referred to in the preceding paragraph. An examination of the facts shows this to be the case, and hence we must include the usually accepted criteria for tautomeric mobility within the more extensive series of criteria for the activated condition.

Another widely applicable criterion of the existence of activated hydrogen is furnished by the formation of metallic derivatives. It will be evident that there is a remarkable parallelism between the property of forming metallic derivatives and capacity for tautomerism, and it is probably true to say that all substances which are capable of yielding metallic derivatives, and which, in addition, contain an appropriately situated double or triple bond, are actively tautomeric under suitable experimental conditions. The case of acetylene is an apparent exception, for it does not seem to have been previously suggested that acetylene is a tautomeric substance. However, the close formal and chemical analogy with hydrocyanic acid, which contains the dyad system, $(H).C\equiv N \rightleftarrows C=N(H)$ (Usherwood, *Trans. Chem. Soc.*, 1922, **121**, 1604) leads one to believe that acetylene might contain a similar mobile system, $(H).C \vdots CH \rightleftarrows C:CH(H)$, and it is of interest to note that Nef (*Annalen*, 1897, **298**, 332; 1899, **308**, 325) has obtained evidence of the existence of two series of halogen acetylenes corresponding with the two forms suggested for the parent hydrocarbon. If this analogy is sound, acetylene, although consisting mainly of $CH \vdots CH$, should be in equilibrium with a minute amount of $C:CH_2$, and a series of experiments designed to test the truth of this deduction are at present being carried out by the writer. In the meantime, therefore, it may be permissible to reserve the question as to whether acetylene is really an exception to the generalisation suggested at the commencement of this paragraph.

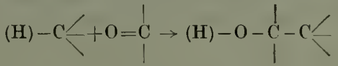
Capacity for alkylation is yet another important criterion of the presence of activated hydrogen. A cursory examination of the properties of typical tautomeric compounds shows that capacity for alkylation is intimately connected with the mobility of the system. For instance, the hydrogen atom of the carboxyl-group, which is sufficiently activated to be partly ionised in aqueous solution, is very readily replaced by an alkyl-group. Hydrocyanic acid, ethyl acetoacetate, ethyl β-aminocrotonate, ethyl glutaconate and indene, to mention only a few typical tautomeric substances, are all capable of alkylation, and indeed the parallelism of the two sets of phenomena is rendered obvious by the briefest survey of the evidence. The following table exemplifies this :—

System	Hydrogen tautomeric, X Hydrogen not tautomeric –		H replaceable by alkyl, X H not replaceable by alkyl –
Carboxyl group	X	..	X
Aci-nitro-group	X	..	X
Diazoaminobenzenes ..	X	..	X
α-γ-Diphenylamidines ..	X	..	X
Diphenylpropenes ..	—	..	—
Benzylidenebenzylamines	—	..	—
Glutaconic esters	X	..	X
Acylacetic esters	X	..	X
Indenes	X	..	X
Propylenes	—	..	—

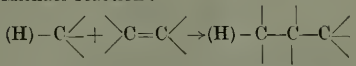
The power of a substance containing activated hydrogen to act as an addendum towards an unsaturated compound affords yet another means of recognising hydrogen in the activated condition, for the characteristic feature of additive reactions of this type is the separation of the activated hydrogen atom from the residue to which it was previously attached :—

$$(H)-X+A\overset{\cdot}{=}B \rightarrow (H)-A-B-X$$

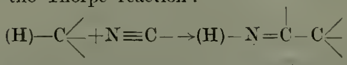
The aldol reaction :—



the Michael reaction :—



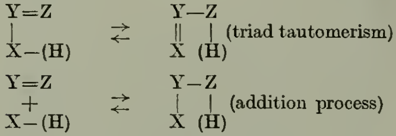
and the Thorpe reaction :—



are three well-known addition processes which belong to this type.

Now it is evident that only certain compounds contain a hydrogen atom which is sufficiently activated for the occurrence of additive reactions of this type. For instance, although acetaldehyde readily unites with itself to give aldol, and benzaldehyde easily combines with acetaldehyde, no one has hitherto succeeded in combining benzaldehyde with ethyl alcohol to give the compound $C_6H_5.CH(OH).CH_2.CH_2.OH$ or with ethane to give the compound $C_6H_5.CH(OH).CH_2.CH_3$. Similar remarks apply to the Thorpe and Michael reactions, and, in fact, an examination of the whole field shows that all these reactions follow upon certain well defined structural conditions which will be specified more definitely hereunder; in the meantime it is sufficient to point out that in the study of these reactions we have another means of obtaining information regarding the activation of any particular hydrogen atom.

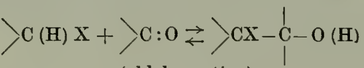
The correlation of this criterion for activated hydrogen with those previously discussed yields interesting results inasmuch as it leads to a number of striking and easily verifiable predictions. It has already been pointed out that activated hydrogen may migrate within the molecule thus giving rise to the phenomenon of triad tautomerism. Since, in order that this reaction should occur, it is necessary that the molecule should contain not only the residue with activated hydrogen but also an appropriately situated double bond, the change can be regarded as a kind of addition reaction, the residue containing activated hydrogen adding to the unsaturated residue, much as in the intermolecular additive processes now under discussion :—



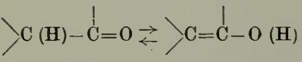
$$\begin{array}{l} Y{=}Z \\ | \\ X{-}(H) \end{array} \rightleftarrows \begin{array}{l} Y{-}Z \\ \| \quad | \\ X \quad (H) \end{array} \text{ (triad tautomerism)}$$

$$\begin{array}{l} Y{=}Z \\ + \\ X{-}(H) \end{array} \rightleftarrows \begin{array}{l} Y{-}Z \\ | \quad | \\ X \quad (H) \end{array} \text{ (addition process)}$$

From this point of view, provided the addition processes can be shown to be reversible, a close formal similarity between the intra- and intermolecular types of change becomes immediately apparent, and we may, for instance, regard keto-enol tautomeric change as the intramolecular form of the aldol reaction :—



(aldol reaction),



(keto-enol tautomerism)

and so forth ; we may, in fact, institute a general comparison between reversible additive reactions involving activated hydrogen in the manner indicated and each of the principal kinds of triad tautomerism.

The analogy is not only a formal one. Taking the aldol reaction and keto-enol tautomeric change as an illustration, it will be shown below that both transformations are dependent on the condition of the hydrogen atom marked (H), activation in each case following upon identical or extremely similar structural conditions. Moreover, the writer has shown experimentally that the aldol reaction is reversible, and that aldols undergo fission into their factors under the conditions of their formation, the result being in each case a balanced action and an equilibrium which can be approached from either end, just as in keto-enol tautomerism. Thus both reactions are reversible and both are conditioned by the same type of activating influence (p. 1249) ; the essential difference between them is that the first is intermolecular and the second intramolecular. Hence we are led to regard the keto-enol change as an intramolecular aldol reaction, which takes place because the substance contains, side by side within the same molecule, both the residues, the carbonyl residue and the residue containing active hydrogen, by interaction of which an aldol reaction occurs. Essentially the same idea can more reasonably be expressed by saying that both the aldol and the keto-enol change are to be traced to a generally prevailing tendency towards the interaction of the two residues mentioned, and that this tendency operates whether the residues are in the same or in different molecules, hence arises the completeness of the analogy between the two processes.

The analogy between the Michael reaction and three-carbon tautomerism is equally complete, although no measurements of equilibria have as yet been made in any instance of three-carbon tautomerism.

Ingold and Powell (*Trans. Chem. Soc.*, 1921, **119**, 1976) first observed the reversibility of the Michael reaction, and Ingold and Perren (*ibid.*, 1922, **121**, 1414) subsequently showed that neither the direct nor the retrograde reaction depends on the conversion of one of the reacting esters into the sodio-derivative.

Hence it is suggested that the three-carbon change is merely an intramolecular Michael reaction, and that the occurrence and reversibility of changes of both types are due to a general tendency towards the interaction of an unsaturated residue with a residue containing active hydrogen, whether these residues occur within the same or in two different molecules.

From this point of view every triad system (H).X.Y=Z, may be regarded as consisting of two elementary parts, (H)–X and Y : Z, by inter-union of which tautomeric change takes place.

It may reasonably be enquired whether the development of this principle serves any purpose in the discovery and collation of organic chemical data. The answer is that it enables one to predict the hitherto unsuspected reversibility of well known additive processes, the aldol reaction for example, and the existence of new types of tautomerism, for instance, the various types of ring-chain tautomerism now under investigation in this laboratory (*compare* Ingold, Perren and Thorpe, *Trans. Chem. Soc.*, 1922, **121**, 1765).

A series of relationships have now been traced between several distinct, and, indeed, entirely dissimilar types of organic chemical reaction. The various manifestations of dyad and triad tautomerism, alkylation, the formation of metallo-derivatives, and additive reactions depending on the separation of hydrogen, have been brought into collation. Further, an explanation for the existence of these relationships has been offered in the suggestion that each of the phenomena dealt with depends ultimately on the same circumstance, namely, the occurrence of a hydrogen atom (or ion, perhaps) in a special condition which has been termed the activated condition. It is therefore of the utmost importance to enquire into the structural factors which give rise to that condition.

Two main classes of compounds containing an activated hydrogen atom have to be considered: (*a*) compounds in which hydrogen is attached to the electronegative atoms oxygen, sulphur or nitrogen; (*b*) compounds in which hydrogen is attached to carbon.

(*a*) Hydrogen attached to oxygen, sulphur or nitrogen is always activated, although naturally the degree of mobility depends on the configuration of the rest of the molecule. In cases in which nitrogen is attached to two hydrogen atoms, only one of these is in the activated condition, but if this becomes replaced by an alkyl group, then the other hydrogen atom becomes activated in turn.

(*b*) Hydrogen attached to carbon may or may not be mobile. It will be evident from the preceding survey that the loosening of a carbon-hydrogen bond runs closely parallel with the presence of the so-called negative groups—C : O,—CO_2Et, etc. That this is not an ordinary electrical effect is shown by the fact that elements such as chlorine and bromine, which, from their position in the periodic table and reactions in inorganic chemistry, are to be considered as strongly electronegative, when attached to carbon do not activate the adjacent hydrogen atom. For instance, there is a very marked difference between the activity of the hydrogen atom marked * in α-γ-dibromopropane and acetyl acetone: $Br{\cdot}CH_2{\cdot}CHH^*{\cdot}CH_2Br$. $CH_3{\cdot}CO{\cdot}CHH^*{\cdot}CO{\cdot}CH_3$. Apparently, then, the unsaturated condition represented by the double or triple bond is also necessary. But it alone is obviously insufficient, because ethylene, for example, which contains a double bond, does not contain an activated hydrogen atom. Neither is an oxygen (or nitrogen or sulphur) atom alone sufficient as may be seen by reference to the case of ethyl ether. Again, the presence of an electronegative element is not always necessary as the case of acetylene shows. It is evident, therefore, that the circumstances necessary and sufficient to secure activation are by no means simple; but it is possible, nevertheless, to embrace in two general formulæ the complete results of the preceding investigation:

(1) *The hydrogen atom represented by* (*H*) *in the group* $[H]{\cdot}C{\equiv}X$ *is activated no matter whether* X *is* C *or* N.

(2) *The hydrogen* (H) *in the group*

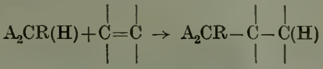
$$\left\{\begin{array}{l}(H)-C-X=Y\\(H)-C-X\equiv Y\end{array}\right.$$

is activated, no matter whether X *is* C *or* N, *provided* Y *is either the electronegative* O, N *or* S, *or is* C, *which itself is involved in the group*

$$\left\{\begin{array}{l}=C-X=Y\\=C-X\equiv Y\end{array}\right.$$

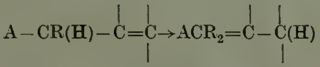
It will be noticed that these generalisations include both Lapworth's α-γ rule, and certain aspects of the more recently developed hypothesis of alternate polarities. There is no doubt that the material of this paper could with interest be interpreted in the light of the polarity hypothesis, but the writer's object, however, is not so much to institute proposals regarding the ultimate cause of organic chemical phenomena, as to effect a collation of data with the minimum of tacit hypothesis, to reduce tendency to undergo reactions to terms of molecular structure, and hence to seek the immediate rather than the ultimate cause of the facts which are on record.

It is to be borne in mind in interpreting the general formula given above, that the same degree of activation is not implied in all cases. Thus whilst two carbethoxyl or cyano-groups (A) are required so far to loosen the hydrogen atom in the system $A_2CR(H)$ that it can pass over to another molecule in the Michael reaction,



$$A_2CR(H)+\overset{|}{\underset{|}{C}}=\overset{|}{\underset{|}{C}} \rightarrow A_2CR-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}(H)$$

only one is necessary when the corresponding intramolecular process (three-carbon tautomerism) is in question:



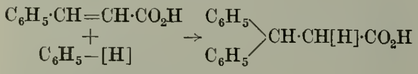
$$A-CR(H)-\overset{|}{C}=\overset{|}{\underset{|}{C}}\rightarrow ACR_2=\overset{|}{C}-\overset{|}{\underset{|}{C}}(H)$$

No doubt the compactness of the tautomeric system is responsible for the greater mobility of a hydrogen atom under given conditions of activation, and from this point of view it is interesting to note that keto-enol tautomeric change may be considered as an intramolecular aldol reaction in which the mobile hydrogen atom is activated by its own carbonyl group.

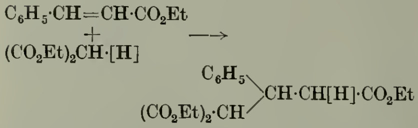
Note on the Activation of Hydrogen by the Benzene Nucleus

Whilst it is unnecessary to pass in review the more obvious application of the rules given on this page, it may not perhaps be inappropriate to call attention to the fact that the benzene nucleus, considered as a Kekulé individual, forms a special application of Rule 2. Therefore it is of interest to note that hydrogen attached to the benzene nucleus, although it satisfies only certain of the criteria which have been given for the existence of activated hydrogen, nevertheless participates in a number of reactions which plainly show that it is in an activated condition.

Thus the Michael and aldol reactions, which were taken as typical illustrations of additive processes depending on the activation of hydrogen, have their counterparts in which benzene C_6H_5-H becomes the addendum: the addition of benzene to cinnamic acid corresponds with that of malonic ester to cinnamic ester:

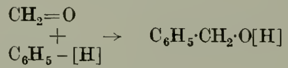


$$\begin{array}{c}\mathrm{C_6H_5{\cdot}CH{=}CH{\cdot}CO_2H}\\ +\\ \mathrm{C_6H_5{-}[H]}\end{array} \rightarrow \begin{array}{l}\mathrm{C_6H_5}\\ \mathrm{C_6H_5}\end{array}\!\!>\mathrm{CH{\cdot}CH[H]{\cdot}CO_2H}$$

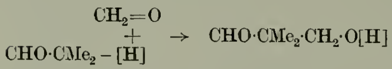


$$\begin{array}{c}\mathrm{C_6H_5{\cdot}CH{=}CH{\cdot}CO_2Et}\\ +\\ \mathrm{(CO_2Et)_2CH{\cdot}[H]}\end{array} \longrightarrow \begin{array}{r}\mathrm{C_6H_5}\\ \mathrm{(CO_2Et)_2{\cdot}CH}\end{array}\!\!>\mathrm{CH{\cdot}CH[H]{\cdot}CO_2Et}$$

and the addition of benzene to formaldehyde* with that of *iso*butaldehyde to the same substance:

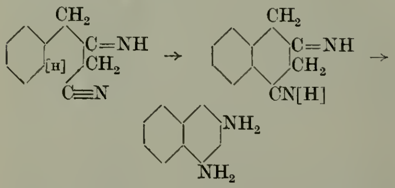


$$\begin{array}{c}\mathrm{CH_2{=}O}\\ +\\ \mathrm{C_6H_5-[H]}\end{array} \rightarrow \mathrm{C_6H_5{\cdot}CH_2{\cdot}O[H]}$$

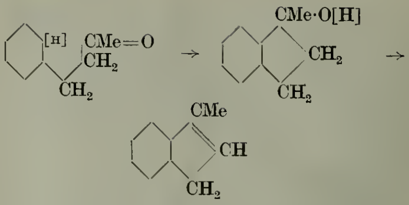


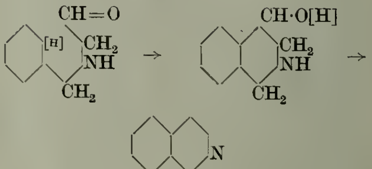
$$\begin{array}{c}\mathrm{CH_2{=}O}\\ +\\ \mathrm{CHO{\cdot}CMe_2-[H]}\end{array} \rightarrow \mathrm{CHO{\cdot}CMe_2{\cdot}CH_2{\cdot}O[H]}$$

Examples of what may be termed "intramolecular additive processes," reactions involving the migration of nuclear hydrogen to a double-bonded grouping situated in a side-chain attached to the same aromatic nucleus, fall into several classes according as the unsaturated residue is a cyano-group, a carbonyl-group, a nitroso-group, etc. Included within the first of these classes are certain of Thorpe's imino-reactions, for instance, the conversion of β-imino—γ-cyano-α-phenylpropane into 1 : 3 naphthylenediamine,

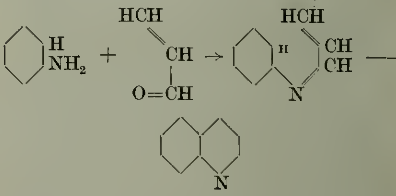


Instances of the class of reaction in which a carbonyl-group is involved are very numerous, illustrating the formation of many types of fused-ring nucleus. The formation of γ-methylindene from benzylacetone, and of *iso*quinoline from benzylaminoacetaldehyde may be taken as typical examples:

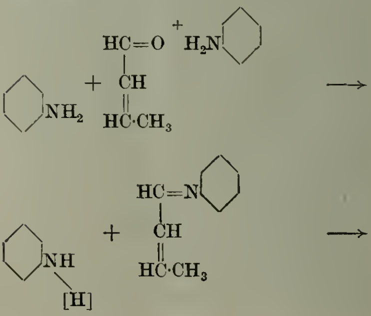




It is probable that Skraup's synthesis of quinoline derivatives also depends on the migration of aromatic hydrogen. The formation of quinoline itself, from aniline and acrolein, has been explained by supposing that the elimination of water from the aldehyde and base is followed by the direct removal of two hydrogen atoms by oxidation:



There is, however, clear evidence that the reaction cannot take this course, because on substituting crotonaldehyde for acrolein not γ-methylquinoline but α-methylquinoline is obtained. Attempts have been made to overcome this difficulty by supposing that two molecules of aniline take part in the reaction in the following manner (Blaise and Maire, *Compt. rend.*, 1902, **144**, 95):



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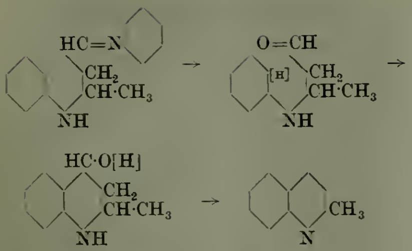
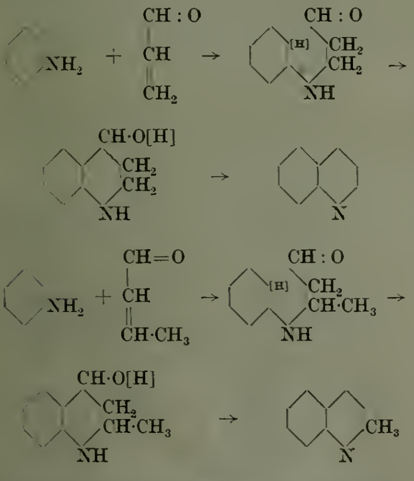
* The isolable product of this reaction is diphenylmethane, but as benzyl alcohol is known to be converted into diphenyl methane under the same experimental conditions, it is legitimate to assume that the reaction represented constitutes the first stage of the process. Indeed, there seems to be no plausible alternative.

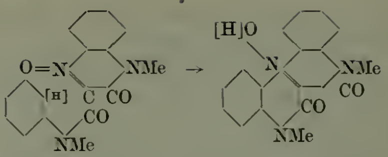


It is difficult, however, to see the necessity for these complicated assumptions, which involve condensation and hydrolysis under the same conditions. It would be simpler to assume that, both in this case and in the formation of quinoline itself, the reaction occurs between two molecules only, and that, in the presence of strong mineral acids, addition at the carbon-carbon double bond occurs in preference to the elimination of water between the amino- and aldehyde groups. Adopting this view the formation of quinoline and quinaldine are both very simply and uniformly interpreted as follows :—



the reactions furnishing additional examples of ring formation involving the passage of aromatic hydrogen on to the oxygen of a carbonyl group.

Some cases of analogous reactions involving the migration of nuclear hydrogen to the group N : O, either in the form of a nitroso-group, a nitro-group, or an *N*-oxido-group, have recently been described (Usherwood and Whiteley, *Trans. Chem. Soc.*, 1923, **123**, 1069), and may be sufficiently illustrated here by the following transformation of an *N*-oxido-compound.



Reactions such as these plainly show that apart from the possible influence of other groupings which the rules on p. 1249 define, the benzene ring, alone, has the power to bring about the activation of the hydrogen atoms attached to it ; but it has been thought right to append this note on the subject in view of the fact that the benzene nucleus constitutes a limiting and very special instance of the standard conditions which have been stated to lead to activation, an instance, which could not, therefore, have been assumed to fall into line with the general conclusions without an examination of the facts.

Imperial College of Science and Technology,
South Kensington

THE ACTION OF SODIUM SILICATE ON CONCRETE

In view of the great national importance of the question of the cost of upkeep of roads, much interest attaches to what is known as the silicate treatment for the hardening of concrete roads. This type of road will undoubtedly be employed very widely in the immediate future, following on the successful experience in the United States, and the progress made in the auxiliary treatment with silicate of soda is bound to play an important part in helping forward this development.

As is well known, the complex mixture known as silicate of soda, made by fusing together a good grade of sand with soda ash, is supplied in a considerable number of different grades or ratios, all of which are completely soluble in water, depending on the relative amounts of sand and soda used, the ratio figure being expressed as the number of molecules of silica (SiO_2) per 1 molecule of soda (Na_2O). The range varies from a low ratio product containing 1·6 molecules of silica to 1·0 molecules of soda to as high as 4·0 molecules silica to 1 of soda, the limits for complete solubility being about 21·5–42·1 per cent. SiO_2 and 5·25–26·95 per cent. Na_2O. Thus an example of a very commonly used silicate is " 2·0 molecules silica," in the form of a thick liquid of 100° Tw. at 20° C., the composition being 27·61 per cent. SiO_2, 14·19 per cent. Na_2O, and 58·20 per cent. water. All the various grades of silicate are generally sold in the liquid state, popularly known as " soluble glass " or " water glass," but may also be obtained as soluble powders and as "solid glass" in the lump form.

When a very dilute solution of silicate of soda, which must, however, be of the correct ratio to give the proper results, is applied to the surface of concrete, the solution penetrates to a depth depending on the condition and the original method of laying of the concrete. All concrete, no matter how carefully mixed, contains microscopic pores, but in practice considerable differences are shown in this respect. The result of the penetration is the formation of an intensely hard and dense outer skin or layer, which is much more resistant to abrasion and general wear and tear than ordinary untreated concrete, whilst being also more proof to water and oil and almost entirely dustless, without becoming slippery. The reactions that result when a very dilute solution, which must contain about 1 part of the commercial silicate of soda to 4 parts of water, is allowed to soak into concrete appears to consist chiefly of a combination of the soluble silicate of soda with free calcium hydrate always present in the concrete (being liberated in the setting of the cement) to give a hard, insoluble calcium silicate which completely fills up all the pores.

The firm of Brunner, Mond and Co., Ltd., which has devoted much attention to the whole question of silicate of soda during the past few years, has just issued an interesting booklet, "Concrete Roads" (which will be sent free of charge on application to the company at Northwich, Cheshire), containing a number of striking photographs of the surfaces of concrete roads, treated and untreated, after 6 months' heavy traffic. Treatment with silicate of soda has, it is stated, reduced the cost of upkeep of roads, so that the subject is obviously of considerable national importance.

Prof. Tammann, of Göttingen, has been elected the first honorary member of the Deutschen Gesellschaft für Metallkunde." Prof. G. F. Hüttig has been appointed professor of inorganic and analytical chemistry at Bonn.

The Académie des Sciences has allocated to M. Samsoen a subvention of 10,000 frs. from the Henry le Chatelier foundation for researches on the viscosity and dilatation of glass at high temperatures. The Montyon prize for mechanics has been awarded to M. H. Chipart, of St. Etienne, for his work on the gyroscopic theory of light, electro-magnetism and industrial electricity, and governors for steam engines.

FORTHCOMING EVENTS

Dec. 29 to Jan. 9. Scientific Novelties Exhibition, King's College, Strand, W.C. 2. Demonstrations and Experiments, 2—5 p.m., and 6—9 p.m.

Jan. 2. Institution of Electrical Engineers, *Wireless Section*, Savoy Place, Victoria Embankment, W.C. 2, at 6 p.m. "Some Experiments on the Screening of Radio Receiving Apparatus," by R. H. Barfield, M.Sc.

Jan. 3. Society of Chemical Industry, *Bristol Section*, Chemical Department, The University, Bristol, at 7.30 p.m. "The Chemical Technology of Canned Foods," by O. Jones.

Jan. 7. Institution of Electrical Engineers, Savoy Street, Victoria Embankment, W.C. 2, at 6 p.m. "Troubles with Domestic Electrical Appliances." Discussion opened by J. W. Beauchamp.

Jan. 7. Society of Chemical Industry, *London Section*, in the Rooms of the Chemical Society, Burlington House, W. 1, at 8 p.m. "The Estimation of Butyric Acid in Presence of Acetic Acid," by Dr. E. Fyleman; "The Estimation of Cadmium in Spelter and Zinc Ores," by C. E. Barrs.

Jan. 7. Institution of Rubber Industry, *London Section*, The Engineers' Club, Coventry Street, W. 1, at 8 p.m. "Consistency of Rubber and Rubber Compounds," by Dr. S. S. Pickles.

Jan. 8. Institution of Mechanical Engineers, *Swansea Section*, at Chamber of Commerce, Swansea, at 6 p.m. "Modern Developments in Steam Raising," by Sir J. H. R. Kemnal, F.R.S.

Jan. 8. Institute of Metals, *Birmingham Section*, Chamber of Commerce, New Street, Birmingham, at 7 p.m. "Nickel Brasses," by O. Smalley.

Jan. 8. Institute of Metals, *North-East Coast Section*, Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne, at 7.30 p.m. "The Action of Molten Brass on Nickel-Steel," by H. M. Duncan, B.Sc.

Jan. 10. Institute of Metals, *London Section*, Institute of Marine Engineers, 85—88, The Minories, Tower Hill, E. 1, at 8 p.m. "X-Rays and Metallurgy," by W. T. Griffiths, M.Sc.

Jan. 10. Institution of Mechanical Engineers, *Glasgow Section*, Royal Technical College, Glasgow, at 7.30 p.m. "Radiation and Atomic Structure," by Prof. J. Muir, D.Sc.

Jan. 11. Institute of Metals, *Sheffield Section*, The University, St. George's Square, Sheffield, at 7.30 p.m. "Influence of Casting Temperature on the Physical Properties of Metals," by F. H. Hurren. (Conjoint Meeting with the Institute of British Foundrymen).

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

NOTICE TO MEMBERS AND SUBSCRIBERS

The Annual Suscription falls due on January 1 next, and Members and Subscribers are reminded that no issues of the Journal for 1924 will be despatched to them until their subscriptions have been received at the Society's offices.

The formal applications for subscriptions will shortly be despatched to Members and Subscribers.

EXTRA COPIES OF ABSTRACTS

Members and subscribers may find it advantageous to have extra copies of the Abstracts section of the Journal printed on one side of the paper only, for filing purposes. The Society is prepared to supply these for the year 1924 in complete sets at a charge of £1 per set. Members and Subscribers who desire to avail themselves of this offer are requested to communicate with the General Secretary as soon as possible.

YORKSHIRE SECTION

On December 13, Mr. Mackay presided over a joint meeting with the Leeds Area Section of the Institute of Chemistry in Leeds, and Mr. Griffith Brewer, C.P.A., delivered an address on "Practice under the Modern Patent Law."

A patent is a bargain with the Crown, the monopoly being given in consideration of bringing a new thing into the country. In patents, therefore, claims must be stated very clearly. The granting of patents to importers was next dealt with and the International Convention explained. The most successful patents were the strings of patents representing progressive steps in building up a business; patents representing the spontaneous acts of individuals were more uncertain. The main portion of the address explained the Regulation introduced in 1919, whereby a patentee may have his patent endorsed "Licences of Right." The object was to secure that the invention is used to the greatest extent and the patentee is rewarded adequately as the Comptroller is empowered to intervene if a patentee refuses to grant a licence on reasonable terms. Although in the last four years 2000 patents had been brought within this Regulation, no compulsory licence of right had been granted against the will of the inventor. As a further inducement to the patentee to be reasonable the taxes payable on the patent endorsed in this way are reduced to half. In this way patentees would save £140,000 per annum in fees alone and in many cases offers to work the invention would result merely because of the declaration of the patentee that he would not be unreasonable. The suggestion was made that in the official announcement of the scale of fees a second column to the table be added showing the half fees payable in respect of patents so endorsed.

In the discussion Mr. Goodall said it was requisite to obtain expert advice before filing an application. Mr. Hodsman asked when a provisional patent for a chemical product had been obtained and in the nine months' interval by some alteration in the conditions an improvement had been effected, could the inventor add this when the complete specification was put in. In reply Mr. Brewer stated that it was first necessary to file a provisional specification describing the nature of the invention sufficiently to enable it to be identified. When an additional step had been gained, a cognate provisional patent should be taken out and the two united in one complete specification.

EDINBURGH AND EAST OF SCOTLAND SECTION

The third ordinary meeting was held jointly with the Edinburgh and East of Scotland Section of the Institute of Chemistry, in the Hall of the Pharmaceutical Society, Edinburgh, on December 11, Dr. A. Lauder presiding.

A lecture on "H.M. Factory, Gretna," was delivered by Mr. Allin Cottrell, who stated that the factory was designed as a propellant explosive factory with a capacity of 40,000 tons of cordite per annum. Previous to the war the volatile solvent acetone played a necessary part in gelatinising a mixture of nitroglycerin and guncotton which, with a small percentage of mineral jelly, composed the British service cordite. War conditions cut down supplies of acetone and it became necessary to develop a new cordite in which a mixture of ether and alcohol could be used to bring about gelatinisation. The Research Department of Woolwich was successful in doing this and evolved what came to be known as R.D.B. cordite. The scientific staff at Gretna had to develop the production on a gigantic scale of an explosive of which the details of the manufacture had just been worked out in the research laboratory.

The factory was divided into three separate areas for manufacturing purposes: Dornock, Ether, and Mossband. On the Dornock area were manufactured dynamite glycerin, sulphuric, nitric, and mixed acids, nitro-cotton and nitro-glycerin. The Ether area was given over to the manufacture of ether, and the

Mossband area was reserved for the production of the finished cordite and the recovery of the ether-alcohol solvent.

Mr. Cottrell described the rapid development of the factory from the time in 1915 when the site was surveyed to the time when the first consignment was dispatched for service at the front in August, 1916, and gave a clear account of the general organisation and running of the works. With the aid of numerous lantern slides the details were shown of the manufacture of cordite from start to finish, the different kinds of large scale plant, and the life and activities of the workers.

BIRMINGHAM AND MIDLAND SECTION

There was a large and representative attendance of chemists, members of the Birmingham and Midland Section of the Society of Chemical Industry, and the Institute of Chemistry, at the joint annual dinner at the Queen's Hotel, Birmingham, on December 15. Prof. G. T. Morgan, F.R.S., chairman of the local section of the Institute, presided. Dr. E. B. Maxted, chairman of the local section of the Society, was unable to be present owing to indisposition. Those present included :—Prof. W. P. Wynne, F.R.S., President of the Chemical Society, Dr. H. Levinstein, President of the British Association of Chemists, and Prof. Smith (Physics Department, University of Birmingham). Dr. E. F. Armstrong, President of the Society of Chemical Industry, wrote apologising for absence.

In proposing the toast, " The Society of Chemical Industry," Mr. H. B. Jacks (President of the Birmingham Metallurgical Society), pleaded for a closer alliance between science and industry, and pointed to the great and increasing part which chemistry was playing in the study of metallurgy. Mr. F. R. O'Shaughnessy, in responding, recalled the fact that a very large number of valuable scientific papers on various phases of metallurgical science had been read at the meetings in Birmingham of the Society of Chemical Industry ; chemistry was playing a greater part in industrial processes than ever before.

" The Institute of Chemistry " was proposed by Dr. Levinstein, who suggested that the democratic British Association of Chemists had rendered an admirable service in arousing the Institute from a prolonged slumber to visible signs of activity in unexpected directions. As a result, the Institute was stronger, more prosperous and more representative of chemists than ever before, and certainly it spoke with greater authority. He attributed this progress largely to the stimulus which had been given by other bodies, particularly the Association. Birmingham was to-day one of the great centres of chemistry, and he felt that the progress it had made was due very largely to the distinguished Professor of Chemistry at the Birmingham University, Dr. Morgan. It had been his business lately to try and acquire some knowledge of what had been done in the various chemical schools of this country in the last twenty or thirty years ; and one of the most striking developments had taken place in Birmingham, which a few years ago—he thought he could say so bluntly—was without a large and important school such as it had to-day. In the great enthusiasm for research, in the volume and quality of the research turned out, and in the number of students, Birmingham was not far behind—if at all behind—any chemical school in this country or elsewhere. The Institute, being a chartered Institute, had special functions to perform and was debarred from carrying out the kind of work which the British Association of Chemists was established to do—namely, to look after the more material interests of chemists, and to do what the Junior Medical Society did in the medical profession. He would welcome a much closer administrative connexion between the British Association of Chemists and the Institute, and it would be very desirable for the affairs of the two bodies to be administered from one office. He would also like to see more unity among the great societies of the chemical profession, and his hope was that it might be possible some day, by means of a combined subscription, for a man to obtain the whole of the literature of the several societies, as well as some closer association with them. Entrance fees and annual subscriptions to each body now made much too heavy a toll upon the financial resources of many young chemists.

The toast was honoured with enthusiasm, and Prof. Morgan, after a warm welcome to Prof. Wynne, likened, in humorous vein, the various chemical bodies to types of government by which mankind is afflicted. Dr. Levinstein had spoken of the lack of co-ordination, but there was a composition fee of £3 for those who subscribed to the publications of the Chemical Society and the Society of Chemical Industry. It would be seen that a good start had been made, and ultimately they might get a composition fee to include the Chemical Society, the Society of Chemical Industry, the Institute of Chemistry and the British Association of Chemists. He was glad reference had been made to the activities of the Institute, and he appreciated what had been said about the work of the Chemistry Department of the University. After all, he was merely the catalyst, the main body of the work being done by the gentlemen in the Department.

Mr. W. A. S. Calder, proposing the toast, " The Guests," referred to the value of university work from the view point of industry, and Dr. D. Stanley (President of the Midland Medical Association) responded.

HULL CHEMICAL AND ENGINEERING SOCIETY

On December 11, a meeting was held to hear an address on "Recent Advances in the Study of Corrosion," by Dr. J. N. Friend.

After emphasising the need for further research on the prevention of rust, Dr. Friend said it is generally recognised that when iron (or steel), air and water are brought into contact corrosion takes place. The iron, owing to the action of substances contained in itself, the air or the water, passes into solution in minute quantities, which are renewed as rapidly as they are thrown out of solution in the form of rust. Thus, for example, carbon dioxide being one of the most prevalent impurities, the action in most cases would appear to be that soluble ferrous bicarbonate and nascent hydrogen are formed, the nascent hydrogen combining with dissolved oxygen to form water. The ferrous bicarbonate is then hydrolysed to form ferrous hydroxide, which is oxidised to ferric hydroxide. The carbonic acid liberated through the hydrolysis of ferrous bicarbonate is free to attack more metal. And so the cycle continues.

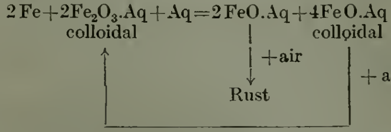
There are, however, many phenomena attendant upon the corrosion of iron which cannot be satisfactorily explained in the above manner, and it becomes evident that another supplementary theory is necessary. When water flows over a piece of iron in a tube the first effect of increasing the rate of flow is to enhance the corrosion of the metal. But a critical velocity is soon reached, namely, approximately one-tenth of a mile per hour, at which the corrosive effect attains a maximum, further increase in velocity resulting in a decrease of corrosion, until with a rate of flow of about four miles per hour, corrosion ceases. The metal under these conditions loses only very slightly in weight, probably in consequence of direct solvent action coupled with mechanical erosion.

This interesting phenomenon can neither be anticipated nor explained by any recognised theory of corrosion. It appears as if the moving water washes away from the surface of the metal something that is needful to induce corrosion. The author therefore suggests that on coming into contact with ordinary air and water, iron slowly dissolves in minute quantities, ultimately yielding ferrous hydroxide sol—that is, colloidal ferrous hydroxide. This sol oxidises in excess of air to ferric hydroxide sol (*i.e.*, colloidal ferric hydroxide, $Fe_2O_3.Aq$); in less favourable circumstances colloidal ferrosoferric hydroxide, $Fe_3O_4.Aq$, is produced.

This higher colloidal hydroxide now acts catalytically, accelerating the oxidation of the iron and simultaneously undergoing reduction to a lower colloidal hydroxide. It reoxidises as the air diffuses towards it, and so the cycle continues. Rust is formed when the colloidal hydroxide precipitates out or "flocculates."

In ordinary cases, therefore, corrosion may proceed in two ways simultaneously, namely: (i) By direct solution—a process rendered possible by the presence of dissolved electrolytes. (ii) By catalysis, this reaction being superimposed on the other, the colloidal iron hydroxide functioning in the presence of air as the active catalyst.

In acid solution the former of these reactions takes place almost exclusively. In neutral solution, the second reaction plays an important part. This colloidal theory may be represented briefly by the following scheme:—



$$2\,Fe + \underset{\text{colloidal}}{2Fe_2O_3.Aq} + Aq = 2\,FeO.Aq + \underset{\text{colloidal}}{4FeO.Aq}$$

This theory enables explanations to be offered for many interesting phenomena that are otherwise anomalous. Thus, for example, it is evident that any factor, whether mechanical, chemical, or electrical, that is capable of destroying the colloidal forms of iron hydroxide, will tend to retard corrosion. That is precisely what is found in practice to take place. Experiment shows that the relative precipitating powers of chromates, sulphates, and chlorides upon ferric hydroxide sol are as follows:—Chromates and dichromates, 100·0; sulphates, 67·0; chlorides and nitrates, 0·3. In other words, large quantities of nitrates and chlorides are required to precipitate the colloid, but only small quantities of chromates and dichromates, the sulphates lying intermediately. It is to be anticipated therefore that small quantities of chromates will inhibit corrosion. This is known to be so, and the addition of chromates to boiler feed waters and to paints destined for the preservation of iron has frequently been recommended.

Another interesting phenomenon is the behaviour of iron towards rays, which usually tend to accelerate oxidation processes. If the corrosion of iron is purely an ionic effect, exposure to radium rays should lead to enhanced corrosion. On the other hand, the rays tend to precipitate colloidal iron hydroxide, and will therefore, according to the colloidal theory, tend to retard corrosion. Experiment has shown that radium rays, springing from an exceedingly feeble source, exert a decided retarding action upon the corrosion of iron.

From France the death is announced of M. P. Pascal, Vice-President of the Société d'Electrochimie.

PERSONALIA

Mr. J. Barcroft has been elected Fullerian Professor of Physiology at the Royal Institution, in succession to Sir A. Keith ; and M. le Duc de Broglie, Dr. C. L. Guillaume and Profs. Debye, Einstein, Groth and von Laue have been elected honorary members of the Institution.

Mr. W. H. Hoffert, M.A., B.Sc., has been appointed research chemist to the Joint Research Committee of the National Benzole Association and the University of Leeds, in succession to Prof. E. C. Williams, now Ramsay professor of chemical engineering in the University of London. Mr. Hoffert will investigate the possibilities of increasing home supplies of motor spirit from coal.

Sir H. Harrison, Bart., founder of the chair of organic chemistry in the University of Liverpool, has contributed a further sum of £2500 towards the endowment of the chair.

Prof. A. Fowler, professor of astrophysics in the Imperial College of Science and Technology, has been appointed by the Royal Society to one of the Yarrow research fellowships which have been established in consequence of the gift of £400,000 by Sir A. Yarrow, to mark his " sense of the value of research to the community." Prof. Fowler has done valuable experimental work in spectroscopy, work in close association with the theoretical studies of Bohr which have led to such remarkable advance.

The title of Emeritus Professor has been conferred upon Prof. A. Smithells, F.R.S., by the University of Leeds in recognition of the value of his long service to the University.

Mr. R. Forsyth, M.Sc., has been appointed demonstrator in technological chemistry in the Faculty of Technology of Manchester University.

On the occasion of its fiftieth anniversary, the Dutch Union of " Gas-fabrikanten " has elected Dr. Charles Carpenter as an honorary member.

Dr. G. D. Rosengarten of Philadelphia, formerly a member of the board of directors of the American Chemical Society, has been elected to the newly organised executive committee.

* * *

From Germany the following deaths are announced :—J. Norden, founder of the Vereinigten Chemischen Fabriken Julius Norden and Co. ; Dr. A. Rüdiger, of the Chem. Pharm. A.-G. ; Dr. H. Pauli, of Frankfurt ; Dr. H. Teichmann, director of the Rutgerswerke A.-G.

From Italy the deaths are announced of Cav. L. Deponti, a well-known figure in the glucose and inorganic chemical industry, and of Dr. M. Ferko, well known in the soap industry.

NEWS AND NOTES

JAPAN

Patent Rights in Japan

During the recent disaster the whole of the registers and almost all the documents in the Japanese Patent Office were destroyed. To prevent detriment or inconvenience, the following regulations have been promulgated :—

Any right or interest given prior to September 1, 1923, and due to expire between September 1, 1923, and March 31, 1924, shall expire on the latter date, with the exception of rights and interests granted for a special period of duration, which shall remain valid during the specified period, provided that such period may be curtailed by the decision of an administrative office.

For any default of an application to be made to, or other steps to be taken with, the Minister of Agriculture and Commerce or the President of the Patent Office, between September 1 and December 30, 1923, in connexion with Patent, Utility, Model, Design, or Trade Mark, being caused by the earthquake, the aforesaid Minister or President may exempt the party concerned from the result of default, if he apply or take such steps not later than December 31, 1923, provided that, regarding the assertion of the right of priority grown out of the stipulation of a treaty, the aforesaid dates shall be March 30, 1924, and March 31, 1924, instead of December 30, 1923, and December 31, 1923, respectively.

Any person who, prior to September 1, 1923, applied for the prolongation of a patent right, and has not yet been granted any decision, shall present to the Patent Office not later than December 31, 1923, copies of the application and other relevant documents, together with a written statement declaring the date of the original application.

Any person who has obtained the registration of a Patent, Utility Model, Design, or Trade Mark shall apply for the recovery of registration prior to October 31, 1924, on which application his right of Patent, Utility Model, Design, or Trade Mark shall maintain the order in the original register.

It is important to note that a person not resident within the Empire of Japan cannot make an application to or take any other steps at the Patent Office except through a representative who is resident in the Empire.

FRANCE

Agricultural Research

A recent decree orders the creation of stations for research for the investigation and trial of scientific processes for the improvement and development of agricultural production. A number of central stations will be established for investigation of the various branches of agricultural science, whereas regional stations are to be established to carry out practical experiments and to test methods suitable for local application.

REVIEWS

The Chemistry of Rubber. By B. D. W. Luff, F.I.C. *Pp.* 232. *London: Ernest Benn, Ltd.*, 1923. *Price* 25*s.*

The chemistry of rubber is a subject that has received a good deal of attention in recent years. The rise and growth of the plantation rubber industry has synchronised with the development of research on the properties of rubber and the processes of vulcanisation. In the same period several textbooks or treatises have appeared covering the whole or part of the subject according to the individual outlook of the author. It is, however, curious to note that there is no recent book dealing specifically with the manufacturing side of the industry, the last to appear being that of Terry, published in 1907.

It is therefore somewhat disappointing to find that Mr. Luff has treated the manufacture of rubber goods in a very brief fashion, and consequently it cannot be said that the book relieves a pressing need. As research chemist to one of the largest manufacturing concerns in the industry, the author would appear well fitted for the task of filling a very conspicuous gap in the literature of the subject.

However, within the limits of his subject-matter the author has succeeded in writing a very excellent treatise in which he has embodied the essence of most of the research work that has been carried out on rubber during recent years. He possesses the gift of sorting out the subject-matter, selecting the essentials and putting them before the reader in a brief and lucid form. The historical introduction is well written. It is followed by chapters on rubber latex, wild rubber and plantation rubber, which contain a fairly correct description of the preparation of plantation sheet and crêpe rubber, which represent the bulk of the supply of raw material now reaching the manufacturer. The main body of the book deals with the physical and chemical properties of raw rubber, vulcanisation and the properties of the vulcanised rubber. They afford a very readable *résumé* of the experimental work so far accomplished, and although limitations of space have necessitated condensed accounts of the subject-matter, the author has nevertheless succeeded in presenting the essentials and has covered the whole ground without omitting any matter of first importance. There is a chapter on synthetic rubber amply commensurate with its technical importance; a chapter on the methods of manufacture, which, as already stated, is brief and contains no information which cannot be found in books written twenty years ago; and the final chapter deals with methods of analysis and epitomises the best methods in vogue.

The book is well illustrated with half-tone blocks, is well printed and light to handle. The editing has been most carefully done and the book does not contain a single misprint.

The book can be confidently recommended as supplying a brief yet readable account of our present knowledge of the chemistry of rubber, giving the essential details of the more important research work which has been carried out on the subject.

Henry P. Stevens

The Chemistry of Paints, Pigments and Varnishes. *By* J. Gauld Bearn, M.Sc., A.I.C. *Pp.* *x*+277. *London: Ernest Benn, Ltd.*, 1923. *Price* 30*s.*

Referring to the above it is stated that:—

> "This book, written from a strictly practical standpoint, supported by the author's twenty years' experience with various leading firms in the industry, covers all the most recent developments, and as such, as well as for the detailed description given of the chemistry and properties of all the various raw materials and finished products which they are called upon to handle, works managers, chemists, architects, engineers, and indeed, any persons either connected with the industry or whose calling necessitates the specification of materials for various protective uses, must find it invaluable.
>
> "A full description of the methods of analysing these raw materials and finished products have been included so that County Analysts and others dealing with this kind of work on behalf of County Councils, Local Authorities, and similar public bodies, may at last have a much-needed book of reference."

The author has endeavoured to attain his object in twenty-one chapters, each of which is devoted to a special section of the subject, in addition to which there are over forty illustrations, a bibliography and a ten-page appendix of mathematical and chemical data The general scheme of presentation is well conceived, but the detailed treatment is to some extent unsatisfactory. Typographical errors are far too numerous, and some are of such a character as to be a possible source of danger to anyone unfamiliar with the subject. Few of these should have escaped detection in proof-reading.

Apart from printers' errors, the work is open to criticism in certain sections, because of incomplete and out-of-date descriptions of both manufacturing processes and methods of chemical and physical examination. This is particularly seen in connexion with materials of which the author obviously has not first-hand knowledge, and has therefore been compelled to rely on the writings of others for much of the information he brings forward.

The ramifications of the paint and varnish industry are so numerous and varied, that it is almost impossible for one person to possess the knowledge necessary for the production of a treatise adequately covering all branches of the industry. There is marked reticence in the publication of details concerning manufacturing processes; the literature is not only scanty and incomplete, but often contradictory; and nice judgment and experience are required in determining the suitability of much of the published material for inclusion in a general work.

The author, at all times readable, is quite sound when he deals with his own subjects, and in places shows refreshing candour in his treatment of some of the perennial problems of general importance to the industry and the users of paint.

In its present form, the work has but a limited value, and in order to appeal to the large circle of readers for which it was intended, careful revision is necessary. The high price places the work outside the reach of many students of paint technology whose limited purses, in common with those of other students, do not appear to be considered in such matters. Students generally are complaining bitterly of the high prices asked for scientific and technical works to-day, and there would appear to be a good future for any publisher who will make the right move in this direction.

C. A. Klein

Oil Analysis. *By* A. H. Gill, S.B., Ph.D. *The Standard Short Hand-Book for Chemists and Engineers. Tenth edition, revised. Pp.* 223. *London: J. B. Lippincott.* 1923. *Price* 10*s.* 6*d.*

It will be noticed that the title of this book has been altered from "A Short Handbook of Oil Analysis" to "Oil Analysis," but the volume of the book has not very much increased. It has now reached its tenth edition, from which it would appear that it has been appreciated; the points of appreciation, however, are not very apparent.

Part I deals with physical and chemical tests, and includes two chapters devoted to petroleum products, one to animal and vegetable oils, and one to the examination of an unknown oil. In Part II the properties of some of the more commonly-occurring oils are considered, including petroleum products, vegetable and animal oils, waxes, and "waste fats." A voluminous appendix includes various tables of constants, notes on reagents, specifications for lard oil, petroleum products, compound oils, etc., and a description of Bailey and Baldsiefen's hexabromide method. This appendix appears to be the most valuable part of the book. The book is intended primarily for students, and descriptions of apparatus and methods of procedure receive considerable attention. These descriptions, however, are often of a somewhat telegraphic nature, which would matter less were the style adopted more lucid. As a typical example one may quote a sentence dealing with refractive index: "*This is of the same value as the determination of specific gravity; it has, however, the advantage that it is more rapid and uses only one or two drops of the oil.*" A perusal of the remarks under iodine value must necessarily leave the student with his mind in confusion. Minute details of various investigators' methods are given, but no guiding principle to enable the student to adopt the most accurate way of working himself.

This edition of the book is stated to bring the contents thoroughly up-to-date, but a lack of reference to modern literature is nevertheless one of its most striking features.

It may be noted that butter, which is treated under pages headed "Waste Fats," is described as "*adulterated with oleomargarine, renovated butter and cocoanut oil. The first may be detected by testing for cotton-seed or sesame oil either by the color tests or by the index of refraction.*" It is questionable whether such enlightenment may not be worse for the student than no knowledge of the subject at all. The author states that this work is intended to serve as an introduction to the standard textbooks, but the thought strikes one that the student would be better advised to tackle the standard works straightaway than get ideas into his head which a later perusal would certainly eradicate.

The work, however, may have found a use in supplying headings to be amplified in lectures, and this may account for the publication of ten editions.

E. R. Bolton

Lehrbuch der Keramik. *By* Dr. H. Hecht *Pp.* 336. *Berlin and Vienna: Urban and Schwarzenberg*, 1923.

As Dr. Hecht is not only a tutor associated with the Technical School at Charlottenburg, but is the successor to Professor Seger (the inventor of the well known "Seger cones") in the Chemisches Laboratorium für Tonindustrie, in Berlin, any book written by him will naturally attract the attention of all interested in the great clayworking industries. Yet a careful reading of this newly published volume is very disappointing because the author has not written a new and really modern book incorporating useful information not published in other works on ceramics, but has followed very closely an old and well known book. This new volume can, perhaps, best be described as a précis of Kerl's "Handbuch der gesammten Tonindustrie" (the last edition of which, published in 1906, was revised by Cramer and Hecht), to which have been added various items of information which have aroused interest during the seventeen years since the last edition of Kerl's book was published. Not only is there a very close resemblance in the text (the recipes for bodies and glazes being the same in many instances), but many of the old wood-cut illustrations from Kerl's book appear in the new volume. It is true that the present volume is only about one-third of the size of the older one, but few readers will consider this an advantage, as a considerable amount of valuable information and most of the references to the original papers are omitted.

In this new volume, attention is chiefly paid to what may be termed "practical" information as distinct from that of a more purely scientific character, although a considerable amount of space is devoted to the latter. The various raw materials are described first, then the methods employed for converting them into various kinds of wares. The drying and firing of the ware occupies only 20 pages, methods of decoration 13 pages and supervision and control 11 pages. Each class of ware is then briefly described together with the methods employed in its manufacture, more than half the volume being occupied in this way; one page is devoted to an alphabetical list of papers and books almost wholly by German authors, the only English one mentioned being Solon's "History of Old English Porcelain."

The only reference to the colloidal nature of clays which the reviewer has been able to find is in a single paragraph on page 11. The cause of plasticity is summed up in ten lines and then in an erroneous manner!

The three formulæ proposed by Groth, Zulkowsky and Purkall, respectively, for the chemical constitution of clay are all mentioned, but no attempt is made to show which, if any, is correct, or to point out the objections to them.

The sections on refractory materials and on the electro-osmosis process are brief but good, though they are descriptive rather than critical; Wernicke's book on the latter subject has been freely used, with, of course, due acknowledgment, but without criticism. The summary of Berdel's work on semi-refractory sanitary ware and the description of the technique of Chinese porcelains are among the best of the newer parts of the work. The index, like those in most German books, is very poor.

Notwithstanding these defects, the volume as a whole forms a handy summary of the chief methods employed in the pottery and allied industries in Germany, and so may be useful to those who do not wish to study the larger, or more specialised works by other writers. If it is really up-to-date, it shows quite clearly that the Germans are in no way ahead of the British in regard to the technique of clayworking, and they are distinctly behind in some respects—particularly in lustre ware, fine earthenware, chemical stoneware and sanitary ware with a fireclay basis.

Apparently the only matter in which they are still in advance of the average English practice is that they burn some of their fire-bricks at a much higher temperature than is customary here. A. B. Searle

REPORTS

Report on the Economic Situation of the Netherlands East Indies to June, 1923. *By* H. A. N. Bluett, *Commercial Agent, Batavia. Department of Overseas Trade. Pp.* 112. *H.M. Stationery Office,* 1923. *Price* 3*s.*

The optimism expressed in the last report (*cf. J.*, 1922, 458) has been justified and during the period now under review the trade depression has passed away. Export trade is now almost booming, and a greater demand for imports has followed.

The year 1922-3 proved favourable to most crops and prospects for the current year are good. Oil palm cultivation is increasing, and though the output is still small the industry appears to be well established.

The administration of the State-owned mines and collieries has recently been re-organised. The production of crude petroleum in 1921 was 2,361,509 t. Several oil-fields are as yet undeveloped. The bulk of the coal obtained in the islands comes from the State-owned mines, which produced 765,431 t. in 1922, about 180,000 t. less than in 1921. Gold, silver, and tin are also mined. Sodium iodide is obtained from springs; in 1922 25 t. of iodine and 46 t. of copper iodide were exported.

Manufacturing industries have made progress during the last two years, principally in the preparation for the market of various naturally occurring substances. The plentiful water-power is a great asset, and extension of industry will no doubt lead to further hydro-electric developments; at present only 60,000 to 70,000 h.p. has been developed out of the 5,500,000 h.p. available.

The principal exports in 1922 included sugar, 1,400,000 t; rubber, 31,659 t.; cinchona bark, 6616 t.; quinine, 125 t.; tin, 15,546 t.; indigo, 17 t. For importers the period was not favourable, mainly owing to local conditions. There is now, however, a good demand for, among other things, chemicals, cement, tin-plate, copper and brass. There is a considerable market for some lines of chemicals and manures of British origin, and there is reason for hoping that in the future Great Britain may be the principal source of heavy chemicals.

Report on Financial, Industrial and Commercial Conditions in Canada, to June, 1923. *By* F. W. Field, *H.M. Trade Commissioner, Toronto.* Together with a Supplementary Report on Western Canada *by* L. B. Beale, *H.M. Trade Commissioner of Vancouver. Department of Overseas Trade. Pp.* 96. *London: H.M. Stationery Office.* 1923. *Price* 2*s.* 6*d.*

During the year under review conditions have rapidly approached normal (*cf. Chemistry and Industry*, 1923, 57). There were some financial failures, but these can only be considered as a result of the inflation and over-extension that took place in the years just after the war. The industrial situation was improved by elimination of weak concerns, by consolidation, and by reduction of overhead charges. Preference for British goods in the tariff was extended, the preference amounting to 10 per cent. of the duty where it amounted to more than 15 per cent. of the value of the article. A system of bounties is in force by which producers of certain goods, *e.g.*, copper bars and rods, hemp, petroleum, imported duty-free are assisted.

The chief points of interest in the mineral industry were the gold production, which exceeded 1,000,000 oz., and the shortage of coal. The total value of minerals produced in 1922 was $183,029,595. For the first time for many years large quantities of coal were imported from Great Britain, viz., 639,000 tons of bituminous and 178,000 t. of anthracite. Imports from the U.S.A. were 13·4 mill. t. divided in about the same proportion. The question of coal supply seems to be becoming more and more serious. The threat of an embargo by the U.S.A. on exports of anthracite to Canada looms large, and imports from Great Britain may be considerably increased, especially if producers in this country interest themselves in the market. The production of petroleum was 178,567 barrels, valued at $609,679, imports being valued at $36·8 mill.; the Ontario and Brunswick fields are not likely to give an increased yield. Prospecting has been carried out mainly in Western Provinces.

There has been rapid industrial progress in Canada in the past few years. Of the 42,046 factories in existence in 1920, 79 per cent. were in Eastern Canada. The largest number was engaged in the production of non-ferrous metals and their products, chemicals and allied products coming next. Progress continues to be made by hydro-electric developments, and the industry is stable. In 1922 the total installation reached 3,000,000 h.-p.

Total imports into Canada in 1922 amounted to $762·3 mill.; and exports to $898·2. Imports from the U.S.A. are considerably more than those from the United Kingdom, though the position of the latter improved slightly last year. There is a strong demand for British goods, but emphasis is laid on the necessity for considerable study of the special conditions obtaining in Canada.

Prof. C. W. Parmelee, who has been connected with the ceramic engineering department of the University of Illinois since 1916, has recently been made head of the department, having acted in that capacity during the past year.

COMPANY NEWS

PAN DE AZUCAR NITRATE CO., LTD.

At the twenty-second annual meeting the chairman said that after paying the proposed dividend of 15 per cent., less tax, there remained £30,491 to be carried forward. The nitrate industry had shown a marked improvement in the spring of 1923, when demand developed strongly. In the year ended June 30 last, the total world's consumption of nitrate amounted to 2,160,000 tons as against 1,545,000 t. in the previous year, and world stocks at June 30, 1923, were 1,249,000 t., as compared with 1,873,000 t. at the same date in 1922, which showed that consumption had increased satisfactorily during the year and stocks were down to about normal. Sales of nitrate in the current year were going on well, and it was expected that the total would reach 2,300,000 t. The Producers' Association had already sold about 1,409,000 t. for shipment July 1, 1923, to June 30, 1924, and further sales for a considerable quantity were expected to be made. The average sale price secured was about 9s. 3¾d. per Spanish quintal, from which 4d. per quintal had to be paid as compensation to the pool. The outlook seemed encouraging, especially in view of the increasing demand from the United States.

LANGDALE'S CHEMICAL MANURE CO., LTD.

The profit for the year ended September 30, 1923, was £5532, to which should be added reserves transferred to general profit and loss account amounting to £10,170. After deducting the debit balance brought forward from last year the credit balance is £110, which is to be carried forward. Competition by Continental makers has been most severe during the past year, and the quantity of foreign superphosphate sold to the United Kingdom below the cost of manufacture to the home producer has considerably increased. Sales of sulphuric acid and manures were larger than during last year.

EASTERN CHEMICAL CO., LTD.

The result of the year's working up to March 31, 1923, after further writing down of stocks to replacement cost, and allowing for the usual depreciation, was a loss of £10,503. The serious trade depression in India, combined with keen local competition and the dumping of German chemical products at prices much below world values and the cost of manufacture in India, reduced both output and gross profits. The directors are investigating the manufacture of additional products for which there is a demand in India, and they have also started to merchant imported goods not manufactured in India. The directors are unable to recommend the payment of any dividend for the period of the accounts.

MARKET REPORT

This Market Report is compiled from special information received from the Manufacturers concerned.

Unless otherwise stated the prices quoted below cover fair quantities nett and naked at sellers' works.

GENERAL HEAVY CHEMICALS

The heavy chemical market maintains a steady tone, both home trade and export continuing to take tolerably satisfactory quantities. Prices are firm.

Acetic Acid, 40% tech.	£24 per ton. Fair inquiry.
Acid Hydrochloric	3s. 9d.—6s. per carboy d/d., according to purity, strength and locality.
Acid Nitric 80° Tw.	£21 10s.—£27 per ton makers' works, according to district and quality.
Acid Sulphuric	Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 65s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
Ammonia Alkali	£7 10s. per ton, spot, delivery. General export demand good particularly from the Continent.
Bleaching Powder	Spot £11 5s. d/d.; Contract £10 5s. d/d. 4 ton lots.
Bisulphite of Lime	£7 per ton, packages extra.
Borax, Commercial—	
Crystal	£25 per ton.
Powder	£26 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain).
Calcium Chloride	£5 17s. 6d. per ton d/d.
Potash Caustic	£30—£33 per ton.
Potass. Bichromate	5¾d.—6d. per lb.
Potass. Chlorate	3d.—3½d. per lb.
Salammoniac	£32 per ton d/d.
Salt Cake	£4 10s. per ton d/d.
Soda Caustic 76%	£17–£19 10s. per ton, according to quality.
Soda Crystals	£5 5s.—£5 10s. per ton ex railway depots or ports. Good business continues.
Sod. Acetate 97/98%	£24 per ton.
Sod. Bicarbonate	£10 10s. per ton carr. paid. In fair request.
Sod. Bisulphite Powder 60/62%	£19–£20 10s. per ton according to quantity, f.o.b. London, 1-cwt. iron drums included.
Sod. Chlorate	3d. per lb. Very quiet.
Sod. Nitrate refd. 96%	£13 5s.—£13 10s. per ton ex Liverpool. Nominal.
Sod. Nitrite, 100% basis	£27 per ton d/d.
Sod. Sulphide conc. 60/65	About £15 per ton.
Sod. Sulphite, Pea Cryst.	£17—£17 10s. per ton according to quantity, 1-cwt. wooden kegs included, f.o.b. London.

RUBBER CHEMICALS

Prices in this section are unchanged.

Antimony Sulphide—	
Golden	6d.—1s. 5d. per lb.
Crimson	1s. 3d.—1s. 8d. per lb.
Arsenic Sulphide, Yellow	2s. per lb.
Cadmium Sulphide	4s. 9d. per lb.
Carbon Bisulphide	£25—£29 per ton according to quantity.
Carbon Black	6½d. per lb. for shipment c.i.f. London. Spot supplies from 7d. per lb. according to quantity.
Chromium Oxide	1s. 3d. per lb.
Indiarubber Substitutes, White and Dark	4¾d.—6½d. per lb. Fair demand, but much competition.
Lead Hyposulphite	8d. per lb.
Lithopone	£23 per ton. Fair demand.
Mineral Rubber "Rubpron"	£16—£18 per ton.
Sulphur	£10 10s.—£12 10s. per ton, according to quality; demand fair.
Thiocarbanilide	2s. 8d. per lb.
Zinc Sulphide	7½d. per lb.

WOOD DISTILLATION PRODUCTS

With the exception of acetates of lime and lead the demand for wood distillation products keeps below normal. Naphthas are an unsettled market.

Acetate of Lime—	
Brown	£14—£14 10s. per ton d/d. Demand active.
Grey	£22 per ton.
Liquor	9d. per gall. 32° Tw.
Charcoal	£7 10s.—£9 per ton, according to grade and locality. Market quiet.
Iron Liquor	1s. 7d. per gall. 32° Tw.
	1s. 2d. „ „ 24° Tw.
Red Liquor	10d.-1s. „ „ 14/15° Tw.
Wood Creosote	2s. 7d. „ „ Unrefined.
Wood Naphtha—	
Miscible	5s. 6d. per gall. 60% O.P. Competition being met with.
Solvent	6s. per gall. 40% O.P. Fair demand.
Wood Tar	£4 15s.—£6 per ton according to grade. Demand not very brisk.
Brown Sugar of Lead	£42—£43 per ton. Demand more active.

TAR PRODUCTS

Acid Carbolic—	
Crystals	1s. per lb. Weaker, with limited demand.
Crude 60's	2s. 9d.—3s. per gall. Little business passing.
Acid Cresylic, 97/99	2s.—2s. 1d. per gall. Firm, with good demand.
Pale 95%	1s. 10d.—2s. per gall.
Dark	1s. 7d.—1s. 10d. per gall. A little inquiry for forward delivery.
Anthracene Paste 40%	4d. per unit per cwt. Nominal price. No business.

Anthracene Oil—	
Strained	9d.—10d. per gall. Better demand. Little material available.
Unstrained	8d.—9d. per gall. Quiet.
Benzole—	
Crude 65's	8d.—10d. per gall. ex works in tank wagons.
Standard Motor	1s. 1d.—1s. 4d. per gall. ex works in tank wagons.
Benzole, Pure	1s. 6½d.—1s. 8d. per gall. ex works in tank wagons.
Toluole—90%	1s. 3d.—1s. 4d. per gall.
Pure	1s. 9d.—1s. 10d. per gall.
Xylol	2s. 3d. per gall.
Creosote—	
Cresylic 20/24%	10½d.—11d. per gall. Not much business.
Middle Oil Heavy Standard Specification	8½d.—9½d. per gall. according to grade and district. Market very firm.
Naphtha—	
Crude	8½d.—8¾d. per gall.
Solvent 90/160	1s. 1d.—1s. 2d. per gall. Market weak.
Solvent 90/190	1s. 1d.—1s. 3d. per gall. Business quiet.
Naphthalene Crude—	
Drained Creosote Salts	£5—£8 per ton. Demand increasing. Market scarce.
Whizzed or hot pressed	£9—£11 per ton. Quiet.
Naphthalene—	
Crystals	£19 per ton.
Flaked	£19 per ton.
Pitch, medium soft	100s.—105s. per ton. Rather more inquiry, but little business passing.
Pyridine—90/140	22s.—23s. per gall. Demand easier.
Heavy	8s. per gall. Price nominal.

INTERMEDIATES AND DYES

The slight improvement in dyestuffs business has been maintained, but orders are still only for small quantities.

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acetic Anhydride 95%	1s. 6d. per lb.
Acid H.	4s. 7d. lb. 100% basis d/d.
Acid Naphthionic	2s. 5d. per lb. 100% basis d/d.
Acid Neville and Winther	5s. 11d. per lb. 100% basis d/d.
Acid Salicylic, tech.	1s. 6½d.-1s. 7d. per lb. Much better demand.
Acid Sulphanilic	1s. 1d. lb. 100% basis d/d.
Aluminium Chloride, anhyd.	1s. per lb. d/d.
Aniline Oil	9d.—10d. per lb. naked at works.
Aniline Salts	9½d.—10d. per lb. naked at works.
Antimony Pentachloride	1s. per lb. d/d.
Benzidine Base	4s. 7d. per lb. 100% basis d/d.
Benzyl Chloride 95%	1s. 3d. per lb.
p-Chlorphenol	4s. 3d. per lb. d/d.
p-Chloraniline	3s. per lb. 100% basis.
o-Cresol 29/31° C.	5½d.—6d. per lb. Demand quiet.
m-Cresol 98/100%	2s. 1d.—2s. 3d. per lb. Market quieter.
p-Cresol 32/34° C.	2s. 1d.—2s. 3d. per lb. Market quieter.
Dichloraniline	2s. 2d. per lb.
Dichloraniline S. Acid	2s. 6d. per lb. 100% basis.
p-Dichlorbenzol	£75 per ton.
Diethylaniline	5s. 0d. per lb. d/d., packages extra, returnable.
Dimethylaniline	2s. 6d. per lb. d/d. Drums extra.
Dinitrobenzene	10d. per lb. naked at works.
Dinitrochlorbenzol	£83 per ton d/d.
Dinitrotoluene—48/50°C.	8d.—9d. per lb. naked at works.
66/68°C.	1s. 2d.—1s. 3d. per lb. naked at works.
Diphenylamine	3s. 3d. per lb. d/d.
Monochlorbenzol	£63 per ton.
β-Naphthol	1s. 1d. per lb. d/d.
a-Naphthylamine	1s. 6d. per lb. d/d.
β-Naphthylamine	4s. per lb. d/d.
m-Nitraniline	5s. 3d. per lb. d/d.
p-Nitraniline	2s. 6d. per lb. d/d.
Nitrobenzene	5¾d. per lb. naked at works.
o-Nitrochlorbenzol	2s. per lb. 100% basis d/d.
Nitronaphthalene	11¾d. per lb. d/d.
p-Nitrophenol	1s. 9d. per lb. 100% basis d/d.
p-Nitro-*o*-amido-phenol	4s. 6d. per lb. 100% basis.
m-Phenylene Diamine	4s. 6d. per lb. d/d.
p-Phenylene Diamine	10s. 6d. lb. 100% basis d/d.
R. Salt	3s. per lb. 100% basis d/d.
Sodium Naphthionate	2s. 8d. lb. 100% basis d/d.
o-Toluidine	7d.—8d. per lb.
p-Toluidine	4s.—4s. 6d. per lb. d/d.
m-Toluylene Diamine	4s. 6d. per lb. d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC CHEMICALS

The demand is falling off as the end of the year approaches, but further appreciation in prices may be expected after the holiday period.

Acid, Acetic 80% B.P.	£48 10s. per ton.
Acid, Acetyl Salicylic	3s. 7d.—3s. 9d. per lb. Price hardening. Some makers asking 4s. In very steady demand.
Acid, Benzoic	B.P. quality almost unobtainable. Commercial quality offered forward at 2s. 3d. per lb. for cwt. lots. Makers fully sold ahead.
Acid, Boric B.P.	Cryst. £54 per ton, Powder £58 per ton.
Acid, Camphoric	17s.—19s. per lb.
Acid, Citric	1s. 5½d. per lb., less 5%, for ton lots. Dearer.
Acid, Gallic	3s. per lb. for pure crystal.
Acid, Pyrogallic, Cryst.	6s. per lb. for 28 lb. lots.
Acid, Salicylic	2s. 6d.—2s. 7d. per lb. Very firm market. Makers hard pressed to meet demand.
Acid, Tannic	3s. 3d. per lb. for B.P. quality. Very firm.
Acid, Tartaric	1s. 1½d. per lb. less 5%. Firmer. More inquiry for forward delivery.
Amidol	9s. per lb. d/d.
Acetanilide	Advanced to 3s. 6d. per lb. on a short market.
Amidopyrin	13s. 6d. per lb. Demand negligible.
Ammon. Benzoate	4s. 3d.—5s. per lb. for English make. Cheaper than other benzoates.
Ammon. Carbonate B.P.	£27 15s. per ton.

Atropine Sulphate	12s. 6d. per oz. for English make. Dull market.
Barbitone	18s. per lb. Without much inquiry.
Benzonaphthol	6s. per lb. Very much firmer.
Bismuth Salts	A steady market. Prices according to quantity:
Bismuth Carbonate	12s. 9d.—14s. 9d. per lb.
,, Citrate	11s. 4d.—13s. 4d. ,,
,, Salicylate	10s. 2d.—12s. 2d. ,,
,, Subnitrate	10s. 9d.—12s. 9d. ,,
Borax B.P.	£29—£31 per ton, carriage paid any station in Great Britain.
Bromides—	Per lb.
Potassium	9d.—10d. Remain very firm. Continental prices advancing.
Sodium	9½d.—10d.
Ammonium	10d.—11d.
Calcium Lactate	2s. 9d. per lb. for best English make. A better market.
Chloral Hydrate	4s. 3d. per lb. Position very firm and active.
Chloroform	2s. per lb. for cwt. lots. More active.
Creosote Carbonate	6s. 6d. per lb. Little demand.
Guaiacol Carbonate	Spot supplies very scarce. Present value 14s. per lb.
Hexamine	4s. 6d. per lb. for foreign makes. Manufacture in England has been discontinued since formaldehyde was removed from the dutiable list.
Homatropine Hydrobromide	30s. per oz.
Iron. Ammon. Citrate, B.P.	1s. 11d.—2s. 3d. per lb., according to quantity.
Magnesium Carbonate—	
Light Commercial	£36 per ton net.
Magnesium Oxide—	
Light Commercial	£72 10s. per ton, less 2½%.
Heavy Commercial	£27 per ton, less 2½%.
Heavy Pure	1s. 6d.—2s. per lb., according to quantity. Steady market.
Menthol	A.B.R. recryst. B.P. 62s. 6d. per lb.
Mercurials	Firm and likely to advance.
Red oxide	4s. 11d.—5s. 1d. per lb.
Corrosive sublimate	3s. 8d.—3s. 10d. ,,
White precip.	4s. 6d.—4s. 8d. ,,
Calomel	4s. 1d.—4s. 3d. ,,
Methyl Salicylate	3s. per lb. for carboys. Brisk market. Slightly advanced.
Methyl Sulphonal	22s. per lb.
Methylene di-tannin	7s. 6d. per lb. In good demand.
Paraformaldehyde	3s. 9d. per lb.
Paraldehyde	1s. 7d. per lb.
Phenacetin	7s. 6d. per lb. Steady market. English makers fully employed. Foreign supplies shorter.
Phenazone	8s. 9d. per lb. In short supply.
Phenolphthalein	8s. 6d. per lb. Very firm.
Potass. Bitartrate—99/100% (Cream of Tartar)	90s. per cwt., less 2½%. Market firmer.
Potass. Citrate	1s. 8d.—2s. per lb.
Potass. Ferricyanide	3s. per lb.
Potass. Iodide	16s. 8d.—17s. 5d. per lb., according to quantity. Demand continues.
Potass. Permanganate	9d. per lb. for B.P. crystal English make. In good demand.
Quinine Sulphate	2s. 3d.—2s. 4d. per oz., in 100 oz. tins. Steady market.
Resorcin	5s. 6d.—5s. 9d. per lb. Neglected.
Salol	4s. per lb. In more plentiful supply.
Silver proteinate	10s. 6d. per lb. Quiet.
Sod. Benzoate	3s. 6d. per lb. Scarce.
Sod. Citrate, B.P.C., 1923	1s. 5d.—1s. 9d. per lb., according to quantity. Very firm, in common with other citrates.
Sod. Hyposulphite—Photographic	£14—£15 per ton, according to quantity, d/d. consignee's station in 1-cwt. kegs.
Sod. Nitroprusside	16s. per lb. Less for quantity.
Sod. Potass. Tartrate (Rochelle Salt)	82s. 6d.—85s. per cwt. Market quiet.
Sod. Salicylate	Powder 2s. 11d. per lb., and Crystal at 3s. per lb. Firm and very active. Supplies still scarce.
Sod. Sulphide—Pure recryst.	10d.—1s. 2d. per lb., according to quantity.
Sod. Sulphite, anhydrous	£25—£26 per ton, according to quantity, 1-cwt. drums included f.o.b. London.
Sulphonal	17s. 6d. per lb.
Thymol	13s. 6d.—14s. 6d. per lb. for good white crystal from ajowan seed.

PERFUMERY CHEMICALS

Acetophenone	11s. 6d. per lb.
Aubepine	14s. ,, ,,
Amyl Acetate	3s. ,, ,,
Amyl Butyrate	7s. 3d. ,, ,,
Amyl Salicylate	3s. 6d. ,, ,,
Anethol (M.P. 21/22° C.)	3s. 9d. ,, ,,
Benzyl Acetate from Chlorine-free Benzyl Alcohol	3s. 3d. ,, ,,
Benzyl Alcohol free from Chlorine	3s. 3d. ,, ,,
Benzaldehyde free from Chlorine	3s. 3d. ,, ,,
Benzyl Benzoate	4s. ,, ,,
Cinnamic Aldehyde Natural	22s. 6d. ,, ,,
Coumarin	20s. ,, ,,
Citronellol	19s. 6d. ,, ,,
Citral	10s. ,, ,,
Ethyl Cinnamate	10s. ,, ,,
Ethyl Phthalate	3s. 9d. ,, ,,
Eugenol	11s. ,, ,,
Geraniol (Palmarosa)	37s. 6d. ,, ,,
Geraniol	6s to 13s. 6d. per lb.
Heliotropine	8s. 6d. per lb.
Iso Eugenol	15s. 9d. per lb.
Linalol ex Bois de Rose	20s. ,, ,,

Linalyl Acetate ..	.. 20s. ,, ,,
Methyl Anthranilate	.. 8s. 6d. ,, ,,
Methyl Benzoate	.. 6s. ,, ,,
Musk Ketone ..	.. 52s. 6d. ,, ,,
Musk Xylol ..	.. 19s. ,, ,,
Nerolin	.. 4s. ,, ,,
Phenyl Ethyl Acetate	.. 10s. ,, ,,
Phenyl Ethyl Alcohol	.. 16s. ,, ,,
Rhodinol.. ..	.. 60s. ,, ,,
Safrol	.. 1s. 10d. ,, ,,
Terpineol ..	.. 3s. ,, ,,
Vanillin	.. 25s. 3d.—26s. 6d. per lb. Firm with steady demand. Raw materials dearer.

ESSENTIAL OILS

Almond Oil, Foreign S.P.A... ..	.. 14s. 6d. per lb.
Anise Oil.. ..	.. 1s. 11d. ,, ,,
Bergamot Oil ..	.. 13s. 3d. ,, ,, spot.
Bourbon Geranium Oil..	37s. ,, ,,
Camphor Oil ..	.. 75s. per cwt.
Cananga Oil, Java	.. 9s. 6d. per lb.
Cinnamon Oil, Leaf	.. 5¾d. per oz.
Cassia Oil 80/85%	.. 11s. 6d. per lb.
Citronella Oil—	
Java 85/90%	.. 4s. 9d. ,, ,,
Ceylon.. ..	.. Very little on offer.
Clove Oil.. ..	.. 10s. 6d. per lb.
Eucalyptus Oil 70/75%..	2s. 6d. per lb.
Lavender Oil—	
French 38/40% Esters	24s. 6d. per lb.
Lemon Oil ..	.. 2s. 10d. per lb. Higher prices expected.
Lemongrass Oil ..	.. 2¾d. per oz.
Orange Oil, Sweet	.. 11s. 9d. per lb.
Otto of Rose Oil—	
Bulgarian ..	.. 34s. per oz.
Anatolian ..	.. 26s. per oz.
Palma Rosa Oil	.. 24s. 6d. per lb.
Peppermint Oil—	
English ..	.. 70s. per lb. Market very unsteady.
Wayne County	.. 15s. 6d. per lb. Market very unsteady.
Japanese ..	.. 12s. 6d. per lb. Market very unsteady.
Petitgrain Oil ..	.. 9s. 6d. per lb. Dearer.

TRADE NOTES

British Empire Exhibition: Mineral and Metallurgical Exhibits

In connexion with the British Empire Exhibition, the Imperial Mineral Resources Bureau, 2, Queen Anne's Gate Buildings, Dartmouth Street, London, S.W. 1, has in preparation a descriptive handbook and guide in which reference will be made to mineral and metallurgical exhibits. Under each mineral or metal references will be made in this guide to those firms who are known to be showing raw materials and semi-manufactured products of the mineral and metal industries.

It is requested that all firms proposing to exhibit materials likely to come within the scope of the handbook will communicate to the Bureau the exact nature of their exhibit so that it may be considered for the purpose of cross-reference. Where possible an analysis and the source of the material should be stated.

The Bureau cannot accept any responsibility for any omissions from the handbook, but will endeavour to include references to all firms exhibiting crude mineral and semi-manufactured products, if information about the exhibits is received at the Bureau not later than March, 1924.

French Company News

The production of coal by the Cie. des Mines de Béthune during the year ended June 30, 1923, was 1,655,326 metric tons. Development of the mines continues, and electrification is being extended. At the company's factories the policy of providing for the utilisation of all the by-products continues to be applied. Tests of the Claude process have given results which have induced the company to decide to manufacture synthetic ammonia by this process. Tar distillation plant to treat 40 tons per day is now working and purifying apparatus has been attached to the coke-ovens. The generating station, which now develops 32,000 kilowatts., is shortly to be enlarged to develop 48,000 kw.

On December 7 the sequestrated factory of Weiler ter Meer at Tourcoing was sold to the Flament Co., for 432,000 francs, whereas the sequestrated factory belonging to the International Galalith Gesellschaft Hoff und Co., at Gennevilliers, was sold for 1,061,667 fr. to Monsieur Boussac, of Paris.

Cement Industry in Esthonia

The first cement factory was built in Esthonia in 1870, and owing to the high quality of the product, Esthonian cement soon became known in the Russian and foreign markets. The output was considerable, especially in years preceding the war, a favourable factor being that all the necessary raw materials are available on the spot, and located near the sea coast and main railway lines. After the revolution and the declaration of Esthonian independence the cement works were quickly rebuilt and work resumed. Esthonian oil-shale was found to be a most satisfactory substitute for imported coal, and the oil-shale ash is now used successfully as an ingredient of the cement, the quality of which remains unaffected. Exports of cement totalled 20,519 tons in 1922, as compared with 7480 t. in 1921 and 5412 t. in 1920. The purchasing power of Russia is still very insignificant, and the principal buyers of late years have been Latvia, Finland, Lithuania, the Scandinavian States, Belgium and France, the cement being used in the two last-named countries for reconstruction work.

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